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ÖSTERREICHISCHES INSTITUT FÜR WIRTSCHAFTSFORSCHUNG

Drivers and Obstacles to Competitiveness in the EU

The Role of Value Chains and the Single Market

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Abstract

This report offers an extensive analysis of the effects of the EU Single Market. It sheds light on four interrelated aspects: It first reveals the asymmetric economic performance across member countries, which also mirrors structural differences. These differences in economic outcomes are next confronted with measures of the Single Market, economic institutions, changes in demand patterns, industrial turbulence and producer price developments. Next, the changes in value chains are tracked over time, and also put into a global perspective. Eventually, firm level evidence complements the findings. The results are highly relevant for economic policies at the member country and the EU level.

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Extended Abstract

- This report offers an extensive analysis of the effects of integration into the Single Market of the European Union. It studies the asymmetric economic performance across Member States, which is linked to structural differences. These include a series of aspects, such as economic institutions and integration in international value chain trade. A firm-level analysis complements the findings.
- The asymmetric economic performance of EU Member States is motivated by an approach which distinguishes industries by the degree of tradability of the sector output. The sector producing higher levels of tradables contributes more to aggregate productivity than industries focusing on the provision of goods and services which are rather nontradable. Hence, the sector structure is a determinant of aggregate productivity. The sector structures differ across Member States, suggesting different productivity growth potential from a hypothetical structural adjustment.
- Productivity growth was highest in the bulk of the "Core countries" of the EU. The productivity growth contributions mirror the macroeconomic development. In countries that weathered the crisis of 2008/2009 well, the largest growth contribution came from within-sector productivity gains from tradables. The countries that later suffered severely from imbalances exhibited the largest contributions to productivity gains from structural shifts towards nontradables. The tradable-nontradable approach also has implications for macroeconomic imbalances, and serves as a link between economic structures and trade competitiveness.
- An analysis of demand patterns reveals consumption trends which point at an increasing importance of nontradables as aggregate productivity grows. This puts the structural, supply-side interpretation into perspective. At the same time, international trade increased and demand from both the Single Market and from extra-EU economies grew in importance. The provision of tradable goods and services tended to shift from domestic structures to the Single Market.
- Integration into the Single Market can take various forms, and there is no 'silver bullet', 'one-size-fits-all' indicator. Two types of indicators are chiefly applied in the present study: (i) EU membership status and (ii) intra-EU value chain trade integration. The latter indicator captures both upstream (backward) and downstream (forward) integration into European value chains as opposed to extra-EU value chains.
- A series of outcome indicators shows that becoming an EU Member State has accelerated the transition process of CEE countries. EU accession led to employment and value added gains. This suggests a prominent role of the implementation of the Community Acquis over and above trade and FDI relations with other EU Member States. EU accession also induced more modest producer price dynamics. The catching-up process of CEE countries is also reflected by strong industrial turbulence.
- Forward integration in European value chain trade is positively related to employment and value added. Backward integration in European value chains is positively associated with employment. The effects of trade integration on economic outcomes are procyclical, and rise in magnitude with the general tradability of a sector's ouput.

- Value chain integration is the outcome of market processes, which are shaped by economic institutions. The effects of market integration should be jointly interpreted with the institutional setting. The most important aspects are a sound legal system, an effective public administration and, to a lesser degree, labour market regulation and finance. High quality institutions and market integration mutually favour within-sector productivity growth. The bulk of the differences in the long-run productivity growth within the EU can be explained by institutional differences at the Member State level.
- This suggests that a better institutional quality fosters path dependence, which is also reflected by the interplay of industrial dynamics with value chain trade based integration indicators. Forward integration tends to decrease entry rates, while backward integration reduces exit rates.
- Given the importance of Single Market integration for competitiveness, an in-depth analysis of the dynamics in international value chains was conducted. These were affected by the Great Recession. The expansion of international value chains has come to a halt in the years since 2011. While on a global level there is some evidence that certain value chains have disintegrated, this is not discernible in the European Union. EU Member States capture a large domestic value added in exports.
- The EU as a whole held its competitive position in the global market, although new players such as the BRICS countries entered the market. However, the intra-EU value chain dynamics led to a reallocation of market shares. Central European economies benefitted. Global value chains performed on par with regional value chains, with a modest shift towards the former. The organisation of value chains is strongly influenced by the source of final demand. While regional value chains predominantly produce for the EU market, GVCs rather produce for extra-EU markets. Large countries, especially Germany, play a central role in regional value chains and serve as central hubs for other Member States. Joint production largely tends to occur within the Single Market and across Member States, rather than with outside countries.
- A global comparison shows that the EU is the largest trading bloc in terms of volumes of the triad. At the same time, regional introversion is highest in 'Factory North America', followed by 'Factory Europe' and 'Factory South East Asia'.
- Firm-level evidence on sourcing choices by corporate groups sheds further light on the dynamics within value chains. In particular, the integration of service inputs is associated with the higher productivity of parent companies. Specialised firm groups are more productive. Larger parent firms are the drivers of sourcing inputs via foreign direct investment, suggesting barriers to market entry that they can overcome more easily.
- The intensity of integrated inputs is explained by country rather than parent firm characteristics. Again, sound economic institutions foster economic integration. The facilitating effect of sound institutions is stronger for manufacturing than for service parent firms. The firm-level evidence corroborates the policy agenda which seeks to reduce barriers to trade and FDI. The strength of legal systems and flexible local labour markets are linked to integrating inputs by manufacturing firms. Eventually, more efficient insolvency procedures in host countries facilitate FDI spillovers.

Executive Summary

The aim of this report is to provide an analysis of the effects of the Single Market of the European Union. Covering the 2000-2014 period, it sheds light on four interrelated aspects. It first documents the asymmetric economic performance across Member States. Second, these differences in economic outcomes are confronted with both measures of market integration and economic institutions. Third, the changes in value chains are tracked over time, and also put into a global perspective. Fourth, firm-level evidence complemented these findings.

The analyses of the effects of the Single Market and the economic performance of Member States are motivated by a two-sector approach. From a purely structural perspective, a larger share of tradable goods is associated with greater export potential and competitiveness. A shift from a current account deficit to a current account surplus involves a shift in the composition of domestic production. Hence, a higher share of tradable goods and services can be interpreted as an indicator of competitiveness. The share of nontradable goods production increased significantly in the peripheral countries of the EU prior to the financial crisis. Against this background, the output composition of the countries in the "South" was rather distinct to the countries in the "Core" and "CEE", where it remained more or less stable. The "South" countries in turn were those which faced the severest recessions, especially with regard to their duration, and to a lesser extent with respect to the amplitude of the economic downswing.

The sector of tradable goods and services contributes more to aggregate productivity than nontradables. Hence, the sector structure is a determinant of aggregate productivity. Since the sector structures differ across Member States, there is productivity growth potential from a hypothetical structural adjustment in some countries. A scenario analysis shows that the labour productivity of, in particular, Greece, Romania, Croatia, Ireland, Cyprus Bulgaria, Portugal, Slovenia and Italy would grow in aggregate productivity, if they were able to implement the sector structures of the most labour-productive countries in the sample.

Then again, general consumption trends point at an increasing importance of locally provided goods and services. More generally, the consumption of domestically produced goods and services that are tradable has decreased, while tradables from the Single Market have grown in importance. Also, extra-EU exports grew more quickly than their intra-EU exports, mirroring the increasing importance of extra-EU destinations. Hence, both the Single Market and extra-EU destinations gained in importance relative to domestic markets.

Productivity growth was asymmetric across Member States. It was highest in the bulk of the Core countries of the EU. In the pre-crisis period, Sweden, Finland and Austria exhibited the highest labour productivity growth rates. The productivity increases in the Core countries prior to the crisis were largely driven by within-sector productivity increases. The lowest productivity growth was found in Italy, Spain and Bulgaria. In the post-crisis period, the aggregate annual labour productivity growth dropped. The three best performing countries were Denmark, Ireland and Sweden, and the lowest productivity increases after 2008 were observed in Greece, Bulgaria and the United Kingdom.

These performance differences are next linked to economic integration into the Single Market, which can take various forms. Two types of indicators are chiefly applied in the present report: EU Membership status and intra-EU trade linkages, which refers to both backward (upstream) and forward (downstream) linkages.

EU accession led to employment and value added gains in accession countries. This suggests a prominent role of the Community Acquis over and above trade and FDI relations with other EU Member States. Hence, EU accession accelerates the economic and institutional transition process. EU accession also induces more modest producer price inflation. The catching-up process of CEE countries is also reflected in higher degrees of industrial turbulence.

Forward integration in European value chain trade has a positive effect on employment and productivity, especially for industries characterized by higher levels of tradability. Backward integration in European value chains is positively related to employment but no significant correlation with sectoral value added is observed. These results indicate procyclical effects of integration into the Single Market, which also increase in magnitude with the general tradability of a sector's goods and services.

Economic institutions moderate the effects of market integration on employment and value added. Trade patterns and value chains are determined by competitive advantages, which are shaped by economic policies. Institutions serve as vehicles of integration, through which employment and productivity materialise. In this interpretation, the often attested "Single Market gap" is an outcome of different institutional performances at the Member State level. Hence, the joint effect of value chain trade integration and economic institutions on both employment and vaue added were analysed. The results stress the importance of high institutional quality at the Member State level, which, jointly with integration into the Single Market, affects productivity and employment levels.

The findings suggest that specific types of institutions are more important than others. In particular, the quality of the public administration, the availability of modern infrastructure and a sound legal system ensuring the presence of an impartial judiciary have been found to be significant determinants of economic performance. In addition, many countries have made great strides towards freer and less regulated labour markets. The results for labour market freedom were mixed, insofar as there was some evidence that intermediate levels of labour market regulations seem to be best for employment and industrial dynamics. Then again, there is also some evidence that freer labour markets tend to attract FDI and facilitate local sourcing, but these effects may also be non-linear. The use of external finance – especially from shareholders – was found to be positively related to sectoral levels of employment and value added.

Sound institutions have mixed effects on long-run productivity growth rates. On the one hand, they favour path dependence and therefore within-sector productivity growth. On the other hand, they reduce productivity growth contributions resulting from changes in the composition of the economy. Confronting the growth contributions with economic institutions allows for a hypothetical policy reform scenario analysis, in which overall government effectiveness and the legal system are improved. The results explain the bulk of the differences in the long-run productivity growth rates across EU Member States.

Economic integration is related to industrial dynamics turbulence within sectors. Forward and backward integration into European value chains generally has a negative effect on firm turnover rates, which can be explained by the stability of the Single Market. The turnover rate is a composite indicator consisting of entry and exit rate points. Forward integration leads to a decrease in the entry rate, pointing at sunk costs. Backward integration reduces exit rates, suggesting a stabilising function of intra-EU sourcing.

The Single Market is embedded in international value chain dynamics, which have dramatically altered the international trading system. In view of the joint cross-border production processes, numerous products would deserve the designation of origin "Made in the World", as suggested by the WTO initiative of the same name – although in general there is the perception that international value chains are predominantly regional in scope. Since the Great Recession, however, there have been concerns that the trend towards geographically-dispersed production has come to a halt with, among other factors, re-shoring initiatives and protectionist tendencies trying to "bring manufacturing back" and increase domestic value added contributions to exports. One of the questions linked to this phenomenon relates to the extent to which international value chains have contributed to the decline in the income elasticity of trade, which is well-documented for the post-crisis period.

This leads to the more general question of the actual impact of value chain integration and resulting value chain trade (also referred to as '21st century trade') on economic structures and performance, and to what extent these effects differ from conventional trade. These topics are captured by an analysis of re-exported domestic value added, i.e. exports of intermediates that cross international borders at least twice. This metric accounts for about 17% (2014) of total EU gross exports and is a forward-looking production indicator, meaning that value added originating from one country is traced forward along the value chain, passing through other countries which are involved as production partners, until it reaches the country of final demand. Using this re-exported domestic value added as the indicator for international VC trade supports the conjecture that the expansion of international value chains has come to a halt in the post-crisis period (2011-2014). This is not to say that international value chains have been dismantled; the EU's VC trade was still growing at the same pace as value added exports (VAX) in general in the post-crisis years (approximately 3.3%-3.4% when the entire economy is considered, about one percentage point less for manufacturing only). Comparing different types of export flows (gross exports, value added exports and VC trade) reveals that, in the post-crisis period and, in contrast to the longer-term trend, the growth of value added exports exceeded that of gross exports. At the same time, the VC trade component did grow on par with the value added growth. This constellation is compatible with a situation in which EU Member States manage to capture large domestic value added in export transactions *without* dismantling value chains.

Worldwide VC trade was less dynamic than value added exports (except in the case of advanced manufacturing industries), which in turn grew at a slower pace than gross exports. This could be seen as a sign that some value chains are on the retreat. While this would be a subject for further investigation, the data at hand are in line with the idea that the European Single Market, due to the guaranteed free movement of goods, services and investments and accompanying regulations such as the competition rules, acts as a reinsurance mechanism against potential protectionist tendencies. This is not to say that the EU28 is immune to economic nationalism. Nevertheless, the idea that the Single Market provides an institutional anchor to safeguard internationally-organised production is consistent with the patterns of the post-crisis export data. This is supported when considering VC trade *intensities* of the EU, defined as the ratio of VC trade to value added exports. The VC intensity levelled off after 2011, so that the VC trade to VAX ratio of about 26% may be considered a peak in VC trade. Still, no signs of a massive decline in this VC intensity are discernible for the EU28. A related finding is that the changes in attitudes towards international value chains contributed to the significant decline in the income elasticity of trade, which is well documented in the literature. Supporting and supplementing existing findings with in-depth gravity estimations for gross exports, value added exports and VC trade flows (i.e. re-exported domestic value added), the decline in the elasticity of exports with regard to both own-country and foreign-country GDP is rather similar across the three types of export flows. If anything, the decline in this elasticity is typically lower for VC trade. Hence, it is unlikely that disruptions in international value chains had a significant impact on the lowered income elasticity of overall trade. In all likelihood, there are other structural factors that caused the falling income elasticity of trade – a fact that entails the prospect that the current trade slowdown in the EU28 will be a medium- to long-term phenomenon.

The trade slowdown and the reduced dynamic in VC trade are not trends specific to the EU. While the EU28 was clearly underperforming in terms of economic growth and much of Member States' trade in intra-EU trade, the EU was relatively successful in defending global export market shares, given that with China and other emerging economies there appeared a number of important new players in the international trade arena. This is equally true for VC trade and becomes visible when comparing the 1 percentage point loss in the world market share in VC trade of the EU with the corresponding losses of the United States and Japan, which amounted to 8 percentage points and 5 percentage points, respectively (2000-2014), with an extended manufacturing sector also considering business services. Zooming closer into the EU and at the individual Member States reveals VC trade developments that are well-known from overall trade developments. In particular, there was a marked reshuffling of market shares of Member States in EU-wide VC trade from large Member States such as France, Italy and the United Kingdom towards a group of Central European (CE) economies – Germany, Austria, the Czech Republic, Hungary, Poland and Slovakia, which isthe Central European Manufacturing Core. By 2014 this CE Manufacturing Core accounted for 35% of the EU's entire VC trade, a more than 5 percentage point increase since 2000. All countries of this group contributed to this trend, which also continued in the post-crisis years.

The complexity of VC trade implies that more than one partner country is involved. In addition to the source country, which is the origin of the value added, an immediate production partner and the ultimate production partner, i.e. the last link in the production chain, can be identified in addition to (as usual) the destination country where the value added is absorbed. By identifying the production partners that are involved in VC trade as value added from the source is shipped to other countries, processed and further re-exported, such VC trade can be separated into regional value chain (RVC) trade and global value chain (GVC) trade. The former includes all VC trade which involves only partners from within the region of the source country. Defining the EU as the 'European region', European RVCs include VC trade where only EU Member States act as producers. In contrast, all GVC trade is VC trade involving third countries as production partners. This way of defining the regional scope of value chains is arguably more precise than existing approaches in the literature, but also relatively restrictive, and to some extent challenges the stylised fact that cross-border production cooperation is predominantly regional in scope. According to this definition, the split between RVC trade and GVC trade for the EU28 is about half-half. The shift between RVC trade and GVC trade in the 2000 to 2014 period was modest, moving slightly towards more GVC trade, so that European value chains indeed became more global but only slightly more so, with the share of GVC trade in total VC trade increasing from 49.4% to 51.1% when all industries in the economy were considered (numbers are similar for manufacturing).

One of the most striking results in the context of RVCs and GVCs is the extent to which demand shapes the organisation of production. In models of offshoring, the extent of production relocation and hence cross-border production sharing is determined by the trade-off between the coordination costs of offshoring and the advantages resulting from the wage differential. However, the data suggest that demand patterns strongly influence the decisions on where to locate production. Qualitatively, this result is not surprising, however, it is surprising from a quantitative perspective. Splitting VC trade not only into RVCs and GVCs (determined by producers), but also by type of final demand, and distinguishing between extra-EU and intra-EU demand (determined by the country of absorption) reveals that the EU's RVC trade serving intra-EU demand accounts for 33% of total EU VC trade compared to only 16% destined for extra-EU markets. For GVC trade exactly the opposite is true. More than 40% of total VC trade is GVC trade serving extra-EU demand, while less than 10% of GVC trade involves value added destined for EU markets. Hence, RVCs predominantly produce for the EU market, and GVCs predominantly produce for third countries. Setting the focus on the RVC trade part, which can also be labelled 'Factory Europe', and looking at production linkages between Member States shows the expected picture: Germany emerges as the hub which is the key production partner for basically all other Member States. Also, the cross-tables of production linkages within Factory Europe reveal that the other large Member States – France, the UK and Italy – are key production partners for other EU Member States. The most prominent feature in this context is that for Germany, apart from the larger Member States, the members of the CE Manufacturing Core are key production partners, which once more underlines the tight production integration within this country group.

The established patterns regarding production linkages are to a large extent driven by the economic size of the Member States. One way to eliminate the influence of country size is to turn to revealed export preference, which – applied to VC trade – indicate the intensity of joint production with a specific partner, relative to how much the world average produces with that partner. The revealed export preferences (RXP) document a strong tendency of Member States to engage in joint production with other EU Member States, highlighting the role of geographic proximity. The exceptions here are Greece, which is actually less involved in RVC trade than the average country, and Ireland, which has also only a small positive RXP index. But distance is not the whole story, as the example of Switzerland exemplifies. Located amidst EU Member States, its RXP index is strongly positive, but still much lower than that of all its neighbouring countries, such as Austria, Germany, France and Italy. This suggests that the Single Market, in addition to geographic proximity, facilitates cross-border production sharing, possibly due to lower non-tariff barriers within the Single Market.

Putting European RVC trade into perspective by comparing it with 'Factory North America' (United States, Canada and Mexico) and 'Factory South East Asia' (Japan, Korea, China, Indonesia and Taiwan) shows that in absolute terms 'Factory Europe' is by far the largest of the three regional factories. With a size of EUR 463 billion it is about five times larger than Factory North America. By comparison, the EU's total VC trade is only about twice as large as that of NAFTA members. Again, this comparison is biased in the sense that the numbers strongly reflect the size of the respective trading bloc and also the number of members. To remedy this issue, the regional introversion index (RII) is used, which is equal to the RXP index applied to trade within a region. This metric establishes a clear ranking, which has Factory North America at the top with an RII of more than 0.70 when considering the entire economy, followed by Factory Europe with an index hovering around 0.6 over time and, finally, Factory South East Asia, where the RII dropped significantly from about 0.5 to below 0.4 between 2000 and 2014. This constellation lends itself to the interpretation that, while being large and globally important, the EU is not a closed bloc by international standards.

The investigation of international VC trade has established rather clear results regarding recent developments. Yet the relative importance of RVC trade and GVC trade, the role of demand and the implications of VC trade for structural change and competitiveness are harder to assess. The question is: to what extent is VC trade qualitatively different from overall trade. This can be answered by studying the economic impact of the VC trade *intensity*, i.e. the ratio of VC trade over VAX. In this context, structural change is measured by changes in the value added share of manufacturing in total GDP, while labour productivity and world market shares in value added exports serve as measures of competitiveness. There seem to be few extra effects from VC trade, *in addition* to the effects of overall trade. VC trade is conducive to labour productivity growth in Member States, but so is value added trade (i.e. overall trade). Hence, there are no additional productivity gains to be expected from VC trade *relative* to trade in general. With regard to structural change, there is an interesting result indicating that higher VC trade intensity does not foster the manufacturing sector across Member States in general. However, there is a positive effect of VC trade intensity for the members of the CE Manufacturing Core, which seems to stem from the GVC part of VC trade. Arguably, there is a slight positive impact of VC trade suggested for the same country group on world market shares of VAX, but this effect is not robust. The main insight here is that the expectations towards international value chains, both regional and global, should be scaled down, given the wide-spread view that integration in international VCs necessarily facilitates structural upgrading and guarantees a stronger presence in global export markets. Certainly, this may be the case and the CE Manufacture Core demonstrates that there are examples where VC integration makes a difference, but it should not be seen as an automatism. Rather, the implications of VC trade and the 'additionality' of VC trade in comparison to trade in general are country and context specific.

Firm-level evidence on the extent and determinants of intra-EU production and trade linkages uncovers productivity differentials across parent groups with different production structures. There are systematic productivity differences between manufacturing and service parent firms integrating manufacturing and services inputs, in favour of the latter. In terms of group structure, i.e. separating parent companies depending on whether they integrate manufacturing inputs, service inputs or both, a premium for production specialization emerges. For both manufacturing and service parent firms, integrating affiliates in both manufacturing and services is associated with lower productivity, relative to the parent firms that opt to integrate inputs of one kind only, either in manufacturing or in services.

Manufacturing firms that source inputs intra-firm via foreign direct investment (FDI) across EU countries are larger, more productive, more intensive in tangible and intangible capital and less intensive in skills than manufacturing firms that source inputs at arm's length. Affiliates of manufacturing firms are likely to be located in large countries, countries with lower production costs, and with lower intensity of production factors (tangible, intangible, and human capital). The average intensity of intra-EU integrated inputs by manufacturing firms is higher in large countries – that is, in countries with higher R&D intensity and higher GDP per capita. It is lower in countries focussing more intensively on tangible capital. The intensity of integrated inputs by services firms increases with economic size and the strength of legal systems. It is larger in less developed countries and in countries with less flexibility of regulations for the use of temporary contracts. The latter result is, however, only marginally significant.

The probability of integrating inputs by manufacturing firms across EU countries is positively linked with the strength of legal systems and less stringent employment protection legislation for regular contracts, and negatively linked to corporate tax rates and financial development in host countries. Manufacturing firms tend to locate in countries with high corporate tax rates and more developed financial systems. This is consistent with the literature on multinational activity and imperfect capital markets, which argues that affiliates are more likely to borrow in countries with high corporate tax rates where they can benefit from debt-related tax allowances. Less efficient insolvency procedures are associated with a higher probability of sourcing inputs via FDI relative to arm's length sourcing. This is consistent with the prediction that contractual frictions incentivise firms to source inputs intra-firm. The empirical evidence indicates that the probability of sourcing inputs via FDI is negatively linked to sectoral restrictions to FDI and positively linked to the impact of service regulations on downstream industries. Finally, barriers to entrepreneurship in host countries do not seem to matter for the sourcing choice of manufacturing firms.

The intensity of integrated inputs by service parent companies is less sensitive to economic and institutional characteristics in host countries. Less efficient procedures for resolving insolvency are positively linked to the intensity of integrated inputs by service firms with service affiliates only. Finally, the intensity of integrated inputs in the case of service firms with both manufacturing and service affiliates is lower in countries where the impact of service regulations on downstream industries is larger. Market integration has been used widely in this report as a channel through which the effects of economic institutions are transmitted. The findings therefore corroborate the policy agenda that seeks to reduce barriers to trade and FDI. For instance, the effects of the sourcing of service inputs from host countries have been found to be associated with higher productivity of parent companies. Hence, optimising service regulations across EU countries is likely to foster sourcing of inputs from downstream industries. Given the heterogeneity of institutional and regulatory characteristics of EU countries, such policy measures need to be tailored to country-specific conditions.

The probability of integrating inputs by manufacturing firms across EU countries is positively linked to sound legal systems and labour market flexibility (especially less stringent employment protection legislation for regular contracts). It is negatively linked to corporate tax rates and the financial development of host countries. However, the empirical results indicate that the effect of corporate tax rates on the intra-EU integration of inputs is non-linear, depending on the level of financial development. The results show that manufacturing firms tend to locate in countries with high corporate tax rates and more developed financial systems. This is consistent with the literature on multinationals and imperfect capital markets, which finds that affiliates rather borrow in countries with high corporate tax rates where they can benefit from debt-related tax allowances. There is an intriguing result for insolvency procedures with respect to FDI spillovers. If these are more efficient, they have been found to be associated with a higher probability of sourcing inputs via FDI relative to arm's length sourcing. There seems to be a 'vintage effect' of the stock of firms, where low transaction costs in firm exit leads to a more efficient firm base, which again leads to more FDI spillovers.

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1. Introduction

Economic growth has been accompanied by an increasing relevance of cross-border trade and a greater international division of labour. This has induced more specialisation and fragmentation of production, which has in turn led to integrated production structures across countries and regions. While these dynamics are a worldwide phenomenon, in Europe they were accelerated by the EU and its Single Market. Both are important drivers of economic performance and welfare. In addition, the European Union has in the past proven to be an 'integration engine'. Yet there is mounting evidence of imbalances across Member States. Not only economic performance, but also economic integration into the Single market differs from country to country (Gill and Raiser, 2011). From a macroeconomic perspective, the EU lags behind other regions in productivity and GDP growth (Van Ark and Bartelsman, 2004; Timmer et al., 2010; Pelkmans et al., 2014).

The economic recession of 2008/2009 and the slow recovery that followed revealed structural issues in many EU Member States. Parts of the European Union continue to suffer from sluggish productivity growth, poor investment performance and high unemployment rates. However, a closer look at the EU economies indicates substantial performance differences. Some economies have recovered well and seem to be returning to their growth path, while others are still severely suffering from the consequences of the crisis. These asymmetries are the starting point of this report.

This study aims at offering an extensive analysis of the effects of the Single Market of the European Union. It will make a real economy enquiry into a variety of aspects concerning the functioning of the Single Market. It seeks to gain an understanding of how institutions and economic policies shape sector performance, which jointly determines macroeconomic outcomes (Timmer et al., 2010). It is argued that sector performance is determined by the interaction of country and industry characteristics. Countries specialise in industries whose production needs can best be met through the countries' factor endowments and institutional strengths (Chor, 2010).

The report will shed light on four interrelated aspects:

The second chapter sets the stage for the assessment of the Single Market by analysing the performance of the economies of the EU. It explores the macroeconomic performance differences that have become obvious, and links these to the performance of industries with respect to labour productivity. This allows for a scenario analysis, which assesses the effects of hypothetical structural adjustments. A decomposition of productivity growth across Member States explores the structural change dynamics before and after the crisis.

From a conceptual perspective, this chapter draws on an economic two-sector approach that discusses imbalance dynamics and adjustment mechanisms. It uses a framework that splits the economy into a sector that produces goods and services that are tradable and into a sector that produces nontradables (Sachs and Larraine, 1993). A larger share of tradables is associated with greater export potential and greater external competitiveness. This has implications for the current account, since a shift from a current account deficit to a current account surplus involves a shift in the composition of domestic production. It is important to stress that tradability is a property of the goods and services. This does not automatically mean that an industry effectively trades with intra-EU and extra-EU partners.

The basic mechanism of the approach resembles the price adjustments depicted by the Balassa-Samuelson model (Asea, Corden, and others, 1994; Samuelson, 1994). However, the tradable-nontradable approach differs in the adjustment mechanism, which focuses on economic structures instead of exchange rate adjustments. The structural adjustment perspective seems to be more appropriate than price adjustments against the background of a Single Market in which many countries are in the Currency Union. This is also why this approach has gained prominence in the rebalancing literature (Ruscher et al. 2009; Tressel et al. 2014).

The macroeconomic tradable-nontradable approach (TNT) provides the conceptual background that links trade competitiveness to economic structures. The greater an economy's external competitiveness is, the higher is the share of industries providing tradable goods and services. To study this mechanism, a straightforward dichotomy of tradables and nontradables is used in the performance diagnostics chapter which motivates the study. Tradability is a mere industrial property and not a market integration indicator *per se*. The subsequent chapters of this report use a series of integration indicators, and only control for this industrial characteristic by a steady index of tradability, which is based on value chain trade. Eventually, the TNT framework is relinquished altogether in an analysis of value chains and firm-level sourcing decisions. Both rely on the modern trade framework in which all goods and services are regarded as tradable.

The third chapter seeks to explain these performance differences against the background of the single market, and offers an eclectic discussion of a variety of aspects. First, a demand side analysis puts the tradable-nontradable framework into perspective, and documents a trend toward nontradable goods and services as economies become more productive. At the same time, there is an ongoing trend toward international trade – tradables goods and services are increasingly purchased from other EU Member States. This implies that the role of domestic provision of tradable goods and services became smaller. Also, extra-EU demand grows in importance. Larger economies serve as a link to global value chains and customers outside of the EU.

Next, asymmetries in economic performance are linked to both the Single Market and institutions. The Single Market is defined as *"the EU as one territory without any internal borders or other regulatory obstacles to the free movement of goods and services." (*Cit. EC[1]). Hence, integration into a Single Market is a multifaceted and complex phenomenon, which comprises both economic aspects (e.g., trade in goods and services) and policies (e.g., standardisation and harmonisation of rules and regulations). The latter can be discussed from a de-iure and de-facto perspective (Egan and Guimarães, 2017). This suggests that there is no single measure that could serve as the one-size--fits-all "silver bullet". Several indicators and indicator sets are used, and each has its advantages and disadvantages (Pelkmans et al., 2014). Regardless of the indicator, Single Market indicators typically conclude that there is potential for productivity and employment growth in a deeper integration. In this report, two integration measures are chiefly applied in the present report, (i) EU Membership status and (ii) intra-EU value chain trade. The effects of integration on value added, employment and productivity are explored.

Over and above integration measures, domestic institutions relevant to economic outcomes are analysed. Drawing on trade literature (Chor, 2010; Costinot, 2009), three dimensions of

[1] See http://ec.europa.eu/growth/single-market/ (retrieved on 14 March 2017).

economic institutors are captured. These are (i) overall government effectiveness and Rule of Law, (ii) the use of external finance (e.g., bank credits to the private sector and stock market capitalisation), and (iii) labour market regulations. The results suggest a prominent role of domestic institutions, which are, however, not independent of European Integration. It is often argued that there are unrealised benefits of the Single Market for both citizens and companies (Canoy and Smith, 2008; Ilzkovitz et al., 2007). This is insofar supported as that the present study uses integration into the European market as a vehicle through which value added, employment and long-run productivity growth rates materialise. The most important channel seems to be government effectiveness, which captures aspects such as infrastructure and the quality of the public administration as well as Rule of Law, i.e. the presence of a sound and impartial legal system. These findings provide valuable insights for institutional reforms (Pitlik et al., 2012). In addition, an analysis of prices documents the catching-up process of many CEE countries, and indicates the importance of EU-membership and the Community Acquis. These performance difference dynamics are also mirrored by industrial dynamics.

The fourth chapter focuses on value chain trade of EU Member States and the EU as a whole. One of the key elements to be addressed is the more recent post-crisis development in the international organisation of production. This sheds light on the question of whether value chain trade (VC trade) has peaked (Veenendaal et al., 2015) in the aftermaths of the 'Great Trade Collapse' or even before. The analysis is based on the latest update of the World Input-Output Database (Timmer et al., 2016). The trends of the past 15 years are investigated at the global level but also separately for the EU and individual Member States (or groups thereof). The analysis splits international value chains into trade involving only regional production partners, which consequently constitute regional value chains (RVCs), and global value chains (GVCs) that also involve extra-regional partner countries. Hence, in contrast to the bulk of the literature, in the context of this chapter, the term GVC denotes only a subset of international value chains. RVCs and GVCs together constitute international value chains. The importance of distinguishing between RVCs and GVCs becomes evident against the background of observation, such as in Baldwin and Lopez-Gonzalez (2015), where it is argued that GVC trade is a misnomer for '21st century trade' (Baldwin, 2011), given that the international organisation of production is predominantly regional in scope. Consequently, the developments of RVC trade compared to GVC trade of the EU over time are traced with a focus on the post-crisis period. While the EU and its individual Member States, respectively, take centre stage in this analysis, some comparisons with other regions are made, in particular with respect to RVC trade in other trading blocs such as NAFTA and the main trading nations in the South East Asian region, notably Japan, China and Korea.

Turning to the implications of value chain trade, a subsection of this chapter explores the relationship between countries' involvement in value chains and implied value chain trade, on the one hand, and international competitiveness and structural change, on the other hand. Regarding competitiveness, two different concepts are considered: the first, which is in line with the firm-level literature, associates competitiveness with productivity, whereas in the second concept competitiveness is interpreted as success in international markets, which allows making use of world market shares as an appropriate measure. The analysis of structural change emphasises the impact of value chain trade on the value added share of manufacturing. The implicit assumption in this analysis is that manufacturing, due to its particular characteristics, is of central importance to the economy, such that an increase in the manufacturing share is considered 'positive structural change'. The econometric models used in both the competitiveness and the structural change analysis are applied to the entire sample of countries available in the World Input-Output Database (WIOD, 2016 release). Additionally, individual effects for the EU or sub-groups of Member States, notably the Central European (CE) Manufacturing Core, are identified.

Another subsection addresses the issue of the decline in trade-to-GDP elasticity since the Great Recession (Freund, 2009; Constantinescu, Mattoo, and Ruta, 2015). The updated WIOD comprises five post-crisis years (2010-2014), which allows tackling this question with both gross and value added based measures of trade in a gravity framework. This extends the available analysis by analysing both reporter and partner specific elasticities as well as distinguishing between intra- and extra-EU trade flows as a proxy for differences between RVCs and GVCs.

The fifth chapter augments this analysis with a firm-level analysis of outsourcing and offshoring. The chapter examines the sourcing strategies of firms established in the EU and identifies institutional and regulatory factors that could foster further integration across EU countries, particularly with respect to the integration of services inputs by manufacturing firms.

This is important, given that over the past two decades there has been an increased fragmentation and integration of production and innovation within and across national borders. This was driven by technological change and trade liberalisation (Antràs and Chor, 2013; Siedschlag and Murphy, 2015). There has also been an increased integration of services and manufacturing activities via vertical integration and outsourcing (Pilat and Wölfl 2005; Francois and Woerz, 2008). Trade and FDI patterns are jointly determined with organisational structures such as sourcing and integration strategies (for recent reviews, see Helpman, 2006; Antràs and Chor, 2013). There is also growing evidence showing that international production and innovation networks have heightened the transmission of macroeconomic shocks across countries (Costinot, Vogel, and Wang, 2013).

This can be linked to evidence on the Single Market and competitiveness in the EU and its Member States, which indicates that reforms at both the EU and Member State levels could improve productivity and competitiveness (Pitlik et al., 2012; Friesenbichler et al., 2014). One of the identified sources of productivity growth is the geographic reallocation of resources within the Single Market and the more efficient integration of EU firms in international value chains. This reallocation of resources would also lead to a better exploitation of backward and forward linkages in global value chains by strengthening the integration of business services in key manufacturing sectors. In this context, understanding what determines intra-EU production and trade linkages at the firm level across EU countries is key to designing policies aimed at competitiveness and growth at the firm, country and European levels.

The final chapter summarises the findings. The report links economic institutions to Single Market concepts, and argues that these jointly shape economic performance. It also draws a series of policy conclusions which are embedded in the summary. These take two policy perspectives. The results of this study are relevant for the reform agenda at the Member State level, and also have implications for economic policy-making at the European Union level.

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2. Performance diagnostics from a structural perspective

This chapter motivates the subsequent analysis of the Single Market of the European Union. It provides diagnostical evidence on the performance of the economies of the European Union from a structural perspective. The analysis draws on a structural two-sector approach, the tradable-nontradable framework (TNT). This framework splits the economy into two parts, one whose goods and services are tradable, and one that is consumed domestically and therefore regarded as nontradable.

The two-sector perspective is rooted in a long-standing strand of economic research on structural change and productivity (Krüger, 2008), and dual economy models have gained popularity in economic modelling (McMillan, Rodrik, and Verduzco-Gallo, 2014; Baumol, 1967; Lewis, 1954; Ngai and Pissarides, 2007). The tradable-nontradable framework is in line with this tradition, and splits the economy into industries that are more competitive and industries that are less competitive. Such models typically perceive the economic structure to comprise a 'modern' (progressive, urban) and a 'traditional' (stagnant, rural) sector (McMillan, Rodrik, and Verduzco-Gallo, 2014; Lewis, 1954; Ngai and Pissarides, 2007; Baumol, 1967; Baumol, Blackman, and Wolff, 1985).

Changes of sector shares of tradables and nontradables fall within the structural change literature (Janger et al., 2011; Baumol, Blackman, and Wolff, 1985; McMillan, Rodrik, and Verduzco-Gallo, 2014), which documents a decline of the manufacturing share and the rise of the business service sector as economies increase their aggregate productivity (Herrendorf, Rogerson, and Valentinyi, 2013). This pattern has also been documented for the EU Member States and the United States (Hölzl et al., 2013; Janger et al., 2011), even though the shift from manufacturing to services may be partly due to statistical reclassifications (Bernard, Smeets, and Warzynski, 2016). These observations serve as the starting point for productivity diagnostics, which strongly lean on recent evidence of productivity dynamics and structural change (McMillan, Rodrik, and Verduzco-Gallo, 2014).

Two prominent approaches have emerged which explain the rise of services at the cost of manufacturing (Hunt, 2009). One is that demand for services is income elastic and, as economies grow and consumers' purchasing power increases, the demand for services increases as well (Rowthorn and Ramaswamy, 1999; Rowthorn and Coutts, 2013). A second approach is Baumol's idea of a 'cost disease', which poses an unbalanced growth theory, whereby faster productivity growth in goods production drives up the relative price of services, leading to their nominal share in GDP increasing (Baumol, 1967). In other words, it is argued that one sector is capital and technology intensive and therefore able to generate 'productive growth'. Another sector is deemed to be largely stagnant and labour-intensive. It has been claimed that, due to factor mobility, the production costs and prices of the stagnant sector should rise indefinitely. In the long run, the stagnant part of the economy attracts more labour to satisfy demand, if demand is either income elastic or price inelastic, but should vanish otherwise. While Baumol focused on the service sector (especially the health industry) as the 'traditional' part of the economy, this report takes a slightly different perspective and implements the TNT framework in the context of the EU.[2]

In the following, the sectoral productivity patterns are explored.

First, the tradable-nontradable framework is introduced at the macroeconomic level. It shows empirically that well-performing economies shift towards sectors classified as producers of 'tradables', whereas economies struggling with structural issues shifted towards 'nontradables'. This has implications for an economy's current account, and reflects industrial competitiveness issues.

Second, these macroeconomic patterns are further analysed at the meso (sector) level. Descriptive statistics will explore productivity patterns at the sector level. These will be linked to the tradables versus nontradables framework, and a scenario analysis reveals growth potential from a change of sector structures.

Third, changes in labour productivity at the country level are decomposed using shift-share analysis. The tradability framework is also used in the discussion of the results on structural change across EU Member States.

Fourth, additional information from the EUKLEMS (release December 2016) will be used to describe changes in the factor composition and contributions to both value added growth and labour productivity growth.

2.1. Nontradable goods and macroeconomic imbalances

2.1.1. An introduction to the tradable-nontradable framework

A remarkable aspect of the global financial crisis is the extent with which it affected the EU countries. The fact that many EU countries succumbed simultaneously to the recent global financial and economic crisis suggests that the crisis was triggered by international factors. But the differences among the countries in terms of the initial impact of the crisis, as well as the extent and the duration of the ensuing recovery suggest that factors internal to the countries have also played a role.

One lesson from the crisis is that sectoral booms may lead to an unsustainable composition of output. This imbalance can build up underneath a seemingly tranquil macroeconomic surface, in which inflation is low and output gaps are close to zero. The effects of a correction of these imbalances are highly non-linear: long and gradual build-ups can be followed by abrupt and sharp busts with major welfare consequences (see for instance IMF, 2011; Eichengreen, 2007; Atoyan et al., 2013, Eichengreen, 2007; Bayuomi et al., 2011).

The environment before the crisis was characterised by an abundance of liquidity and high-risk appetite. Funds were available at low interest rates. It seemed that the combination of low interest rates and rapid growth assured that servicing loans in the future would be no problem. As the public and private sectors in the periphery countries of the EU took advantage of easy access to new and cheap credit, the capital inflows were not always

[2] Another approach refers to classification issues. For a long time, only manufactured goods have been regarded as tradable goods. However, this assumption is relaxed by the presently used classification which is based on WIOD indicators.

sufficiently used for productive investments in the economy that would generate incomes for replaying the debt. This characterised the path towards an increasingly unsustainable output composition. When the cut-off in new international lending materialised, domestic interest rates rose significantly in the EU debtor countries. This initiated a process of squeezing the domestic absorption towards raising domestic savings. This demand side adjustment was accompanied by a major reallocation of resources: unemployment soared during the crisis period in previously booming sectors; in the aftermath of the crisis, employment now became buoyant in different sectors than prior to the crisis. The major supply side rebalancing gives rise to the notion that demand side adjustments might be accompanied by a corresponding adjustment on the supply side. In economic theory, this commonality describes a core result of the so-called tradable-nontradable-goods (TNT)[3] approach: a shift from a current account deficit to a current account surplus involves a shift in the composition of domestic production.

The current account balance has pointed towards increasing risks in several EU countries already long before the outbreak of the global financial crisis: in the onset of the crisis, most EU countries that experienced persistent current account deficits went through a period of unsustainable aggregate demand growth, fuelled by expanding credit in the private sector, housing bubbles and construction booms. In some countries, these imbalances were aggravated by a procyclical fiscal policy stance. The corresponding large build-up of current account deficits in turn implied a significant increase in net foreign liabilities, which on occasion seemed harmless as long as risk premiums were low.

Since the start of the global financial crisis, EU countries have experienced large current account adjustments. Since 2008, the current account balance of Greece, Ireland, Portugal and Spain improved by up to more than 10 percentage points of GDP. The reversal in the external balance reflects a combination of imports compression, in particular in Greece and Portugal, and also higher exports in Ireland, Spain and Portugal. In Greece, the decline in imports was the main contributor to the current account improvement, while exports had a lower contribution than the decline in imports in Spain.

As a reaction to the financial crisis, the European Union's economic governance framework was modified. In particular, the macroeconomic imbalance procedure (MIP) was introduced. It aims to identify, prevent and address the emergence of potentially harmful macroeconomic imbalances that could adversely affect economic stability in a particular EU country, or the EU as a whole. In this framework, the current account balance characterises a key measure as it captures the difference between aggregate savings and aggregate net investment in a country; countries that invest more than they save at home need to borrow money from abroad. It is therefore a measure for imbalances.

In this context, the current account comprises a key measure to capture imbalances. Any gap in the saving-investment relation leads to a corresponding deficit or surplus in the current account. The current account figure in turn captures the change in net foreign assets (or liabilities when negative). However, what is ignored in this respect is that any imbalance on

[3] To foreclose the key characteristic of tradeable vs nontradable good: goods (and services) produced in an economy can either be traded across national borders or not. Nontradable goods can, by definition, only be consumed in the economy in which they are produced; Tradable goods in turn can be exchanged internationally at negligible cost. This is discussed in greater detail in subchapter 2.1.3 and subchapter 2.1.4.

the demand side must be replicated with a corresponding imbalance on the supply side. The role played by the nontradable goods and services sector in the external adjustment processes has so far received little attention in the empirical literature despite the fact that the standard inter-temporal approach of the current account ascribes an important role to the composition of output. Among other things, the distinction between tradable and nontradable goods on the production side captures a country's potential to repay its external debt. Against this background, this introductory chapter will describe the path of the composition of output in the EU countries. For this, the sectors of the production accounts are split into two categories only – the tradable sector and the nontradable one. Based on this, the paths of nontradable goods production are characterised, and the extent to which they vary across the EU countries is highlighted.

Box 2.1: Capital inflows and domestic cycles

The TNT approach explains the switch in the output composition in response to reversals in the trade balance or current account balance in more general terms. A number of empirical studies (e.g. Aizenman and Jinjarak 2009 and Ferrero 2011, 2012) have analysed the link between large capital inflows and asset prices (and growth performance alike). In this respect, the current account is used as a proxy for capital inflows, and has been found to contribute significantly positively to domestic asset prices and growth performance in more general terms.

The most basic version of the TNT framework in this respect ignores the extent to which the composition of the capital inflows matter for sustaining a current account deficit over a prolonged period of time, and hence an excess of nontradable to tradable goods production. In this respect, Olaberría (2012) and Jara and Olaberría (2013) argue that the association between capital inflows and asset-price booms (and economic boom and bust cycles in more general terms) is indeed stronger for debt-related than for equity-related investment instruments. Their research provides a systematic empirical analysis of the association between capital inflows and booms in asset prices (for both housing and stock prices). Controlling for other macroeconomic factors and using different estimation methodologies and instrumental variables, they show that the association varies across capital inflow categories – being noticeably higher for debt-related investment than for equity-related investment. It has to be emphasised that capital inflows in the form of equity or FDI do not imply that the probability of observing an asset price boom declines; instead the probability is only smaller than in the case of capital inflows in the form of debt. In addition, they find that the association is weaker in countries with more flexible exchange-rate regimes and better quality of institutions.

Gopinath et al. (2015) highlight an alternative view of how the large inflow of capital into Southern European countries may have affected economic fluctuations; they argue that, following the lowering of interest rates, capital was not allocated efficiently across firms in the South. In turn, the misallocation of capital flows generated declines in total factor productivity. In a similar vein, Benigno et al. (2014, 2015) argue that sustained current-account deficits driven by cheap access to foreign capital can produce a shift of productive resources toward nontradable sectors such as construction. The resulting allocation of resources can hinder the development of a dynamic export sector and dampen long-run competitiveness, since the scope for productivity gains in the nontradable sectors is relatively limited. Inspired by the literature on the natural resource curse (e.g. Van der Ploeg 2011), they refer to the link between cheap access to abundant foreign capital and weak productivity growth as the financial resource curse.

In this context, Blanchard et al. (2015) show in a theoretical and empirical application that the macroeconomic effects of capital inflows on output crucially depend on their nature. For a given policy rate, bond inflows lead only to an exchange rate appreciation and are contractionary. In contrast, "non-bond" inflows lead to both an appreciation and a decrease in their rate of return; depending on which effect dominates, such flows may be expansionary. As concerns FDI in particular, they find that FDI inflows have a large negative and significant effect on credit: a plausible explanation is that some of the intermediation which would have taken place through banks is replaced by FDI financing.

As regards FDI inflows in the tradable and nontradable sector, there is evidence that the sectoral distribution of FDI matters, and that too much FDI in the nontradable sector can exacerbate external imbalances. For instance, countries with a large market size, a higher degree of economic openness, a higher productivity level and good institutions are more likely to receive FDI in the tradable sector (see, for example, Mateus et al., 2016; Culem, 1998; Kinoshita, 2011).

This macroeconomic chapter continues with a short review of the literature concerning the role of the nontradable goods sector in macroeconomic modelling (2.1.2). Section 2.1.3 gives a short overview of the TNT approach and its key implications. Section 2.1.4 classifies the two production categories and Section 2.1.5 illustrates the evolution of nontradable goods production in EU countries over the last one and a half decades, in addition to discussing key characteristics against the background of the TNT approach. Section 2.1.6 finally carries out a sensitivity analysis using the IMF's Global Integrated Monetary and Fiscal (GIMF) model. The simulations focus in particular on the effects of financial market shocks on the tradable and nontradable goods sector in shaping aggregate fluctuations.

2.1.2.The literature review on the importance of nontradable goods

The literature offers empirical and quantitative evidence supporting the role of nontradable goods for understanding the dynamics of real exchange rates as well as key macroeconomic variables in general. On the empirical front, focusing purely on the importance of nontradable goods for explaining real exchange rate fluctuations, Betts and Kehoe (2006) provide evidence of the important role of nontradable goods in accounting for the variance of the real exchange rate of the most important U.S. trade partners. As traditional theory attributes fluctuations in real exchange rates to changes in the relative price of nontraded goods[4], the authors find that this relation depends crucially on the choice of price series used to measure relative prices and on the choice of trade partner. The relation is stronger when they measure relative prices using producer prices rather than consumer prices.

Burstein et al. (2006) argue that fluctuations in the relative price of nontradable to tradable goods are an important source of real exchange rate movements. They use an approach proposed by Engel (1999) and decompose the variance of the real exchange rate into the variance of the relative price of tradable goods across countries, the variance in the relative price of nontradable to tradable goods, and a covariance term. To implement this decomposition they introduce a measure of the relative prices of pure-traded goods across countries using a weighted average of import and export price indices. They find that, for the median country, variations in the price of nontradable goods relative to the price of traded

[4] Theories on the real exchange rate differentiate between either traded or nontraded as early as Cassel (1918) or Pigou (1923). Traded goods can be internationally exchanged at negligible cost, and therefore, because of arbitrage, their prices obey the law of one price. Nontraded goods cannot be exchanged in this manner, so their prices are determined by purely domestic factors. This implies that aggregate real exchange rate movements are driven entirely by cross-country movements in the relative prices of nontraded to traded goods within countries.

goods account for over half the movements in the real exchange rate. Viewed overall, their results suggest that a successful theory of real exchange rate fluctuations must incorporate changes across countries in the relative price of nontradable goods to pure-traded goods.

The findings of Drozd and Nosal (2010) suggest that, while the parameterised standard model can generate a volatile and persistent tradable component of the real exchange rate, the model still pervasively implies an important role for the nontradable component relative to the data. Relative to the results presented both in Engel (1999) and Betts and Kehoe (2006, 2008), their approach of using value-added deflators makes the results on the relative contribution of nontradable goods in the data higher.

Tesar (1993) argues that the incorporation of nontraded goods helps to explain the low cross-country consumption correlations and the high correlation between savings and investment. Based on this, Stockman and Tesar (1995) show that introducing nontradable goods in macroeconomic models is crucial to explaining international business cycle characteristics. More recently, Dotsey and Duarte (2008), Benigno and Thoenissen (2008) and Corsetti et al. (2008) highlight the role of nontradable goods in explaining real exchange rate behaviour, and in particular, its persistence and volatility, and its correlations with other international relative prices and real variables.

Ruscher and Wolff (2009) show that the link between external balances and real-effective exchange rates hinges on the relative price of nontradable to tradable goods in relation to their trading partners. They find in a panel co-integrating framework, that the long-run relation between real exchange rates and the trade balance depends on the relative price of nontradable to tradable goods. In particular, only real-effective exchange rate measures that include the prices of nontradable goods are significantly connected to the trade balance in the long run. In contrast, narrow measures of the real-effective exchange rate, which only include the relative prices of tradable export goods, are not significantly connected to the trade balance in the long run. They conclude that "[their] results suggest that policy makers would be well-advised to keep a close eye on the nontradable sector when looking for ways to adjust to external imbalances" – Ruscher and Wolff (2009).

Finally, the most recent contribution to the literature in this area is from Rabanal and Tuesta (2013). They find that nontradable goods play an important role in explaining real exchange rate dynamics and several international macroeconomics facts. Their starting point is an estimated two-country (U.S.-Euro area), two-sector (tradable-nontradable goods) dynamic stochastic general equilibrium (DSGE) model with nominal rigidities, of the class that is now becoming mainstream in academic circles and policy institutions for macroeconomic analysis. They highlight that the variance decomposition exercise (using their preferred model) shows that the nontradable sector in the model does indeed help explain real exchange rate fluctuations: nontradable sector technology shocks explain as much as 30 % of the fluctuation of the bilateral real exchange rate, while tradable sector technology shocks and monetary policy shocks together explain less than 2 %.

2.1.3.The TNT approach and its implications

The previously mentioned empirical and theoretical approaches to introducing nontradable goods start by assuming that the goods (and services) produced in an economy can either be traded across national borders or not. This distinction is at the core of the so-called TNT- (tradable vs. nontradable) approach. Nontradable goods can, by definition, only be consumed in the economy in which they are produced; they cannot be exported or imported. Tradable goods can in turn be exchanged internationally at negligible cost. The basic version of the tradable-nontradable-goods-framework (henceforth: TNT approach) is a partial equilibrium model; however, it has repeatedly been incorporated in large-scale macroeconomic models.

There are in principle two main factors that determine tradability or nontradability: The first is transport costs, which matters for tradability. The lower the transport cost relative to the total price of a good, the more likely it will be that this good is traded in international goods markets. However, technological progress is likely to render some traditionally nontraded goods to tradable ones. This applies in particular to the service sector where several kinds of financial services, including private banking, insurance, etc. are nowadays considered tradable, whereas some decades ago they were perceived to be not internationally tradable. The second factor that matters for tradability is the extent of trade protectionism. Impediments to trade by means of tariffs and trade quotas create an obstacle to the flow of goods across national borders, even when transportation costs are low. These impediments comprise an artificial barrier to trade.

Sachs and Larrain (1993) have a detailed description concerning the implications of the presence of nontradable goods. Explicit consideration of the role of nontradable goods was given early by classical economists such as John Stuart Mill and David Ricardo. Their analysis, however, generally considered all final goods to be tradable, and production inputs to be nontradable. Only in the late 1950s and early 1960s has the role of nontradable goods been considered in formal economic models. Nowadays, the feature of nontradability is still considered important, among others, once it comes to explaining real exchange rate (reer) fluctuations. As highlighted in the previous section, both theory and data support that much of the variations of real-effective exchange rates across countries are accounted for by fluctuations in the prices of nontradables relative to those of tradables, and particularly so among developing countries (see for instance Catao, 2007; Burstein et al., 2006).

The nontradable character of certain goods (and services) has several direct implications. Without the possibility of net exports or imports, local demand and supply must balance. Without international trade, a drop in domestic demand cannot be met by an increase of net exports, and domestic prices can differ from foreign prices without setting in motion a shift of international demand. Moreover, the fact that nontraded goods are not traded across borders implies that their prices are determined by domestic factors only. In the case of tradable goods, their prices obey the law of one price because of arbitrage. This implies that aggregate real exchange rate movements are driven entirely by cross-country movements in the relative prices of nontraded to traded goods within countries (see for instance Wickens, 2012; Sachs and Larrain, 1993).

Perhaps the most important implication of the presence of nontradable goods is that the internal structure of production in an economy tends to change with the trade balance. In particular, as domestic absorption rises or falls relative to income (so that the trade balance rises or falls), the mix of production in the economy between tradable and nontradable goods changes, too. This implies that any imbalance on the demand side – usually described in the form of a trade or current account imbalance – is replicated by a corresponding imbalance on the supply side. Hence, in the process of generating a trade surplus, the production of tradable goods has to increase, while the production of nontradable goods has to decline. In other words, the trade surplus comes about not merely because of a fall in demand, but also because of a shift in the composition of output: away from nontradable goods production towards more tradable goods production.

This implication helps to explain why domestic booms are usually associated with increasing current account deficits: when the overall domestic absorption rises, there is more spending on both tradable and nontradable goods. The higher demand for nontradable goods requires greater production of nontradable goods, in order that demand and supply for nontradable goods be in balance. But higher production of nontradable goods can only occur by shifting resources out of the tradable goods sector into the nontradable sector. Higher overall demand therefore leads to a rise in the production of nontradable goods, but a fall in the production of tradable goods. This asymmetry reflects a simple fact: An increase in demand of nontradable goods can only be satisfied by greater domestic production; by contrast, an increase in demand for tradable goods can be satisfied by imports.

Another important implication of the approach is that a change in the output composition – that is, a change in the share of tradable goods production relative to nontradable goods production – is characterised be a high degree of inertia. Suppose, for example, that a government which has borrowed heavily in the past now needs to repay its foreign debt. In order to do this, it increases taxes. As a result, consumption declines. If all goods in the economy are tradable, the effect of this fall on consumption will be a rise in output relative to domestic absorption and thus an increase in net exports. Tradable goods producers facing a fall in domestic demand for their product will simply export more[5]. But this adjustment can take place only with tradable goods. If some goods are nontradable, the process cannot be so easy. Nontradable goods producers cannot react to the decline in demand by exporting more. They might cut prices in turn, as long as their cost structure allows. In the end, nontradable goods prices will decline relative to tradable goods' prices which decrease the nontradable goods sector's attractiveness for doing business. Hence, input factors to production will in turn be moved away from the nontradable to the tradable goods sector. As capital and workers are shifted away from the nontradable sector into the tradable sector, there is likely to be a period of at least temporary excess unemployment, while workers take time to match up with new job opportunities. Thus, the presence of nontradable goods in an economy makes the process of adjusting the composition of output more complex, often more painful and most notably more inertial.

A final noticeable implication of the TNT approach concerns the extent to which it relates a country's share of nontradable goods production to its export potentials. The presence of nontradable goods and, in particular, the share of nontradable goods in total production has important implications for a country's export potential. In order to make the argument clear, assume two different economies – the first economy produces only nontradable goods whereas the second economy produces only tradable goods. The fact that nontradable goods are not traded across countries implies that the first country has zero exports; moreover, this country's export potential is zero as long as the production of tradable goods remains at zero. Assume that in the second economy, though only tradable goods are produced, domestic absorption of tradable goods equals its supply. In this case, the second economy also has zero exports. However, the fact that it produces tradable goods implies that it could quickly adjust to changes in domestic supply and demand conditions by adhering to foreign trade. In fact, up to all of this country's production could be exported. Hence, this country's export potential is enormous and stands in stark contrast to the one of

[5] Of course, this argument rests crucially on the extent to which tradable goods producers are competitive in export markets relative to tradable goods producers of other countries, as well as on global demand conditions in general.

the first country. Against this background, the share of tradable goods production also offers some insight on the extent to which current account deficits, and in turn, a country's net foreign liability position are sustainable; by running an external deficit, a country accumulates foreign debt. The repayment of the foreign debt requires higher exports in the future. This in turn requires a high share of tradable goods production. If, however, the current account deficit comes along with increases in the share of nontradable goods production, the country might then find itself in a position of not being able to service the external debt, as it does not have the necessary tradable production capacity to adhere to higher exports.

To conclude, through a simple and important extension, the TNT approach captures real economic features that have profound implications for the workings of an economy. The presence of nontradable goods affects every important feature of an economy, from price determination to the composition of output, the effects of macroeconomic policy, etc.

2.1.4.Classification of tradable and nontradable goods

In much of the literature addressing tradable and nontradable goods, the distinction is drawn along sectoral lines of the production accounts. The idea of this approach has been to classify and measure tradable and nontradable sectors, and to further disaggregate tradables into import and export sectors for analysis and comparison. Much of the work done concerning the specification of tradable and nontradable goods was undertaken by Dwyer (1992). This contribution extended the work of Knight and Johnson (1997) who have also significantly contributed to the literature on tradables and nontradables. They define a tradable item as "a domestically produced good or service if it is actually traded internationally (as are exports) or if it could be traded internationally at some plausible variation in relative prices". This leads to the important conclusion that the difference between a commodity being tradable and a commodity being traded is the result of the profitability of trade. This definition follows the definition of Dwyer (1992). Knight and Johnson further note that the tradables category will include domestically produced goods and services that replace imports.

Dwyer (1989, 1991 and 1992) pointed out that the lack of an existing methodology hindered efforts by previous authors to classify and study differences between tradable and nontradable components. Without any existing methodology, the identification of tradable and nontradable sectors has been subjective and static (see comments of, among others, Goldstein et al., 1980; and Knight and Johnson, 1997). The key point of critique concerned the use of a priori reasoning in producing a subjective classification which could in turn be both a source of weakness for existing research and the reason for lack of such research on this topic.

Dwyer (1992) uses a classification system to determine the relative size of tradable and nontradable sectors, the size and composition of export and import sectors (as subsets of the tradable sector) and the internal competitiveness of each sector. This set-up is based on a theoretical approach comprising a small open economy with traded and nontraded goods sectors, where the relative prices of traded and nontraded goods determine resource allocation (Dwyer, 1992).

Drawing on the literature and apply a methodology that has the advantage of removing the subjectivity of previous specifications of tradables and nontradables. This approach is flexible enough to allow industrial sectors to move between classifications over time. This is of particular importance as industries change over time and the same applies to the feature of tradability of goods and services.

The applied methodology operates in the following steps:

(i) identify the export share of each industrial sector, and define a threshold above which this sector can be characterised as export orientated;

(ii) sum up the production volume of those industries which are defined as export orientated to create a measure characterizing the tradable goods sector;

(iii) sum the production volume of the remaining industries to establish a measure for the nontradable goods sector.

Even though an objective methodology is given, the approach still leaves one degree of subjective judgment; this concerns the decision on the threshold value. A threshold value is chosen in such a way that the classification guarantees stability, while also maintaining representativity of the tradables sector as well as stability throughout the business cycle. In this context, the stability property would be flawed if an industry repeatedly moves between classifications over time. Against this background the threshold is chosen such that the resulting classification is not subject to an unstable industry composition (Knight and Johnson, 1997). Using a stable definition of tradability is also justified against the background of the period analysed, which covers 14 years. It has been shown that industries change their properties with regard to tradability, but such processes take decades to necessitate reclassifications (Dixon et al., 2004). For this reason several robustness checks are applied (see Appendix 2.7).

Table X [Tradability at the Nace 1digit level] in Appendix X provides an overview concerning the sectoral categorization of each industry into tradable and nontradable goods. Tradability and nontradability are defined by considering EU-wide aggregates. Then the same nontradable goods and services classification is imposed on each EU member state and related to the value added of nontradable goods production to GDP in order to obtain the corresponding share of nontradable goods production.

2.1.5.Nontradable goods and macroeconomic imbalances in the Euro area

Based on the previous definition, Figure 2.7, Figure 2.8 and Figure 2.9 (see Appendix 2.7) display the path of the share of nontradable goods as a share of GDP for each EU Member State. In each case, the earliest possible starting point is used, which generally refers to the year 2000. Further details on the data and the source can be found in Appendix. Figure 2.1 shows the corresponding path of nontradable goods production as a share of GDP for three country groups: (1) "Core" EU countries, (2) "South" countries, and (3) "CEE" countries (see section 5.1 for the motivation for this particular country group classification)[6].

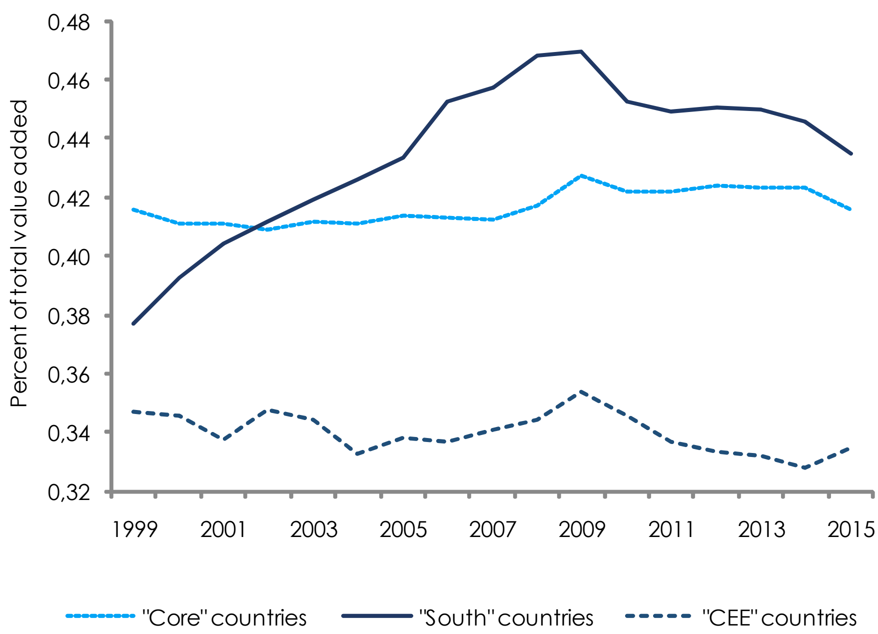
Figure 2.1 describes the imbalance on the supply side by means of changes in the output composition, which is characterised by the change in the share of nontradable and tradable goods production in this context. As such, the figures highlight the change in the sectoral composition of production across various EU Member States over time. In order to compare

[6] The "Core" economies include Germany, France, the UK, the former Benelux countries and Scandinavian countries (Denmark, Sweden and Finland). The countries of the group “South” are comprised as follows: Greece, Italy, Cyprus, Ireland, Portugal, Matla and Spain. And finally the "CEE" countries are the Eastern, and Central Eastern European countries: Bulgaria, Croatia, Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland, Romania, Slovenia and Slovakia.

the supply side imbalances with those on the demand side, the figures also show the current account to GDP ratio. The figures point out several characteristics that are in line with the "Core" implications of the TNT approach.

The boom in the "South" countries prior to the outbreak of the global financial crisis is associated with a significant increase in the share of nontradable goods production. For the country group as whole, the share increased by nearly 10 percentage points (compare Figure 2.1): from a low of 0.37 in 1999 up to nearly 0.47 by the end of 2009. The rise occurred homogeneously in all countries of this group; the strongest increase was observed in Greece where the share of nontradable goods production was at a level of around 0.41 in 1999 and increased to above 0.53 in 2012. In contrast to this, the change in the share of nontradable goods production was negligibly small in the "Core" economies; for the group as a whole this share remained fairly constant until the global financial crisis. Against this background the descriptive statistics give some hint as to why some EU countries were hit harder by the crisis than others. Among all EU countries, the "South" countries were hit hardest by the crises; the economic downswing in these countries not only affected the amplitude, but especially the duration of the economic slack. In the boom phase prior to the recession, these countries' economic development was characterised by (i) a strong increase in the share of nontradable goods production in the years prior to the crisis and (ii) a remarkably high level of nontradable goods production at the onset of the crisis. This highlights the extent to which the composition of output has changed in these countries within a few years.

Figure 2.1: Nontradable goods share



Source: WIFO calculations.

The correction of the unsustainable output composition in the "South" countries was characterised by a remarkable reallocation of resources: away from the nontradable goods sector towards the tradable goods sector. The excessive unemployment rates as well as low degree of capacity utilization rates in general in the "South" countries within the European debt crisis show the extent to which these countries faced – and in some countries this is still ongoing – a structural adjustment process on the production side. For three countries of this group – Spain, Ireland and Cyprus - the outbreak of the global financial crisis marked a regime switch to the steady upward trend in the share of nontradable goods: the share of nontradable goods production has declined significantly since 2009. This switch comprises a move towards rebalancing the composition of output. The drop was strongest in the case of Ireland, followed by Cyprus. These two countries' nontradable goods share in gross value added has now reached a level which is comparable to the one prior to the boom episode of the 2000s. In the case of Spain, the process of supply side rebalancing is still ongoing. In all three countries, the supply side rebalancing is replicated on the demand side – the current account to GDP ratio improved significantly. As concerns the remaining countries in this group, the share of nontradable goods has remained at elevated levels throughout the crisis episode until now. If anything, there are only weak signs of a supply side rebalancing. In contrast to that, the demand side rebalancing, however, has already progressed noticeably, as can be seen by the rebound in the current account to GDP ratio.

The co-movement between the change in the share of nontradable goods production and the change of the current account to GDP relation provide some insights concerning the extent to which the demand side rebalancing is cyclical or rather structural in nature. The current account to GDP ratio has improved significantly in the "South" countries over the last seven years (see also IMF, 2011; ECB, 2012; Atoyan, 2013). This raises one key question: how many of the current account adjustments in the "South" countries will be lasting? In other words, does the adjustment reflect mainly structural improvements or just cyclical factors driven by the large increase in output gaps? A method building on the IMF's 2012 External Balance Assessment analysis suggests that the change in the output composition is, among others, an important structural factor in rebalancing the economy. Against this background, the increase in the share of the tradable goods sector in Cyprus, Spain and Ireland gives rise to the notion that the improvement in these countries' current account balances has not only been driven by cyclical factors. Indeed, structural factors have set in to rebalance the demand side. This finding is in line with the evidence found in Tressel and Wang (2014).

The observation that an unsustainable composition of output aggravated the recession in the "South" countries is supported by the pattern of the "Core" EU economies: Their nontradable goods production share has been surprisingly constant across the last 15 years; it fluctuated slightly within a narrow band, with 0.41 as a lower and 0.425 as an upper boundary. Moreover, the "Core" countries’ nontradable goods share has been significantly lower than that of the "South" countries. Hence, the "Core" economies faced lower structural impediments to growth, as they were able to adhere to increased exports once global demand conditions improved. An example for that is Germany, which reported a strong increase in exports once domestic demand faded and the European debt crisis emerged. The strong rebound in German exports after the financial crisis occurred at a point in time when global demand strengthened. As Tressel and Wang (2014) highlight, Euro area countries have experienced significant differences in the demand for their exports. For instance, between 2008 and 2012, total trading partners' demand for Germany's exports grew by 4.7 percent, compared to 2.8 percent for France, 1.8 percent for Spain, 1.7 percent for Italy, 0.5 percent for Greece, and -0.3 percent for Portugal. These differences reflect the country's initial geographical specialization. Against this background, export demand growth was more sluggish in "South" countries as a result of either specialization in slower growing markets outside the euro area (in the case of Greece and Italy) or lower share of exports to non-Euro area countries (Spain, Portugal).

With regard to the "CEE" countries, the picture concerning the evolution of the share of nontradable goods is again distinct to the former two groups. The difference can be pinned down to two elements: (i) the first refers to the fact that the share of nontradable goods production is comparably low in these countries; for the group as a whole the average share of nontradable goods across the time span considered in Figure 2.1 is around 0.34; the corresponding numbers for the "Core" and "South" economies are 0.40 and 0.44 respectively; (ii) for the country group as a whole, the share of nontradable goods production has been trending downward over the period 1999-2015; however, there is some degree of heterogeneity across countries – Hungary, Lithuania, Poland and Slovenia are characterised by an explicit downward trend; whereas in Latvia and Croatia the share of nontradable goods production is on an upward sloping path. The share is rather constant in the remaining economies of this country group.

The mirror picture of the low and declining share of nontradable goods production in the "CEE" countries is that the tradable goods sector's share is high and increasing. This in turn highlights the – on average – high export shares of the "CEE" countries. In fact, export shares of these countries increased, on average, within the last decades and are still rising. Referring to the TNT approach, the adherence to higher export shares in turn requires a higher share of domestic input factors for production devoted to the tradable goods sector.

2.1.6.Model simulations

This subchapter's intention is to demonstrate the resilience of countries to global shocks. In particular, the effects of global shocks on key macroeconomic variables are analyised, in particular the composition of production. A multi-country DSGE (dynamic stochastic general equilibrium) model is used to trace out the adjustment path of the three country groups ("Core", "South" and "CEE") in response to a global financial market shock. The DSGE model used features a production sector extended by nontradable goods production. Of particular interest are the implications of the model concerning the output of nontradable goods and service sector in relation to the tradable sector – that is, the production asymmetry.

Methodology

The theoretical analysis is carried out using the IMF's Global Integrated Monetary and Fiscal (GIMF) Model (Kumhof et al., 2010; Anderson et al., 2013). This is a multi-country DSGE model that has been repeatedly used for cross-country analysis. The model offers a rich framework that includes different sectors and frictions. This makes the model particularly suitable for the analysis in the context of this project. Computational limitations require keeping the number of simulated economies small. Therefore three groups of countries have been defined that have experienced vastly different economic dynamics. Appendix 2.7 provides a brief overview of the GIMF model.

To gain a broad view of the interplay of structural characteristics and asymmetries in the transmission of economic shocks, the EU member states are divided into three groups, as already depicted in Figure 2.1. They are motivated by structural heterogeneities among EU member states, which can be identified along various dimensions. For this the Competitiveness Report (2016) shows some selected indicators that gauge the asymmetry across the three regions beyond the information provided in the previous subchapter and in particular in Figure 2.1.

The idea behind the choice of the three regional groups is to highlight the extent to which different fundamentals characterise the asymmetric transmission paths in response to fundamental shocks. The shock considered is a financial market shock in order to capture the economic environment surrounding the global financial crisis. From the viewpoint of the EU economy, the global financial crisis represents an external financial shock. There are many candidates for shocks emanating from the financial sector. In the present study, there is a focus on a shift in the risk perception on the part of lenders (borrow-riskiness), which formally belongs to the financial accelerator block of the GIMF model. The motivation of the choice of structural shock is twofold. On the one hand, it represents an important source of business cycle fluctuations in macroeconomic theory. On the other hand, financial market shocks have become more important in the recent literature, rendering them more easily comparable and interpretable across different models.

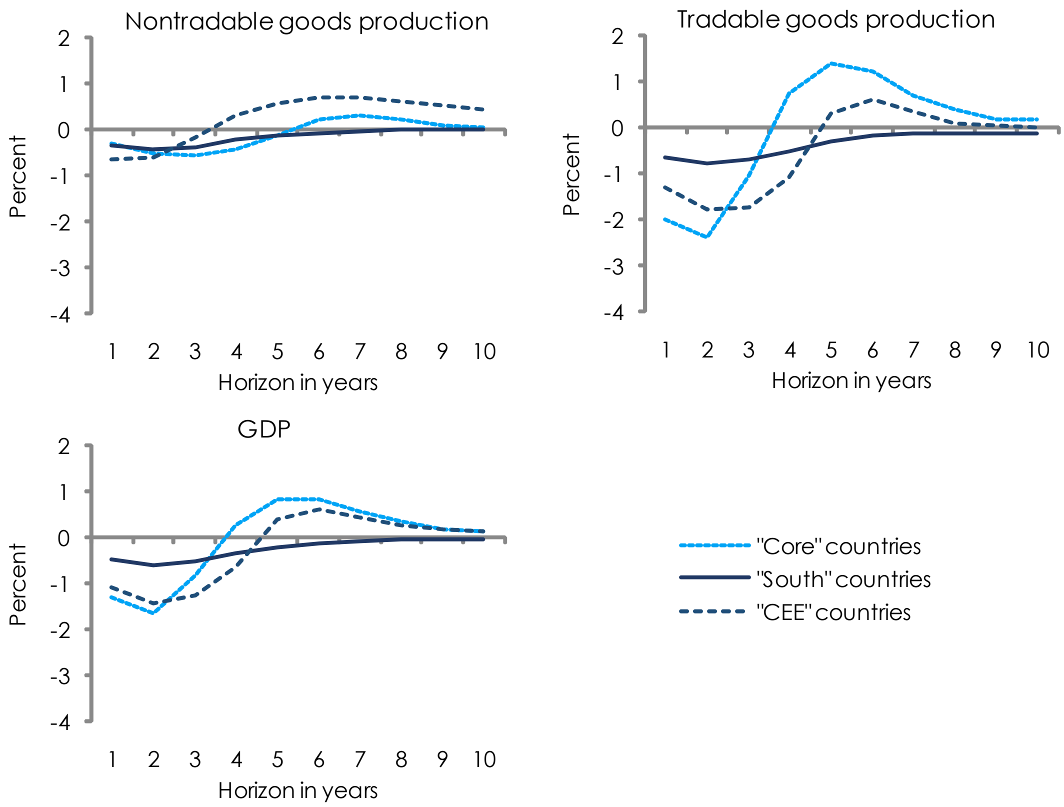
A shock is specified such that the global financial market shock originates in the "Rest of the World". The shock is contractionary so that it generates downward pressure on economic activity. This shock is overlaid with an expansionary demand shock occurring in the "Rest of the World", though only after 2 years. The GIMF model is used to trace out the adjustment path of the three EU regions in response to common external shocks. The degree of heterogeneity of the transmission mechanism in the different regions and their adjustment paths are analysed. This is accomplished by using impulse response functions for a set of key macroeconomic variables derived from the GIMF model.

Implications of the global financial market shock on the output composition

Figure 2.2 shows the impulse response functions of the three regions of the EU to a global financial market shock, which originates in the region comprising "Rest of the World". The impulse response functions shown characterise the spillover effects in the EU economies.

As can be seen, the global shock triggers a negative reaction in GDP across the three regions. This emerges in particular due to a fall in exports. The decline therein contracts income, which in turn compresses domestic demand. The fall in domestic demand exerts downward pressure on both the tradable and the nontradable goods sector. The fall in exports, however, only weighs on tradable goods production. As a consequence of this, tradable goods production contracts by more than nontradable goods production. This basic result applies to each of the three EU regions. Still, there are some differences; for instance, the contraction in the tradable goods sector is lower in the "South" countries. This occurs in particular as their export exposure to countries outside the EU – replicated in the model by means of the fourth region ("Rest of the World") – is lower than in the case of the "Core" countries. As regards the "CEE" countries, the strong decline in tradable goods production occurs due to their significant export exposure to the "Core" economies. Hence, the contraction in the "CEE" economies is similar to that of the "Core" economies.

Figure 2.2: GIMF model simulations



Source: WIFO calculations.

From the third year onwards, the contractionary financial market shock is overlaid by an expansionary global demand shock. As can be seen, the "Core" and "CEE" economies quickly react to this by exporting more. This in turn boosts tradable goods production. The higher income from increased exports exerts upward pressure on domestic consumption and investment, which in turn increases production in the nontradable goods sector. This pattern is, however, in contrast to that of the "South" countries. These economies behave rather differently. They hardly benefit from the global economic upswing. Their exports barely increase; hence, tradable goods production also remains flat. The missing income from higher exports therefore leaves consumption and investment rather flat, which in turn weighs on nontradable goods production.

In the model, this is due to the following:

(i) the "South" countries have a comparably small export exposure to countries outside the EU, which implies that they only marginally benefit from the increased global demand. They could, however, benefit indirectly – via increased exports to "Core" economies that have a comparably larger exposure to the "Rest of the World". As can be seen in the simulations, this effect is, however, rather small. The reason for this is related to the higher adjustment costs – which comprises the second important aspect concerning the different adjustment path in the "South" countries;

(ii) the "South" countries' economic structure is characterised by a lower degree of flexibility, which is taken into account in the GIMF model by means of higher adjustment cost parameters. This in turn renders any economic contraction more painful, as the costs from sticky prices and wages, the lack of sufficient factor mobility and the long lags in investment in the tradable sector become more pronounced.

Finally, (iii) the adverse global financial market shock increases the country risk premium of the "South" countries, which is disproportionately high[7]. This occurs on the back of a high net foreign liability position of the country group. The higher interest rate hence increases the debt servicing expenditures on foreign debt. This weighs on domestic income and hence depresses aggregate demand conditions. As a consequence, the trajectory of GDP of the "South" countries remains rather flat. In contrast, the impulse response functions for GDP of the other two country groups display a hump-shaped pattern – the initial decline is thwarted by a strong positive reaction.

2.2. Sectoral performance differences from the TNT perspective

The previous macroeconomic framework showed used GDP as well as shares of tradables and nontradables in its analysis. Even though the two sectors changed in their importance in some countries, this does not necessarily mean that they declined in absolute indicators such as value added or hours worked. In addition, the industries constituting the two sectors are not uniform. There is variance with regard to sector performance within both tradables and notradables.

To paint a more comprehensive picture, the following explores the changes of employment shares and labour productivity across countries. Section 2.2.1 will discuss data, indicators and some descriptive insights. Next, it will interpret productivity data against the TNT background (subchapter 2.2.2). The rationale of the structuralist approach and thus the relevance of the sector composition for aggregate is confirmed. This invokes the question about the growth potential from structural adjustments, which is discussed in the subchapter 2.2.3.

2.2.1. Data and some descriptive findings across countries and industries

There is a lack of harmonised productivity data at the Nace 2digit level, which this report addresses by therefore drawing on several data sources. It mainly uses Eurostat information, but also makes use of WIOD data for some indicators. Alt additionally uses the updated EUKLEMS dataset, which is, however, only available for ten countries (see Box 2.2).

The period considered covers the years 2000 to 2014, which can be interpreted as one business cycle. This poses challenges to a competitiveness study, which hinges on structural characteristics. The bulk of the data are available from 2000 (or 1995), which falls within the period in which imbalances have built up due to a lack of overall competitiveness. This is reflected in economic structures by an increase of the share of nontradables in the South. Hence, the results of this study are to be interpreted cautiously from a structural change perspective, since the data also show crisis dynamics. In other words, many countries have built up imbalances in the years before 2008/2009, and were then subject to rebalancing mechanisms.

To compute a labour productivity indicator, data from the Annual National Accounts (nama64) provided by Eurostat have been compiled, consisting of 64 industries. In order to

[7] The GIMF models features a mechanism which allows to endogenise the country risk premium. It is modeled as a non-linear function of the current account balance and (optionally) oft he net foreign asset/liability position.

obtain compatibility with the structure of WIOD data, 36 industry aggregates were defined. Next, labour productivity was defined. First, real value added was defined as value added (B1G_CP_MEUR) divided by the deflator (B1G_PD10_EUR) using base year 2010. Second, real value added was weighted by the hours worked (EMP_DC_THS_HW) or – alternatively – per person employed (EMP_DC_THS_PER).

Productivity information (based on hours worked) at the Nace 2digit level is missing for 1,749 observations, which approximates to 12% of the sample. The countries concerned are Cyprys, Estonia, Croatia, Hungary, Ireland, Latvia, Lithuania, Luxemburg, Malta, Poland and Sweden. Using the persons employed for the definition of labour productivity does not substantially change the availability. A total of 8% of the sample is missing. The countries affected are Bulgaria, Cyprus, Estonia, Croatia, Ireland, Latvia, Lithuania, Luxemburg, Malta, Poland, Romania, Sweden and Slovakia.

An analysis of the interplay of economic structures with productivity requires additivity (i.e. the sum of sector shares must equal one hundred percent), which is not given in the Nace 2digit data. Hence, this study will can draw on one digit data, which are fully available. Nace 2digit information can be used for the subsequent regression analysis of questions that do not require a balanced panel.

Alternatively, Eurostat's Structural Business Statistics (SBS) offer information on Nace 2digit industries. However, these time series also contain missing values, and are available from 2005 onwards, which poses a difficulty with structural analysis.

Box 2.2: Other data sources: EUKKLEMS and WIOD

EUKLEMS

In addition, updated EUKLEMS data are available for ten countries: Austria, Belgium, Finland, France, Germany, Italy, Netherlands, Spain, Sweden and the United Kingdom. The update covers the period 1995-2014 for most countries and industries, and draws on ESA 2010, a harmonised accounting framework (Eurostat and European Commission, 2013) and a harmonised and well-established growth accounting methodology.[8] Most of the key variables are (nearly) fully consistent with official Eurostat information. These data allow for both output and productivity analysis, including changes in the factor composition determining value added and productivity growth. Data on labour is available, but not by different types of qualification. EUKLEMS data is analysed descriptively, especially focusing on differences in the use contribution of input factors such as different types of capital to productivity growth. This allows for the analysis of total factor productivity (TFP).

WIOD

In addition, the analysis is partly based on the World Input-Output Database (WIOD), especially with regard to tradability as an industrial property. While WIOD data allow for the computation of value added dynamics over above-trade flows, employment information is currently lacking. The relevant data – the Socio Economic Accounts, Release 2016 - are expected to be published in the summer of 2017.[9] Hence, WIOD data are not expected to be available in time to serve as a basis for the productivity analysis in this report.

[8] See http://www.euklems.net/ (retrieved 6 February 2017).

[9] See http://www.wiod.org/database/seas16 (retrieved 6 February 2017).

The database used contains 27 EU Member States (data for Malta is not available). The descriptive statistics show great variety of economy-wide labour productivity, with Luxemburg exhibiting the highest and Bulgaria the lowest labour productivity. Agriculture as well as real estate activities have been excluded to reduce the bias (see Table 2.1).

The most productive sector appears to be sector B (Mining and quarrying), D (Electricity, gas, steam and air conditioning supply) and K (Financial and insurance activities), and S (Other service activities). The least productive sectors are F (Construction), G (Wholesale and retail trade; repair of motor vehicles and motorcycles), I (Accommodation and food service activities, N (Administrative and support service activities), S (Other service activities) and Q (Human health and social work activities). B (Mining and quarrying), C (Manufacturing), G (Wholesale and retail trade; repair of motor vehicles and motorcycles), I (Accommodation and food service activities, N (Administrative and support service activities), P (Education) and S (Other service activities).

Notably, two sectors – A 'Agriculture, forestry and fishing' and L 'Real estate activities' - have been excluded due to their outliers.[10] Sector A includes crop and animal production, hunting and related service activities, forestry and logging, and fishing and aquaculture. The sector Agriculture shows the lowest productivity figures within almost all countries. Sector L includes buying and selling of own real estate, renting and operating of own or leased real estate, and real estate activities on a fee or contract basis. Notably, this also includes imputed rents of owner-occupied dwellings, which increases the value added substantially. Most countries show real estate as their most productive sector.

[10] These might be due to regulations and subsidy policies (e.g., in Agriculture).

Table 2.1: Average Labour Productivity across countries, 2000-2014

Country (Group)	Code	Economy-wide Labour Productivity	Lowest Productivity Sector	Lowest Productivity Labour Productivity	Highest Productivity Sector	Highest Productivity Labour Productivity
Core						
Austria	AT	64,443	S	31,945	D	273,441
Belgium	BE	74,335	N	35,110	D	330,369
Germany	DE	57,422	I	19,576	D	225,032
Denmark	DK	77,915	I	27,608	B	3,376,356
Finland	FI	64,171	I	29,376	D	364,296
France	FR	62,008	S	29,977	D	255,753
United Kingdom	GB	51,340	I	21,228	B	817,782
Luxemburg	LU	99,541	I	37,100	D	367,109
Netherlands	NL	65,909	I	24,690	B	2,160,375
Sweden	SE	73,278	I	30,817	D	435,153
South						
Cyprus	CY	40,057	G	21,043	D	189,311
Spain	ES	47,063	S	21,316	D	441,002
Greece	GR	41,460	S	17,581	D	176,818
Ireland	IE	83,819	S	3,226	S	1,915,908
Italy	IT	57,396	S	30,177	D	330,399
Portugal	PT	29,850	S	16,263	D	392,792
CEE						
Bulgaria	BG	6,444	C	4,323	D	42,764
Czech Republic	CZ	21,106	G	11,838	D	220,807
Estonia	EE	15,801	I	6,418	K	92,140
Croatia	HR	23,628	S	13,840	B	125,434
Hungary	HU	16,077	B	5,378	D	76,959
Lithuania	LT	11,777	P	6,876	D	60,198
Latvia	LV	18,411	S	7,111	D	50,723
Poland	PL	19,483	I	10,462	D	75,772
Romania	RO	7,516	G	2,437	D	58,849
Slovenia	SI	31,714	N	17,071	D	103,291
Slovakia	SK	18,618	P	8,753	D	160,268

Source: Eurostat, WIFO calculations.

Note: Labour productivity is based on persons employed. The most productive sectors appear to be D (Electricity, gas, steam and air conditioning supply) and B (Mining and quarrying) and K (Financial and insurance activities). The least productive sectors are B (Mining and quarrying), C (Manufacturing), G (Wholesale and retail trade; repair of motor vehicles and motorcycles), I (Accommodation and food service activities, N (Administrative and support service activities), P (Education) and S (Other service activities). Sector A (Agriculture, forestry and fishing) and sector L (Real estate activities) have been excluded. Data for Malta are not available. The labour producvitiy statistics which are based on hours worked are provided in the Annex.

Table 2.2: Average Labour Productivity of Industries across Countries, 2000-2014

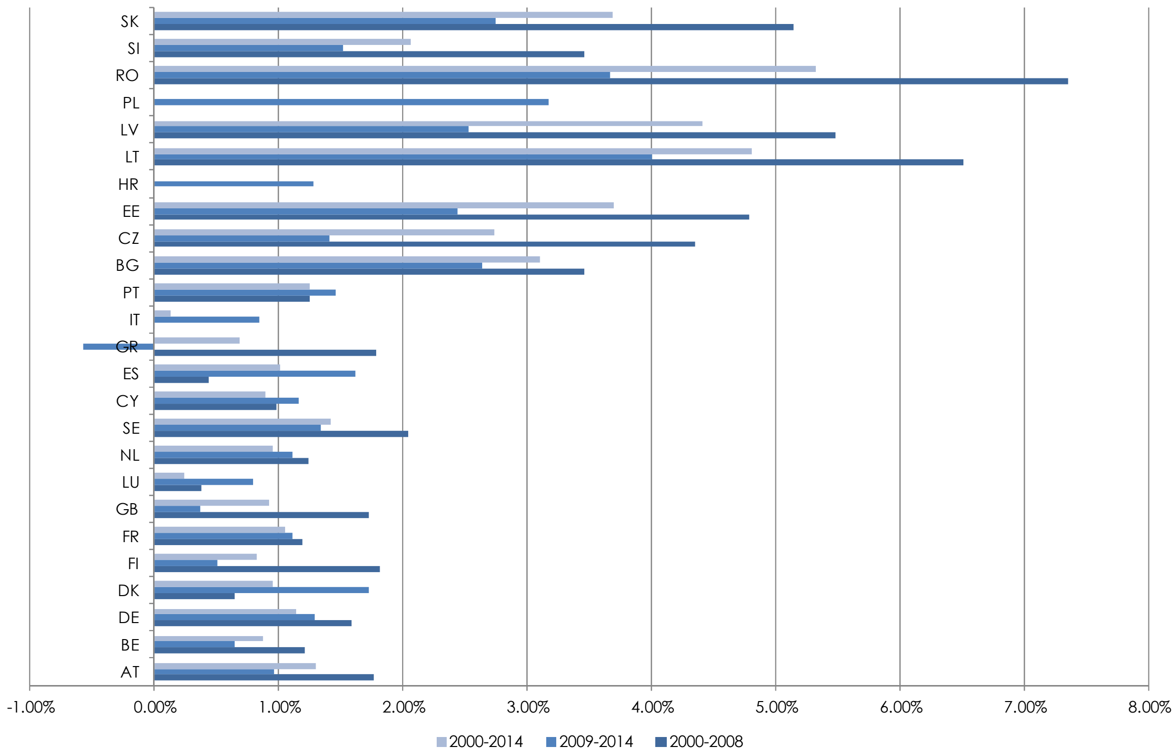
			Maximum Labour		Minimum Labour	
Sector	**Code**	**Mean**	**Country**	**Labour Productivity**	**Country**	**Labour Productivity**
Agriculture, forestry and fishing	**A**	21,415	SE	51,309	RO	2,387
Mining and quarrying	**B**	234,808	DK	1,872,266	RO	15,568
Manufacturing	**C**	47,703	IE	132,700	BG	6,500
Electricity, gas, steam and air conditioning supply	**D**	185,752	ES	400,507	BG	32,784
Water supply; sewerage, waste management and remediation activities	**E**	70,538	DK	143,648	BG	6,879
Construction	**F**	36,688	SE	67,825	BG	10,733
Wholesale and retail trade; repair of motor vehicles and motorcycles	**G**	35,220	LU	75,406	RO	5,308
Transportation and storage	**H**	50,668	IE	157,327	BG	10,081
Accommodation and food service activities	**I**	26,330	ES	53,008	BG	5,435
Information and communication	**J**	73,051	IE	140,665	BG	18,556
Financial and insurance activities	**K**	89,061	LU	242,714	LV	23,797
Real estate activities	**L**	671,564	GR	4,044,646	LV	68,256
Professional, scientific and technical activities	**M**	48,288	LU	100,387	BG	9,660
Administrative and support service activities	**N**	34,093	IE	122,479	BG	7,260
Public administration and defence; compulsory social security	**O**	45,513	LU	104,830	BG	8,756
Education	**P**	37,812	LU	98,866	BG	6,994
Human health and social work activities	**Q**	32,181	LU	58,894	BG	5,940
Arts, entertainment and recreation	**R**	38,453	LU	78,332	BG	7,534
Other service activities	**S**	37,788	IE	308,263	BG	6,946
Total Economy	**TOTAL**	44,559	LU	101,412	BG	8,335

Source: Eurostat, WIFO calculations.
Note: Data for Malta are not available.

In addition, a similar analysis is conducted at the sector level (Table 2.2). The countries with the most and least productivity sectors follow the economy-wide productivity pattern. That is, the industries with the lowest labour productivity are in Bulgaria, Latvia and Romania, and the industries with the highest labour productivity are in Sweden, Denmark, Ireland and Luxemburg. Hence, sector level productivity data show great performance variance across countries and industries. On an aggregate level, these largely follow the patterns suggested by GDP per capita information. However, sector level information paints a more diverse picture, and economies performing poorly at the aggregate level may exhibit highly productive sectors.

The development of labour productivity differs across countries and the periods before and after the crisis supports the expected patterns. That is, the labour productivity growth was highest in the period between 2000 and 2008, and then substantially lower in the after-crisis period from 2009-2014; productivity growth in Greece was even negative in this period (see Figure 2.3).

Figure 2.3: Labour productivity changes across countries in percent p.a., total economy



Source: Eurostat, WIFO calculations.
Note: This graph shows the labour productivity changes of the total economy in percent for the periods 2000-2014, 2000-2008 (before crisis) and 2009-2014 (after crisis). Data for Malta, Croatia, Hungary and Poland are not available for the entire period. Data for Ireland is unreported due to outliers caused by data revisions.

2.2.2. Productivity against the TNT background

Two sector models typically assume a more and a less productive sector. In the present context, tradables are assumed to be more productive than nontradables. This leads to the questions of whether there is a productivity gap between the two sectors, and whether such a gap can be explained systemically. For a global sample it has been shown that there is a gap between agriculture, the traditional sector, and non-agriculture as the modern sector. Interestingly, agriculture has been reported to be more productive. This gap widens as developing countries increase their GDP per capita, and then becomes smaller the further countries develop. Hence, the relationship takes a U-shaped pattern (McMillan, Rodrik, and Verduzco-Gallo, 2014).

The data show a productivity gap between tradables and nontradables. Based on hours worked, the labour productivity of tradables is – on average across all countries and years – seven percent lower than in nontradables; using persons employed still shows a difference of one percent. However, this is driven by the outlier sector Real estate activities (L). If this sector is dropped not considered in the analysis, the labour productivity of tradables in hours worked is on average across the entire sample 19% higher than for nontradables. The corresponding difference for persons employed is 26%.

Is there a relationship between the productivity gap and economy-wide productivity? Plotting the ratio of tradable to nontradable labour productivity in natural logs against the economy-wide labour productivity in natural logs reveals a linear relationship (see Figure 2.4). The higher the economy-wide labour productivity is, the higher the gap between tradables and nontradables becomes. The graph is based on hours worked; using persons employed qualitatively the same picture.

Figure 2.4: Labour Productivity Ratio of Tradables to Nontradables versus Total Economy

Source: Eurostat, WIFO calculations.
Note: The graph shows the relationship between the labour productivity of nontradables versus tradables and the economy-wide labour productivity. It excludes the outlier sector 'Real estate activities' (L), which contains imputed rents and therefore biases the ratio in favour of nontradables.

The descriptive results suggest that the tradable sector is, on average, more productive than the nontradable sector. This leads to the question about the interaction of sectoral and aggregate productivity differences. To identify whether tradables and nontradables differ in their effects on aggregate productivity, this report follows Herrendorf, Rogerson, and Valentinyi (2013) who proposed a regression technique, which has also been implemented by Hölzl et al. (2013) for European countries in a structural change context.

The logarithm of a country's real GDP (hours worked in 2010 Euros) is regressed on the labour productivity (hours worked, in 2010 Euros) of the sector in question in the same country. The regression equation takes the form of:

(Eq. 2-1) $ln(LP_{i,j}) = a_i + b_i\, ln(LP_{GDPj}) + e_{ij,}$

where a_i is an intercept for sector I across a sample of j countries, and b_i is the elasticity of sector i's labour productivity with respect to the aggregate labour productivity (real value added of the total economy per hour worked). The error term is independent and identically distributed with a zero mean. This regression can also be interpreted as deviations from a reference country (Herrendorf, Rogerson, and Valentinyi, 2013):

(Eq. 2-2) $LP_{i,j} \,/\, LP_{i,ref} = (LP_{GDPj} \,/\, LP_{GDP,ref})^{bi}\, exp(e_{ij}) / \, exp(e_{i,\,ref})$.

If the coefficient b_i takes on the value of one, the productivity of the sector in question equals aggregate productivity. If $b_i = 0$, then there is no systematic sector variance associated with aggregate outcomes. A coefficient larger than one indicates a strong influence on aggregate productivity of a given sector.

Following the previous analysis, two different sectors can be identified to implement this regression approach: tradables and nontradables. The results reported in Table 2.4 show coefficients below one for nontradables, and coefficients above one for tradables. These coefficients are largely in line with previous findings using the same method (Herrendorf, Rogerson, and Valentinyi, 2013; Hölzl et al., 2013), and they confirm the notion that aggregate productivity is not independent of sector composition (Duarte and Restuccia, 2010; McMillan, Rodrik, and Verduzco-Gallo, 2014).

Table 2.3: Descriptive statistics of labour productivity for the total economy, tradable and nontradable sectors

	Obs	Mean	Std. Dev.	Min	Max
Labour Productivity (hours worked)					
Total Economy	384	3.10	0.72	1.36	4.24
Tradables	384	3.08	0.77	1.00	4.36
Nontradables	384	3.18	0.66	1.78	4.49
Labour Productivity (persons employed)					
Total Economy	394	10.53	0.66	8.77	11.60
Tradables	394	10.54	0.72	8.52	11.72
Nontradables	394	10.58	0.59	9.23	11.99

Source: Eurostat data, WIFO calculations.
Note: This table reports the descriptive statistics of labour productivity based on hours worked and persons employed for the total economy, tradables and nontradables.

The differences in the coefficients between tradables and nontradables become more pronounced if country fixed effects are considered. The specification explains a substantial degree of the observed variance, with one notable exception. The within R^2 of the country fixed effects estimator for nontradables explains approximately 10%, which is vastly lower than the corresponding R^2 for tradables. This indicates strong country-specific influences affecting the relationship between sectoral and aggregate productivity.

These results are robust to robustness checks. They remain qualitatively unchanged if labour productivity is based on persons employed instead of hours worked, or if economy-wide size weights (hours worked or persons employed) are considered in the estimation. The results remain similar if time effects are included (either by a crisis dummy taking on the value of one for years after 2008 and zero otherwise, or by four-year period dummies).

The regression results indicate that the sector composition is a determinant of aggregate productivity. This implies that a shift towards high-productivity sectors (i.e. tradables) should decrease the gap in aggregate income levels. Structural change in favour of tradables is therefore desirable, especially for less productive economies. A shift towards low productivity activities (i.e. the nontradable sector) is likely to be growth-reducing and should be avoided (McMillan, Rodrik, and Verduzco-Gallo, 2014).

Table 2.4: Elasticity of tradable and nontradable labour productivity on aggregate productivity

	(1)	(2)	(3)	(4)
Estimator	FE	FE	OLS	OLS
Tradables (T), Nontradables (NT)	NT	T	NT	T
Economy wide Y/L (nat. logs)	0.57***	1.18***	0.89***	1.06***
	(0.073)	(0.037)	(0.042)	(0.022)
Constant	1.41***	-0.56***	0.43***	-0.21***
	(0.238)	(0.121)	(0.146)	(0.071)
Observations	384	384	384	384
R^2	0,94	0,99	0,94	0,99
R^2 within	0,1	0,94		

Source: WIFO calculations.
Note: This table reports the regression results for the elasticity of tradables (T) and nontradables (NT) on aggregate productivity. Standard errors in parentheses; overall R^2 and robust s.e. in (1) and (2); clustered s.e. in (3) and (4). Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

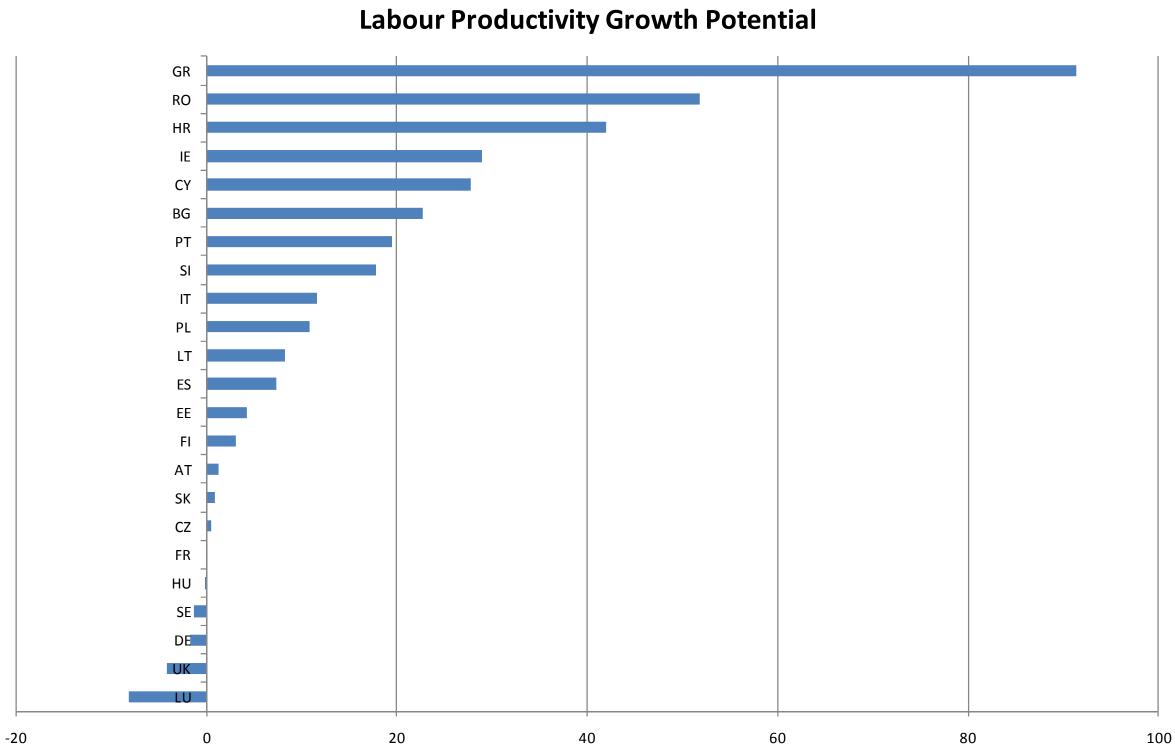
2.2.3.Sector composition and productivity growth potential

The previous subchapter has shown that the rationale of the TNT approach holds. There are differences in productivity levels by sector, and aggregate productivity rather relies on tradables than nontradables. This leads to the question about the degree to which the productivity gap at the aggregate level can be attributed to sub-optimal sector composition. For this purpose, an artificial economy is constructed by calculating the mean sector composition (i.e., the employment shares) of the three most productive economies (Belgium, Denmark and the Netherlands). Next, the sector-specific labour productivities across countries are multiplied by the synthetic employment shares. Eventually, a hypothetical aggregate productivity index is calculated and confronted with the status quo of aggregate labour productivity. This allows identifying the growth potential that countries can realise if they are able to adjust their sector composition to the structure of highly productive benchmarking countries.

The results show that the labour productivity of especially Greece, Romania, Croatia, Ireland, Cyprus Bulgaria, Portugal, Slovenia and Italy would benefit, if they were able to implement the sector structures of the most productive countries.

These results provide some insights into the productivity potential of a straightforward structural adjustment scenario. These can be biased, however, since sector-specific productivities might differ from the benchmark countries due to factors such as technologies, value chain positioning or other competitive advantages. Changing the sectoral structures might imply a shift away from sectors with a high apparent labour productivity, which may lead to a reduction in aggregate productivity. For instance, the UK and Luxemburg would lose from an adjustment of industrial structures, which can be explained by the fact that their peculiar industrial structures are dominated by financial sectors with high apparent labour productivity. This also seems to be the case for Germany and Sweden, which would slightly lose in labour productivity if they adjusted to the average structures of Belgium, Denmark and the Netherlands. Hence, these countries would give up shares of industries with high apparent productivity levels in favour of industries with slightly lower labour productivity. However, this effect is minor in both countries. The results for Hungary also indicate a minor productivity loss (-0.2%) if it adjusted its structures to the benchmark countries. In other words, the sectoral structure of Hungary resembles the structure of a highly productive economy, but the sector level productivity is lagging.

Figure 2.5: Labour Productivity Growth Potential due to Structural Change

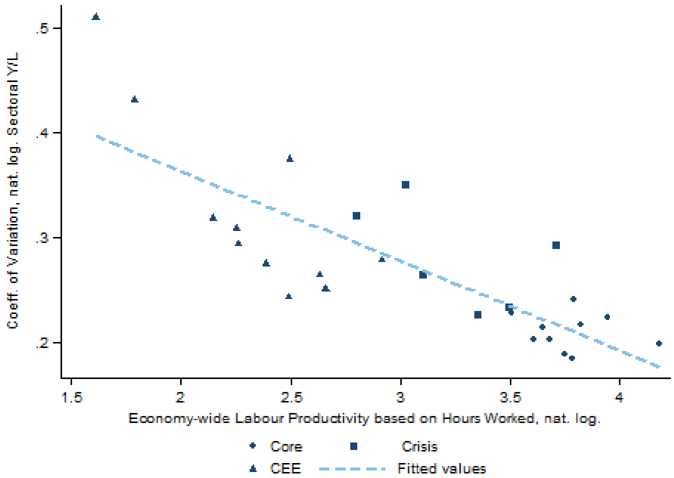


Source: Eurostat, WIFO calculations.
Note: The graph shows the potential growth in aggregate labour productivity. It confronts aggregate labour productivity (mean values for 2000-2014) with aggregate labour productivity if the economic structures (labour share composition) of the three most productive economies are assumed (Denmark, Netherlands and Belgium; Luxemburg has not been considered, even though its highly productive economy is an outlier due to small size).

Such growth potential, relying on structural change scenarios, hinges on differences in labour productivity between sectors. As countries' economy-wide labour productivity increases, the growth potential resting on sectoral reallocation becomes smaller. Plotting the coefficient of variation against economy-wide labour productivity shows a negative relationship for the EU Member States. This is in line with previous results that document falling productivity gaps as incomes increase (Friesenbichler, 2014; Duarte and Restuccia, 2010; Restuccia and Rogerson, 2013; McMillan, Rodrik, and Verduzco-Gallo, 2014).

Certainly, such a scenario analysis has caveats. Sector composition is the outcome of an economy's comparative advantages, which are shaped by a specific country's institutional quality and its factor endowments. This implies that economic structures cannot be simply adjusted. It seems that higher shares of the nontradable sector are rather a symptom of a lack of opportunities in tradables. There are other influences within the broad field of 'competitiveness' that shape the sector composition, as argued descriptively by the tradables-nontradables framework (Sachs and Larraine, 1993), or by institutional literature (Chor, 2010).

Figure 2.6: Intersectoral Productivity Gaps and versus Total Economy Productivity



Source: Eurostat, WIFO calculations.

2.3. A decomposition of aggregate productivity growth

The previous chapters show that countries have built up imbalances in the years prior to 2009, which were expressed in a larger share of nontradables in value added. Next, it showed that the composition of an economy with regard to the shares of tradables and nontradables affects aggregate productivity, and that there is growth potential from structural adjustment. In addition, substantial differences became evident, not only across sectors, but also across countries. This evidence points at a differentiated picture of productivity developments. The question of productivity growth patterns arises, especially whether productivity increases occur in given structures or if these are accompanied by structural change.

2.3.1. Shift-share analysis

The aggregate productivity changes across countries are therefore analysed at the sector level using a shift-share analysis (see Box 2.3). This technique allows the decomposition of labour productivity growth into a structural component (between-effect) and an upgrading component (within-effect). Also, the interaction term indicates an observation in many Baumol type models that employment growth is larger in industries which exhibit low – or below average – productivity growth when demand is inelastic (Ngai and Pissarides, 2007).

Box 2.3: Shift-Share Analysis

Aggregate labour productivity is defined as the sum of ratio of aggregate value added (X) to aggregate labour (Y). Aggregate productivity can then be interpreted as the sum of sector-specific productivity levels weighted by the employment share in the economy, where sector-specific labour productivity $\left(\frac{x_{it}}{y_{it}}\right)$ is defined as the ratio of value added (x) to labour (y) of sector i at time t. Aggregate labour productivity can be expressed as follows:

(Eq. 2-3) $$\left(\frac{X}{Y}\right)\cdot=\sum_{i=1}^{N}x_i/\sum_{i=1}^{N}yi=\sum_{i=1}^{N}\left(\frac{x_i}{y_i}\right)\cdot\frac{y_i}{y}.$$

A change of aggregate labour productivity over time can be decomposed into three effects:

(Eq. 2-4) $$\left(\frac{X}{Y}\right)-\left(\frac{X_{t-1}}{Y_{t-1}}\right)\cdot=\sum_{i=1}^{N}\left(\frac{x_{it-1}}{y_{it-1}}\right)\cdot\left[\left(\frac{y_{it}}{Y_t}\right)-\left(\frac{y_{it-1}}{Y_{t-1}}\right)\right] \quad \text{Between-effect}$$

$$+\sum_{i=1}^{N}\left[\left(\frac{x_{it}}{y_{it}}\right)-\left(\frac{x_{it-1}}{y_{it-1}}\right)\right]\cdot\left[\left(\frac{y_{it}}{Y_t}\right)-\left(\frac{y_{it-1}}{Y_{t-1}}\right)\right] \quad \text{Interaction-effect}$$

$$+\sum_{i=1}^{N}\left[\left(\frac{x_{it}}{y_{it}}\right)-\left(\frac{x_{it-1}}{y_{it-1}}\right)\right]\cdot\left(\frac{y_{it-1}}{Y_{t-1}}\right) \quad \text{Within-effect}$$

Shift-share analysis decomposes changes in aggregate labour productivity into three components: (i) between-sector productivity gains, (ii) an interaction term, and (iii) a within-sector effect (Alam, 2008; Timmer et al., 2010; McMillan, Rodrik, and Verduzco-Gallo, 2014).

The first term is the static shift effect, which captures the contribution arising from changes in the sectoral composition of employment (the between-sector effect). The second term shows the joint effect of changes in employment shares and sectoral productivity (the interaction term). The interaction-effect is higher if the weight of productivity-gaining sectors also increases. It is positive if sectors with above-average productivity growth increase their share in total employment. It is negative if sectors with growing employment shares have below-average productivity growth, or if the shares in total employment of sectors with high productivity growth are also declining. The third term on the right side is the within-sector contribution to overall productivity growth, the within-sector effect (Alam, 2008; Timmer et al., 2010; McMillan, Rodrik, and Verduzco-Gallo, 2014).

2.3.2.Results at the country level

In the pre-crisis period, more than three quarters of the labour productivity increases can be attributed to the within-sector effect. In the post-crisis period, this share increased to more than 90%. This implies that the structural change became almost negligible after the crisis, which indicates rebalancing mechanisms. Contrasting these findings against previous results on productivity growth patterns provides a mixed picture. Approximately half of the productivity growth in catching-up countries has been found to occur within industries (Duarte and

Restuccia, 2010), which is not found in the present data, Table 2.5 for reports the results for tradables, nontradables and the total economy for Core European countries, Table 2.6 for Central and Eastern Europe and Table 2.7 for Southern European or periphery economies.

There are substantial differences across countries, not only with respect to aggregate labour productivity growth, but also to the composition of labour productivity growth. In the pre-crisis period, Sweden, Finland and Austria exhibited the highest growth rates, which were largely driven by within-productivity increases. The lowest productivity growth was found in Italy, Spain and Bulgaria. Also, the role of nontradable sectors differs across countries. For instance, they accounted for more than half of the productivity growth in Cyprus, Greece, Spain and Italy, whereas they contributed less than a quarter in three countries with the highest growth rates.

In the post-crisis period, the aggregate productivity growth dropped. The three best performing countries were Denmark, Ireland and Sweden, and the lowest productivity increases after 2008 were observable in Greece, the United Kingdom and Bulgaria. Furthermore, the role of nontradable sectors dropped throughout the sample, with the notable exception of Greece, where post-crisis growth of labour productivity hinged on nontradables (see Table 2.5).

The countries suffering from lacklustre post-crisis productivity performance exhibit different sectoral performance patterns both before and after the crisis. In the UK, for instance, the industries K (Financial and insurance activities) and M (Professional, scientific and technical activities) accounted for 42% of aggregate productivity increases. In the post-crisis period, Financial services and insurance (K), Public administration and defence; Compulsory social security (O), and Mining and quarrying (B) contributed negatively to productivity growth. In particular, Wholesale and retail trade; Repair of motor vehicles and motorcycles (G) was driving the modest growth performance after 2008.

In Greece, the industries H (Transportation and storage) and L (Real estate activities) accounted for 47% of labour productivity increases before the crisis. The country's decline in aggregate labour productivity after 2008 are mainly explained by negative contributions of the industries Wholesale and retail trade; Repair of motor vehicles and motorcycles (G) and Construction (F). Only seven out of the 19 analysed sectors showed positive productivity growth, and positive productivity growth in nontradables compensated for negative contributions of the tradable sectors.

In Spain, productivity in real estate activities masked structural issues in manufacturing (C), Accommodation and food service activities (I), Agriculture (A) and Construction (F). This development was re-balanced in the post-crisis period by a massive consolidation in construction, which made a negative contribution to labour productivity growth. The aggregate productivity growth was rather evenly distributed across other sectors.

In Bulgaria, the sectors K (Financial and insurance activities) and C (Manufacturing) contributed 45% of aggregate productivity growth. Post-crisis growth hinged on Manufacturing (C) and Wholesale and retail trade, Repair of motor vehicles and motorcycles (G).

Certain data restrictions affect this analysis. Data for Malta, Croatia, Hungary and Poland are not available for the entire period and the period before 2009. Hence, they are not reported for the pre-crisis period. Data for Malta and Hungary are missing in the sample after 2008. Data for Ireland before the crisis is unreported due to outliers with respect to the price deflators. These particularly affect the sectors H (Transportation), L (Real Estate), R (Arts, Entertainment) and S (Other service activities). In addition, there is a break in the employment time series in the year 2011.

Table 2.5: Results of the shift-share analysis across Core countries (pre- and post-crisis, total economy and tradability)

		Pre crisis (2000 - 2008)				Post crisis (2009 - 2014)				Total Period (2000 - 2014)			
Country	Orientation	Within	Between	Interaction	Total	Within	Between	Interaction	Total	Within	Between	Interaction	Total
AT	NT	0.03	0.12	-0.01	0.15	0.02	0.01	0.00	0.03	0.02	0.09	0.00	0.11
AT	T	0.45	0.00	-0.02	0.43	0.3	0.04	-0.01	0.34	0.35	-0.01	-0.03	0.32
AT	Total	0.48	0.12	-0.02	0.58	0.32	0.05	-0.01	0.36	0.37	0.08	-0.02	0.43
BE	NT	0.04	0.09	-0.01	0.12	-0.07	0.13	-0.01	0.05	-0.02	0.15	-0.02	0.11
BE	T	0.59	-0.13	-0.07	0.38	0.44	-0.18	-0.04	0.22	0.50	-0.13	-0.13	0.23
BE	Total	0.63	-0.04	-0.08	0.50	0.37	-0.04	-0.05	0.28	0.48	0.02	-0.15	0.35
DE	NT	0.13	-0.02	0.00	0.10	0.08	-0.10	-0.01	-0.03	0.13	-0.02	-0.02	0.09
DE	T	0.42	0.05	-0.03	0.44	0.48	0.04	0.01	0.53	0.32	0.02	-0.03	0.30
DE	Total	0.55	0.03	-0.04	0.54	0.56	-0.06	0.00	0.50	0.44	0.00	-0.05	0.39
DK	NT	-0.19	0.23	-0.04	-0.01	0.16	0.10	-0.01	0.26	-0.03	0.21	-0.02	0.16
DK	T	0.37	-0.07	-0.03	0.27	0.86	-0.15	-0.02	0.69	0.52	-0.09	-0.11	0.31
DK	Total	0.18	0.16	-0.07	0.27	1.02	-0.05	-0.03	0.94	0.48	0.12	-0.14	0.47
FI	NT	-0.09	0.13	-0.01	0.03	-0.03	0.04	-0.02	-0.01	-0.09	0.15	-0.02	0.03
FI	T	0.65	-0.03	-0.08	0.55	0.35	-0.12	-0.02	0.20	0.39	-0.08	-0.09	0.22
FI	Total	0.57	0.10	-0.09	0.58	0.32	-0.09	-0.04	0.20	0.30	0.07	-0.11	0.27
FR	NT	0.07	0.11	-0.01	0.17	0.13	0.00	0.00	0.13	0.13	0.05	-0.01	0.17
FR	T	0.38	-0.04	-0.03	0.31	0.35	0.02	-0.01	0.36	0.33	-0.03	-0.05	0.26
FR	Total	0.44	0.07	-0.03	0.48	0.48	0.02	-0.01	0.49	0.45	0.03	-0.05	0.43
UK	NT	-0.09	0.33	-0.06	0.18	0.01	0.01	-0.01	0.02	-0.07	0.22	-0.04	0.11
UK	T	0.52	-0.15	-0.04	0.32	0.08	0.03	0.00	0.11	0.28	-0.10	-0.03	0.15
UK	Total	0.43	0.18	-0.11	0.51	0.09	0.05	-0.01	0.13	0.21	0.13	-0.08	0.27
LU	NT	-0.28	0.32	-0.07	-0.04	-0.08	0.25	-0.02	0.15	-0.19	0.35	-0.09	0.07
LU	T	0.16	0.01	0.03	0.20	0.60	-0.17	-0.06	0.37	0.18	-0.10	-0.03	0.05
LU	Total	-0.12	0.33	-0.04	0.17	0.52	0.08	-0.08	0.52	0.00	0.25	-0.12	0.13
NL	NT	0.00	0.13	-0.01	0.11	0.17	-0.06	-0.01	0.11	0.04	0.09	0.00	0.12
NL	T	0.65	-0.18	-0.08	0.40	0.40	0.04	-0.04	0.41	0.45	-0.10	-0.06	0.28
NL	Total	0.65	-0.05	-0.09	0.51	0.57	-0.01	-0.05	0.51	0.49	-0.02	-0.06	0.40
SE	NT	-0.03	0.14	-0.01	0.10	-0.15	0.08	0.00	-0.07	-0.08	0.14	-0.02	0.04
SE	T	0.76	-0.07	-0.06	0.64	0.81	-0.13	-0.05	0.63	0.66	-0.11	-0.09	0.47
SE	Total	0.73	0.08	-0.07	0.74	0.66	-0.05	-0.05	0.56	0.59	0.04	-0.11	0.52

Source: Eurostat, WIFO calculations based on hours worked.
Note: T denotes tradables, NT untradables, and Total the total economy.

Table 2.6: Results of the shift-share analysis across CEE countries (pre- and post-crisis, total economy and tradability)

		Pre crisis (2000 - 2008)				Post crisis (2009 - 2014)				Total Period (2000 - 2014)			
Country	**Orientation**	**Within**	**Between**	**Interaction**	**Total**	**Within**	**Between**	**Interaction**	**Total**	**Within**	**Between**	**Interaction**	**Total**
BG	NT	-0.01	0.06	-0.02	0.03	0.04	0.00	0.00	0.04	0.01	0.04	-0.01	0.03
BG	T	0.12	-0.01	0.00	0.12	0.08	0.03	0.00	0.11	0.10	0.00	0.01	0.11
BG	Total	0.11	0.05	-0.02	0.14	0.12	0.04	-0.01	0.15	0.11	0.04	-0.01	0.14
CZ	NT	0.00	0.07	-0.02	0.05	0.08	-0.05	-0.01	0.02	0.01	0.03	-0.01	0.04
CZ	T	0.46	-0.02	-0.01	0.43	0.14	0.04	0.00	0.19	0.28	0.00	0.00	0.28
CZ	Total	0.46	0.05	-0.03	0.48	0.22	0.00	-0.01	0.21	0.29	0.03	-0.01	0.31
EE	NT	0.08	0.04	-0.01	0.11	-0.04	0.04	-0.01	-0.01	0.04	0.03	0.00	0.07
EE	T	0.39	-0.05	-0.03	0.31	0.33	0.02	-0.04	0.31	0.35	-0.02	-0.04	0.29
EE	Total	0.46	-0.01	-0.03	0.42	0.30	0.06	-0.05	0.31	0.39	0.01	-0.04	0.36
HR	NT					-0.01	0.10	-0.01	0.08				
HR	T					0.08	0.03	-0.02	0.08				
HR	Total					0.07	0.13	-0.03	0.16				
LT	NT	0.05	0.08	0.01	0.14	0.07	0.01	-0.01	0.07	0.04	0.06	-0.02	0.09
LT	T	0.36	0.02	-0.01	0.36	0.34	0.03	0.00	0.37	0.31	0.02	-0.02	0.32
LT	Total	0.41	0.10	0.00	0.50	0.41	0.04	-0.02	0.44	0.35	0.09	-0.03	0.41
LV	NT	0.04	0.16	-0.08	0.12	0.10	-0.01	-0.02	0.07	0.05	0.10	-0.04	0.11
LV	T	0.21	0.14	-0.11	0.25	0.16	0.03	-0.01	0.17	0.19	0.13	-0.12	0.21
LV	Total	0.26	0.30	-0.19	0.37	0.26	0.02	-0.03	0.24	0.25	0.22	-0.16	0.31
PL	NT					0.09	0.00	-0.01	0.08				
PL	T					0.21	0.03	0.00	0.24				
PL	Total					0.30	0.03	-0.01	0.32				
RO	NT	0.03	0.10	0.02	0.14	0.06	-0.05	-0.02	-0.01	0.03	0.06	-0.02	0.08
RO	T	0.19	0.02	0.01	0.22	0.24	0.05	-0.01	0.27	0.19	0.02	0.00	0.22
RO	Total	0.22	0.13	0.03	0.37	0.30	0.00	-0.03	0.26	0.22	0.08	-0.01	0.29
SI	NT	-0.05	0.23	-0.05	0.13	-0.01	0.01	0.00	0.00	-0.06	0.17	-0.05	0.06
SI	T	0.41	0.07	-0.05	0.44	0.27	0.02	0.00	0.29	0.28	0.06	-0.07	0.28
SI	Total	0.36	0.30	-0.10	0.57	0.26	0.03	-0.01	0.29	0.23	0.23	-0.12	0.34
SK	NT	0.09	0.03	-0.02	0.10	0.00	-0.01	0.00	-0.01	0.05	0.02	-0.01	0.07
SK	T	0.48	0.00	-0.04	0.44	0.41	0.01	0.00	0.43	0.42	0.00	-0.06	0.36
SK	Total	0.57	0.02	-0.05	0.54	0.42	0.01	0.00	0.42	0.47	0.02	-0.07	0.42

Source: Eurostat, WIFO calculations based on hours worked, annualised growth contributions.
Note: Data for Croatia, Hungary and Poland are not available for the entire period and the period before 2009. Data for Hungary are missing in the sample after 2008. T denotes tradables, NT untradables, and Total the total economy.

Table 2.7: Results of the shift-share analysis across Southern European and periphery countries (pre- and post-crisis, total economy and tradability)

		Pre crisis (2000 - 2008)				Post crisis (2009 - 2014)				Total Period (2000 - 2014)			
Country	**Orientation**	**Within**	**Between**	**Interaction**	**Total**	**Within**	**Between**	**Interaction**	**Total**	**Within**	**Between**	**Interaction**	**Total**
CY	NT	-0.03	0.18	0.00	0.15	0.05	0.08	0.02	0.14	0.00	0.13	0.00	0.13
CY	T	0.19	-0.04	0.00	0.15	0.01	0.17	-0.01	0.17	0.11	0.05	-0.01	0.14
CY	Total	0.16	0.14	0.00	0.29	0.06	0.25	0.00	0.31	0.10	0.18	-0.01	0.27
ES	NT	-0.13	0.25	-0.05	0.07	0.20	-0.03	-0.04	0.12	0.04	0.13	-0.03	0.14
ES	T	0.16	-0.04	-0.09	0.03	0.31	0.05	0.00	0.36	0.22	0.01	-0.08	0.15
ES	Total	0.04	0.21	-0.14	0.11	0.51	0.01	-0.05	0.48	0.26	0.13	-0.11	0.28
GR	NT	-0.15	0.62	-0.29	0.19	0.33	-0.04	-0.04	0.25	-0.05	0.35	-0.11	0.19
GR	T	0.23	-0.03	-0.06	0.15	-0.37	0.04	-0.03	-0.36	0.00	-0.01	-0.05	-0.06
GR	Total	0.09	0.60	-0.34	0.34	-0.04	0.00	-0.07	-0.11	-0.05	0.34	-0.16	0.13
IE	NT					0.36	0.22	-0.14	0.44				
IE	T					1.18	-0.20	-0.05	0.92				
IE	Total					1.52	0.03	-0.20	1.35				
IT	NT	-0.10	0.12	-0.03	-0.02	0.07	0.01	0.00	0.07	-0.03	0.09	-0.02	0.05
IT	T	0.08	-0.05	-0.03	0.01	0.25	0.03	-0.02	0.26	0.09	-0.03	-0.04	0.02
IT	Total	-0.02	0.07	-0.06	0.00	0.32	0.04	-0.02	0.33	0.06	0.06	-0.06	0.07
PT	NT	-0.01	0.04	0.00	0.03	0.05	0.01	-0.01	0.04	0.01	0.03	-0.01	0.04
PT	T	0.19	0.01	-0.03	0.17	0.13	0.08	-0.01	0.20	0.16	0.03	-0.02	0.17
PT	Total	0.19	0.05	-0.04	0.20	0.18	0.08	-0.01	0.25	0.17	0.07	-0.03	0.20

Source: Eurostat, WIFO calculations based on hours worked, annualised growth contributions.
Note: Data for Malta are not available for the entire period and the period before 2009, and missing in the sample after 2008. Ireland is included since it is among the countries that suffered from substantial structural imbalance. Data for Ireland before the crisis is unreported due to outliers with respect to the price deflators. These particularly affect the sectors H (Transportation), L (Real Estate), R (Arts, Entertainment) and S (other service activities). In addition, there is a break in the employment time series in the year 2011. T denotes tradables, NT untradables, and Total the total economy.

2.3.3. Productivity growth patterns across country groups

These results vary strongly across countries. To summarise the findings, the mean contributions to labour growth in aggregated country groups are calculated. These groups comprise the Core Countries in Northern and Western Europe, Southern Europe and the bulk of the New Member States in CEE.

The results show the highest labour productivity increases were observable in the Core countries, followed by CEE countries in the pre-crisis period, and by Southern European countries after the crisis. The latter suffered severely from structural imbalances, and higher labour productivity growth in the post-crisis period might be a result of re-balancing of economic activities. The mean productivity growth in the group of Core countries and the group of CEE countries dropped after the crisis. In the group of Southern countries that later suffered from imbalances, the low productivity increases before the crisis were compensated by faster growing labour productivity after the crisis.

The shift and share analyses of labour productivity increases reveal that the within-dimension plays a larger role than the between-effect for the countries in Core and CEE countries. However, in the South the structural effect dominates the within-productivity dimension. After the crisis, both the interaction-effects and the between-effects dropped close to nil across all country groups. This indicates that structural change in terms of changes in sector composition – by and large – came to a halt. Productivity increases almost exclusively occur within sectors, which suggest re-balancing mechanisms which are captured by productivity statistics (see Table 2.8).

Table 2.8: Results of the shift-share analysis across country groups (before and after the crisis)

	Within	**Between**	**Interaction**	**Total**
2000-2008				
Core	0.45	0.10	-0.06	0.49
South	0.09	0.21	-0.11	0.19
CEE	0.36	0.12	-0.05	0.42
2009-2014				
Core	0.49	-0.01	-0.03	0.45
South	0.21	0.08	-0.03	0.25
CEE	0.28	0.02	-0.02	0.29
2000-2014				
Core	0.38	0.07	-0.09	0.36
South	0.11	0.16	-0.07	0.19
CEE	0.29	0.09	-0.06	0.32

Source: Eurostat, WIFO calculations based on hours worked; annualised growth contributions.
Note: Data for Croatia and Poland are not available for the entire period and the period before 2009. Poland and Croatia and are not considered in order to obtain a comparable sample. Inculding these countries does not substantially alter the results. Data for Malta and Hungary are missing. Data for Ireland is unreported due to outliers in the deflators.

2.4. Some evidence from EU-KLEMS data

To further explore the productivity developments, this chapter draws on EUKLEMS data. A first look at the changes of the factor compositions reveals cross-country differences. Employment growth measured in hours worked at the industry level is modest in the pre-crisis period. There are two notable outliers before the crisis. The mean growth rate is negative in the UK (minus one percent) and strongly positive in Spain (plus two percent). Since the growth of persons employed is higher than the hours worked, there seems to be a tendency towards declining hours worked per person. Labour growth at the industry level in persons employed after the crisis turned negative in all countries, with Spain being the most affected country (see Table 2.9).

Furthermore, the difference between the mean growth rate across industries and mean growth rate of the total economy is striking. Notably, the indicator used is a relative indicator, for which possible bias has been documented in the firm growth literature. A relative growth indicator does not take into account industry size, which is why it is upward biased for smaller industries and downward biased for sectors with higher absolute employment levels (Coad and Hölzl, 2010; Schreyer, 2000; Hall, 1986). Capital service growth in the total economy dropped after the crisis, but remained positive throughout the sample. The picture of the mean capital service growth rates is similar across industries, even though there is a greater degree of variance in the performance, which again indicates asymmetric developments across industries (see Table 2.9).

Table 2.9: Factor inputs before and after the crisis, mean growth rates

	Pre crisis	**Post crisis**	**Pre crisis**	**Post crisis**	**Pre crisis**	**Post crisis**
Industry Mean	**Employment (hours worked)**		**Employment (persons)**		**Capital services**	
AT	-0.24%	-0.78%	0.21%	-0.12%	2.53%	1.58%
BE	-0.32%	-1.00%	-0.18%	-0.98%	2.00%	0.54%
DE	-0.63%	-0.66%	-0.34%	-0.06%	2.46%	1.13%
ES	1.95%	-3.15%	2.09%	-3.35%	3.80%	0.74%
FI	0.53%	-1.42%	0.76%	-0.96%	1.85%	-1.21%
FR	-0.57%	-1.46%	-0.14%	-0.96%	2.39%	0.94%
IT	0.34%	-2.25%	0.63%	-1.47%	2.44%	0.02%
NL	0.14%	-0.56%	0.46%	-0.89%	2.19%	1.19%
SE	0.36%	0.02%	0.97%	-0.25%	4.00%	2.64%
UK	-0.98%	0.29%	-0.66%	-0.16%	3.00%	-0.09%
Total Economy	**Employment (hours worked)**		**Employment (persons employed)**		**Capital services**	
AT	0.77%	-0.29%	1.01%	0.69%	3.08%	1.69%
BE	1.04%	0.26%	1.09%	0.36%	3.36%	1.21%
DE	0.00%	0.13%	0.57%	0.72%	2.54%	0.87%
ES	3.26%	-2.89%	3.39%	-2.74%	4.95%	1.54%
FI	0.00%	-0.83%	0.33%	-0.36%	3.56%	0.22%
FR	-0.01%	-0.35%	0.66%	0.14%	2.57%	0.84%
IT	0.92%	-1.51%	1.13%	-0.67%	3.49%	0.61%
NL	1.32%	-0.40%	1.58%	-0.38%	2.08%	0.82%
SE	0.81%	0.56%	0.72%	0.63%	4.23%	3.12%
UK	0.71%	0.92%	1.07%	0.63%	3.47%	0.94%

Source: EUKLEMS data (Release December 2016), WIFO calculations.
Note: This table shows the contributions of input factors to value added growth in the pre-crisis (2000-2008) and post-crisis (2009-2014) period. The figures are unweighted mean values across industries. Finland's capital service growth in the pre-crisis period is due to an outlier NACE 16-18 (Wood and paper products; Printing and reproduction of recorded media) in the year 2000; the mean growth value without this outlier would be 1.42%.

These differences in the changes of factor inputs led to different labour productivity growth dynamics (see Table 2.10). Labour productivity growth dropped in all countries in the sample except Spain after 2008. This is also reflected by declining contributions of multifactor productivity ot labour productivity, which even turned negative in Italy and Sweden.

Table 2.10: Contribution to Labour Productivity Growth based on persons employed, industry mean

Mean Contribution to LP (persons employed) in %					
Pre Crisis	**Mean Growth**	**Labour composition**	**ICT capital services**	**Non-ICT capital services**	**MFP**
AT	2.73	1.98	-0.28	-5.28	4.58
BE			n.a.		
DE	1.85	-0.58	0.12	0.07	1.39
ES	0.84	0.08	0.06	-0.06	0.92
FI	2.02	0.05	0.00	-0.27	1.22
FR	1.34	-0.09	0.08	0.26	0.75
IT	0.18	-1.45	0.03	1.01	1.41
NL	2.01	-0.20	-1.04	-25.46	27.71
SE	3.05	-1.69	-0.03	0.17	2.55
UK	2.04	0.09	0.15	0.27	0.49
Post Crisis					
AT	-2.23	-0.84	-0.08	0.13	1.78
BE			n.a.		
DE	-0.17	-0.04	0.15	-0.16	1.05
ES	1.72	0.28	0.05	0.38	0.29
FI	-0.84	0.15	-0.06	0.00	0.91
FR	0.76	-0.02	0.14	0.02	0.86
IT	-0.50	-0.51	0.13	2.90	-1.52
NL	0.50	-0.08	0.11	-0.13	1.09
SE	0.38	0.09	0.07	1.20	-0.37
UK	0.29	-0.11	-0.01	-0.69	1.80

Source: EUKLEMS data (Release December 2016), WIFO calculations.
Note: This table shows the contributions of capital, the labour composition and multi-factor productivity as inputs to labour productivity growth in the pre-crisis (2000-2008) and post-crisis (2009-2014) period. The labour productivity index is based on persons employed. The figures are unweighted mean values across industries. MFP denotes the growth contribution of multi-factor productivity. The data also contain labour productivity based on hours worked as well as value added volume growth. However, these figures are not used due to concerns about the data quality.

EUKLEMS also provides the same decomposition data for the growth of value added in volumes as well as labour productivity growth measured in hours worked. However, there is a data issue concerning the decomposition. The indicator 'Contribution of TFP to value added per hour worked growth (percentage points)' is identical with the indicator 'Contribution of TFP to value added growth (percentage points)'. Hence, these indicators are not considered in the report.

Next, the previous regression analysis (Herrendorf, Rogerson, and Valentinyi, 2013; Hölzl et al., 2013) of labour productivity is replicated, which estimated the influence of labour productivity of both tradables and nontradables on aggregate productivity. The EUKLEMS data offers more information on productivity. The sector data can be used to estimate whether multifactor productivity contributions of tradables influences aggregate multifactor productivity growth more than the contributions of nontradables. To construct the sample of a two-sector economy, the labour productivity information for the total economy as well as the mean values of all tradable and nontradable sectors was used (see Table 2.11 for descriptive statistics).

Table 2.11: Tradable and nontradable MFP contributions, descriptive statistics

Labour Productivity (persons employed)	Obs	Mean	Std. Dev.	Min	Max
Total Economy	132	-0.26	2.00	-8.43	4.30
Tradables	132	0.31	4.10	-14.86	11.22
Nontradables	132	-1.20	1.56	-7.27	1.87

Source: EUKLEMS data, WIFO calculations.
Note: This table reports the descriptive statistics of multifactor contributions of the total economy, tradables and nontradables (NT) to labour productivity growth based on persons employed. The data also contain labour productivity based on hours worked as well as value added volume growth. However, these figures are identical and have therefore not been used.

The regression results support the previous findings (see Table 2.4) by showing that the multifactor contributions to labour productivity growth measured in persons employed exert a greater influence on aggregate productivity growth than nontradables. This is found in the regression coefficients, which are greater than 1 for tradables, and substantially smaller than 1 for nontradables (see Table 2.12). A shift towards higher productivity sectors (i.e. tradables) should accelerate multifactor productivity growth. Structural change in favour of tradables is therefore desirable, especially for less productive economies. On the other hand, a shift towards the nontradable sector reduces multifactor productivity growth.

Table 2.12: Elasticity of tradable and nontradable MFP contributions to aggregate economic performance

	(1)	(2)
Indicator	Y/L growth (persons employed)	
Sector	T	NT
Total Economy	1.25***	0.26***
	(0.202)	(0.047)
Constant	0.63	-0.84***
	(0.394)	(0.181)
Observations	115	115
R-squared	0.456	0.220

Source: EUKLEMS data, WIFO calculations.
Note: This table reports the regression results for the elasticity of multifactor contributions of tradables (T) and nontradables (NT) on aggregate multifactor contributions to labour productivity growth based on persons employed. Standard errors clustered at the country level are in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

2.5. Summary and policy implications

This chapter provided diagnostic performance evidence from a structural perspective. The starting point is the tradable-nontradable framework, which splits the economy into goods and services that are either tradable or nontradable. Tradability is perceived as an industrial property. Not all tradable goods and services are effectively traded. For instance, it is conceivable that goods classified as highly tradable (e.g., machinery and equipment) are traded by more competitive economies, whereas they are not traded at all by firms in economies suffering from poor trade competitiveness. From a purely structural perspective, a larger share of tradable goods is associated not only with greater export potential, but also with more competitiveness. A shift from a current account deficit to a current account surplus involves a shift in the composition of domestic production.

The descriptive statistics highlight that the share of nontradable goods production increased significantly in the Southern countries of the EU prior to the financial crisis. Against this background, the output composition of the "South" countries was rather distinct to that of "Core" and "CEE" EU countries, where it remained more or less flat or even declined on average. The "South" countries in turn were those which faced the severest recessions – in particular with respect to the duration rather than the amplitude of the economic downswing. This characterises the extent to which the output composition in the "South" countries was rendered increasingly unstable prior to the crisis. This escalating supply side imbalance was replicated by the ever higher current account deficits, which identified the corresponding imbalance on the demand side. The discussion also highlighted the extent to which supply side rebalancing has started in several "South" countries (e.g., Spain or Greece), bringing the output composition back to a more sustainable trajectory.

Macroeconomic model simulations highlight the structural differences across the three groups of countries. This applies to output, as well as to other key macroeconomic variables. The results suggest poor competitiveness of the group of Southern countries. These are, inter alia, mirrored by lacking opportunities to benefit from global upswings and economic structures that render adjustments due to contractions in ouput more painful. These also lead to a sluggish recovery performance due to higher risk premiums on the back of a high net foreign liability position.

Next, this two-sector macroeconomic approach is augmented by sector-level findings analysing productivity patterns. As expected, the data showed great performance variance across countries and industries, such that sector information allows painting a more diverse picture than the macroeconomic pattern. Even if economies perform poorly at the aggregate level, they may exhibit highly productive sectors. As countries grow in aggregate performance their intersectoral productivity differences decrease.

The sector analysis is also conducted against the backdrop of the tradable versus nontradable framework. Tradable sectors were found to be a substantial determinant of aggregate labour productivity – much more so than nontradables. This is supported by an analysis using EUKLEMS data, which finds that the contributions of multifactor productivity growth of tradables on aggregate multifactor productivity growth are much larger than the contributions of nontradables. This result is robust to the choice of indicators, which may rely on decompositions of value added growth or labour productivity growth – either based on hours worked or persons employed.

The different elasticity of tradables and nontradables on aggregate performance implies that the sector composition is a determinant of aggregate productivity. Hence, there is potential for productivity growth from hypothetical structural adjustments. These show that the labour productivity of, in particular, Greece, Romania, Croatia, Ireland, Cyprus, Bulgaria, Portugal, Slovenia and Italy would grow in aggregate productivity if they were able to implement the sector structures of the most labour-productive countries in the sample (Belgium, Denmark and the Netherlands). The UK and Luxemburg would lose from an adjustment of industrial structures, which can be explained by their peculiar industrial structures, which are dominated by financial sectors with apparent high labour productivity.

A shift-share analysis decomposed productivity growth before and after the crisis into a within-sector and a structural change effect. In the pre-crisis period, Sweden, Finland and Austria exhibited the highest labour productivity growth rates, which were largely driven by within-productivity increases. The lowest productivity growth was found in Italy, Spain and Bulgaria. The economies that later suffered from structural imbalances showed productivity growth that was largely driven by structural change, i.e. by the between-effect and the interaction-effect. There was a shift in the relevance for productivity growth towards nontradable sectors. This was observable across the EU. For instance, these accounted for more than half of the productivity growth in Cyprus, Greece, Spain and Italy, whereas they contributed less than a quarter in three countries with the highest growth rates.

In the post-crisis period, the aggregate annual labour productivity growth dropped. The three best performing countries were Denmark, Ireland and Sweden, and the lowest productivity increases after 2008 were observable in Greece, Bulgaria and the United Kingdom. Productivity growth from structural change nearly came to a halt across all EU economies. Productivity increases almost exclusively occured within sectors, which suggest re-balancing mechanisms that are captured by productivity statistics. Furthermore, the role of nontradable sectors in productivity growth dropped throughout the EU, with the notable exception of Greece, where post-crisis growth of labour productivity continues to hinge on nontradables. These results are worrying from a catching-up perspective. Less productive economies should exhibit higher productivity growth rates than more productive ones.

This chapter provided a series of findings that are relevant to both research and economic policy. While the tradable-nontradable framework has recently gained popularity in research on exchange rate mechanisms, its application to structural rebalancing is new to the literature. This appears to be an appropriate perspective for the analysis of EU Member States, which are in a Single Market, and often in a currency union. The observed productivity patterns support previous findings from two-sector studies. Their application to EU Member States is, however, new.

The tradable-nontradable approach has implications for macroeconomic imbalances. The observed structural shifts seem to be an indicator of weakening external competitiveness, and this has implications for the trade and current account deficit. A large share of nontradables restricts an economy's ability to balance its current account. Hence, there is a structural implication of the tradable-nontradable approach. Reducing net debt levels by moving from a borrowing to a repayment position implies a shift in the composition of the output produced – less nontradable goods production relative to tradable goods production. Certainly, this is difficult to achieve, since sector structures are the outcome of institutional factors, factor endowments and idiosyncratic comparative advantages. Nevertheless, the mechanisms observed in the tradable-nontradable approach suggest that Member States should seek to avoid macroeconomic imbalances by implementing structural policies that favour tradables over nontradables. Also, the nontradable sector has been found to be less relevant for aggregate productivity. However, it is unclear whether this finding is axiomatic or whether the functioning of the nontradable-sector itself can be changed by economic policies to make nontradables more dynamic.

Altogether, this chapter set the stage for an in-depth analysis of the role of the Single Market and national institutions in these developments. The notion of tradability links the performance diagnostics to the subsequent analysis. This section used a dichotomous definition of tradability commonly considered in macroeconomics. The split is based on a steady index of tradability, which will be used in the next chapter. The steady tradability index indicates the more general scope of a sector to partake in international value chains, and is an industrial property that may affect competitiveness over and above market integration.

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2.7. Appendix to Chapter 2

2.7.1. Appendix: Description of the GIMF model

The GIMF is a Dynamic Stochastic General Equilibrium (DSGE) model that depicts the bilateral trade flows between regions and the relative prices for each region. The version used in this project comprises the three regions ("Core", "South", "CEE") defined above, plus a further region representing the Rest of the World. The shocks simulated with the model are assumed to originate from this external aggregate. The following briefly describes the main features of the GIMF model. A detailed description of the GIMF model and its various applications can be found, for example, in Kumhof et al. (2010) and Anderson (2013).

The structure of the production sector is of key importance in the current application. It includes firms that produce tradable and nontradable intermediate goods. The firms are managed in accordance with the preferences of their owners, the finitely-lived (OLG) households.

Firms operate in monopolistically competitive markets, so that goods and services are sold at a price involving a mark-up over the marginal production cost. Exports are priced to the local destination market, whereas imports are subject to quantity adjustment costs. There are also domestic price adjustment costs that lead to sticky prices.

The parameterisation of the GIMF model relies on a calibration rather than on empirical estimation. The GIMF model is calibrated for four regions: "Core", "South" and "CEE" countries of the EU and the Rest of the World. The scenario considered in the simulations is based on annual data. The data used for the calibration are taken from the AMECO database and the Statistical Annex of Alert Mechanism Report 2016 prepared by the European Commission.

The calibration of monetary rule parameters use own estimates based on annual data for the corresponding regions. For fiscal rule parameters the calibration assumes target deficit-to-GDP ratios consistent with recent average observed government-debt-to-GDP ratios. OECD estimates of the output gap coefficients are used. With respect to the parameters of the financial accelerator, the ratio of corporate debt to corporate equity has been calibrated to match the average of the values in Table 1. Further details concerning the calibration can be found in Kumhof et al. (2010) and Anderson (2013).

2.7.2. Appendix: Macro-economic Indicators

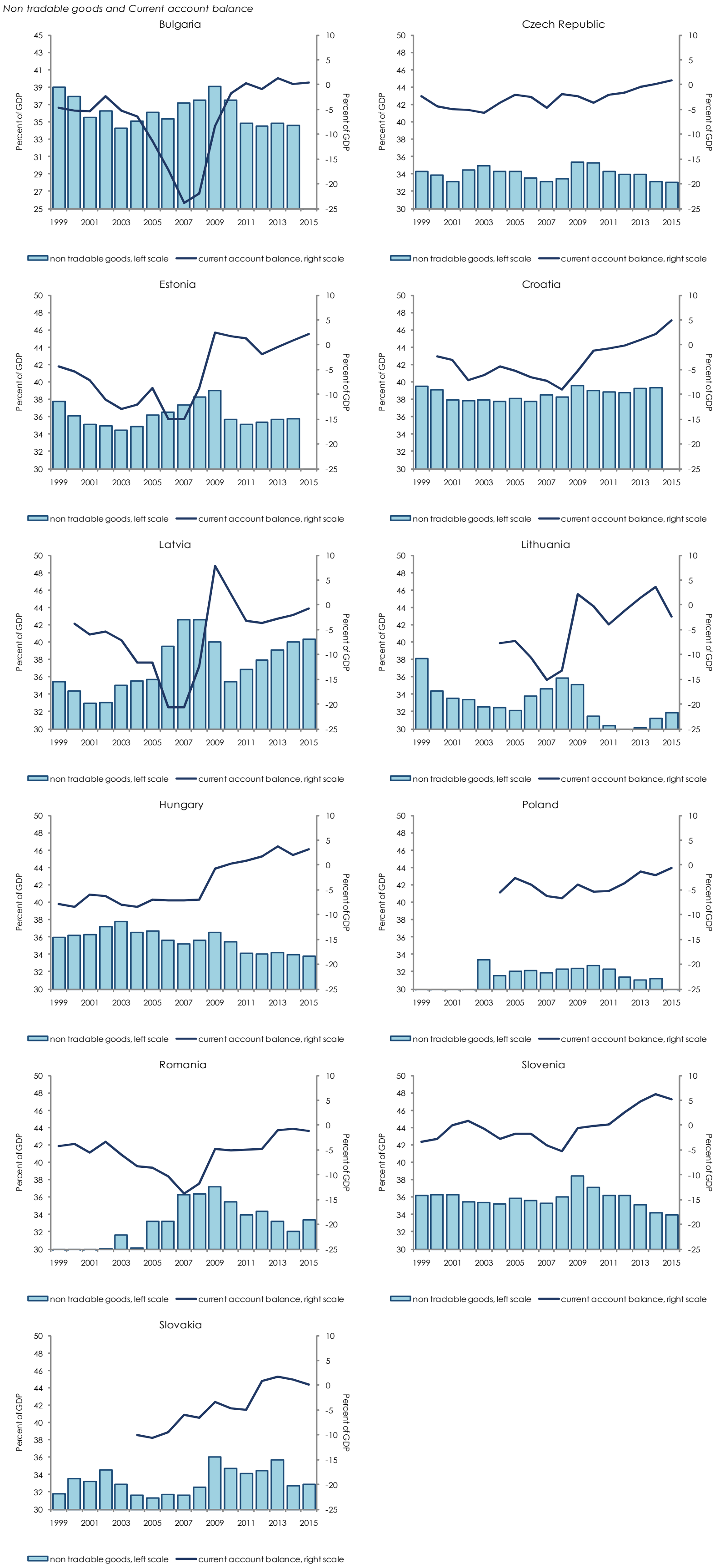
Figure 2.7: "Core" countries: Nontradable goods share and current account balance

Source: European Commission (AMECO), WIFO calculations.

Figure 2.8: "South" countries: Nontradable goods share and current account balance

Source: European Commission (AMECO), WIFO calculations.

Figure 2.9: "CEE" countries: Nontradable goods share and current account balance



Source: European Commission (AMECO), WIFO calculations.

Table 2.13: Average Labour Productivity across countries (hours worked), 2000-2014

Country (Group)	Code	Economy-wide Labour Productivity	Lowest Productivity Sector	Lowest Productivity Labour Productivity	Highest Productivity Sector	Highest Productivity Labour Productivity
Core						
Austria	AT	35.1	S	22.2	D	158.3
Belgium	BE	47.2	S	25.7	D	204.4
Germany	DE	40.7	I	16.2	D	150.6
Denmark	DK	51.1	I	28.5	B	1,554.3
Finland	FI	39.2	I	19.9	D	221.0
France	FR	42.9	S	27.5	D	181.0
United Kingc	GB	33.1	I	15.7	B	391.4
Luxemburg	LU	64.2	F	29.2	D	220.5
Netherlands	NL	45.5	I	23.9	B	1,290.3
Sweden	SE	37.7	I	22.9	D	237.5
South						
Cyprus	CY	21.2	G	13.5	D	116.3
Spain	ES	30.0	S	13.6	D	261.2
Greece	GR	20.6	S	11.6	D	84.6
Ireland	IE	34.0	F	9.9	S	1,056.0
Italy	IT	32.8	S	18.9	D	179.0
Portugal	PT	16.7	S	8.7	D	220.6
CEE						
Bulgaria	BG	5.3	I	3.2	K	25.6
Czech Repu	CZ	15.7	I	9.0	D	130.9
Estonia	EE	11.0	I	4.9	K	44.9
Croatia	HR	12.3	S	8.1	B	72.6
Hungary	HU	12.1	I	6.4	D	37.9
Lithuania	LT	12.3	Q	5.1	D	31.0
Latvia	LV	9.0	I	5.1	J	52.7
Poland	PL	11.0	I	5.5	D	37.2
Romania	RO	8.0	G	2.7	D	31.1
Slovenia	SI	20.1	N	11.7	D	63.4
Slovakia	SK	14.9	I	6.9	D	96.3

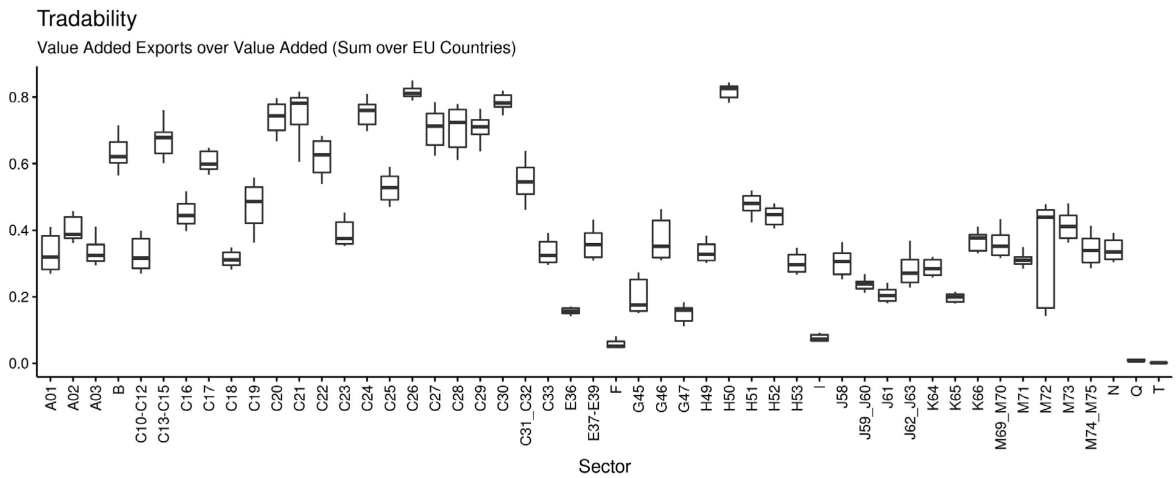
2.7.3. Appendix: Tradability

The tradable-nontradable framework provides the idea of tradability as a general industry (or sector) characteristic. It does not take into account effective trade exposures, which are a function of comparative advantages, country and industry characteristics. For instance, small open economies such as Slovakia produce a high proportion of tradables which are effectively exported, whereas the output of large, competitive economies (e.g., the USA) is often destined for the home market. This issue is avoided by defining tradability by EU-wide aggregates.

The idea of tradability is implemented empirically with WIOD data and is based on the period 2000-2014. Tradability can be defined in various ways. The presently used classification considers the aggregate (i.e. EU-wide) value added exports, regardless whether it is intra-EU or extra-EU trade. Exports are measured as 'value added exports'. That is, the fraction of value added at the industry level which is not consumed domestically. In other words, this is the domestic value added induced by foreign demand. This indicator comprises both direct exports (i.e. exports by a given industry) and indirect exports (i.e. the inputs an industry provides to another exporting industry). Certainly, such an indicator is not optimal. It is conceivable that exporting industries re-import, i.e. a given industry imports previously exported goods from a trading partner. This would not be considered in the present tradability indicator despite the international trade activity, because the eventual consumption occurs domestically.

The export intensities obtained show a robust picture of tradability over time (see Figure 2.10), corroborating the notion of tradability as an industry property. Again, tradability itself does not imply that a given industry trades in each country, but rather that the goods and services of a specific industry are generally traded on aggregate. These export intensities are used to split sectors into a tradable-nontradable dichotomy (see Table 2.14). Figure 2.11 plots the results of our tradability calculations at the Nace 1digit level.

Figure 2.10: Average induced value added export intensities, 2000-2014



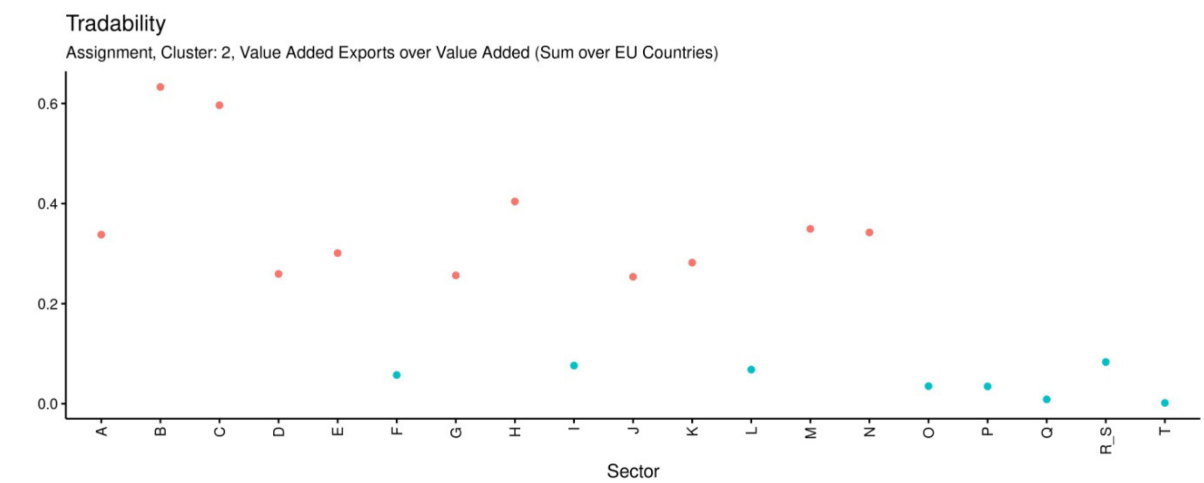
Source: WIOD, WIFO calculations.
Note: Aggregate value added exports both extra and intra EU.

Table 2.14: Tradability at the Nace 1digit level

Section	**Title**	**Division**	**Tradable (1) or Nontradable (0)**
A	Agriculture, forestry and fishing	01 – 03	1
B	Mining and quarrying	05 – 09	1
C	Manufacturing	10 – 33	1
D	Electricity, gas, steam and air conditioning supply	35	1
E	Water supply; sewerage, waste management and remediation activities	36 – 39	1
F	Construction	41 – 43	0
G	Wholesale and retail trade; repair of motor vehicles and motorcycles	45 – 47	1
H	Transportation and storage	49 – 53	1
I	Accommodation and food service activities	55 – 56	0
J	Information and communication	58 – 63	1
K	Financial and insurance activities	64 – 66	1
L	Real estate activities	68	0
M	Professional, scientific and technical activities	69 – 75	1
N	Administrative and support service activities	77 – 82	1
O	Public administration and defence; compulsory social security	84	0
P	Education	85	0
Q	Human health and social work activities	86 – 88	0
R	Arts, entertainment and recreation	90 – 93	0
S	Other service activities	94 – 96	0
T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	97 – 98	0
U	Activities of extraterritorial organisations and bodies	99	0

Source: WIFO classification based on trade intensities (WIOD).

Figure 2.11: Tradability assignment at the Nace 1digit level



Source: WIOD, WIFO calculations.
Note: Aggregate value added exports both extra and intra EU.

There are various ways to define tradability. However, the dichotomous classification of tradables and nontradables is robust to the choice of indicators even though continuous indicators vary by the way they are constructed. Introducing more than two cluster levels does not necessarily provide more information but threatens robustness.

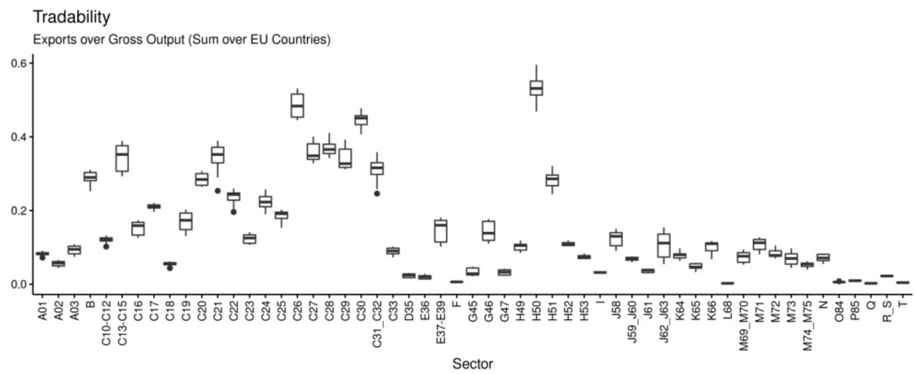
The definition of tradability requires two components – the degree of international exposure and some weight factor which is a measure of output. The numerator can either contain exports or both exports and imports. In addition, there might be variance across the tradability of a sector; both the Nace Rev. 2 two-digit classification from WIOD and Eurostat as well as the EUKLEMS sector division which are based on the same classification are used. The denominator can be either gross output or value added. Gross output is defined as the total sales of all products and services of a given sector to all consumers, whether to serve final or intermediate consumption. Value added is defined as the difference between gross output and intermediate consumption, i.e. the purchases of intermediate inputs.

The remainder contains the plots of the different measures of tradability:

- Exports over gross output
- Exports and imports over gross output
- Value added exports over value added

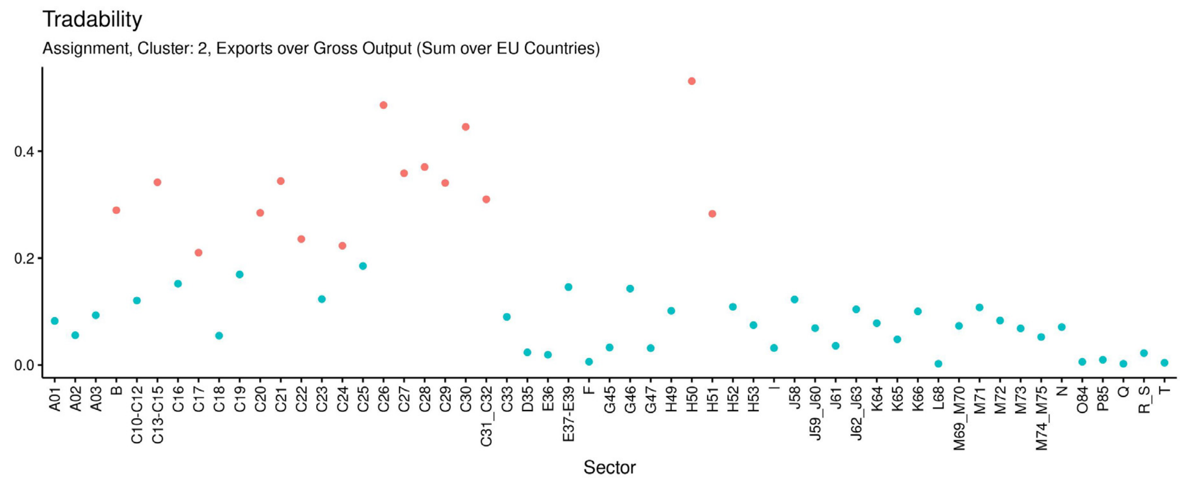
Exports over Gross Output

Figure 2.12: Exports over gross output shares, WIOD classification, 2000-2014



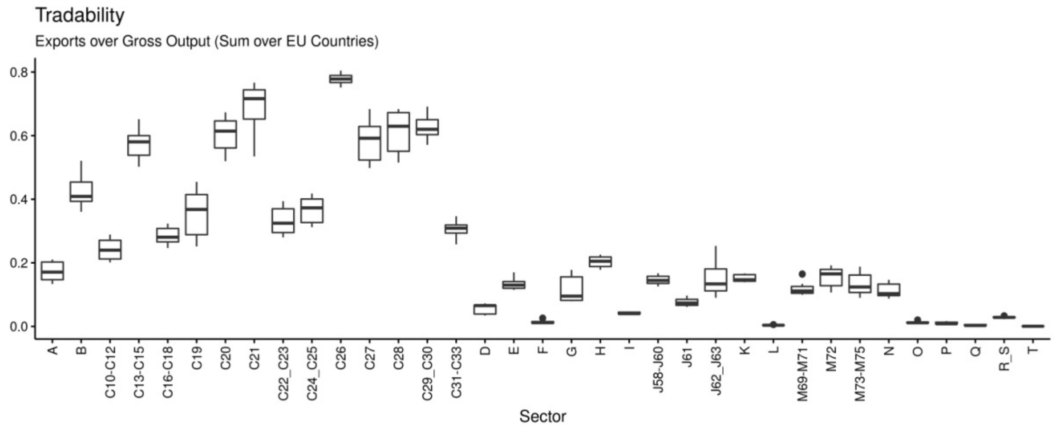
Source: WIOD, WIFO calculations.
Note: Aggregate exports both extra and intra EU.

Figure 2.13: Tradability assignment, exports over gross output shares, WIOD classification



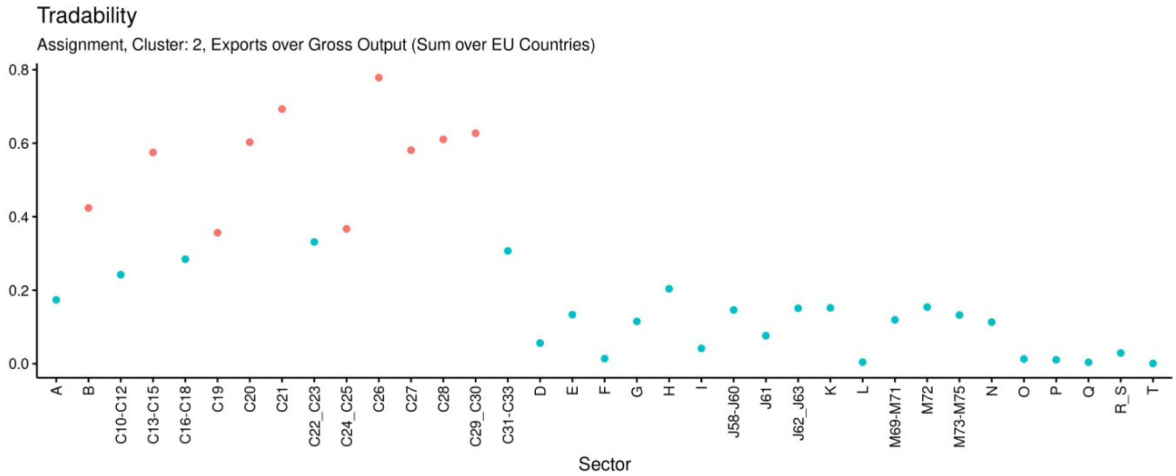
Source: WIOD, WIFO calculations.
Note: Aggregate exports both extra and intra EU.

Figure 2.14: Exports over gross output shares, Eurostat classification, 2000-2014



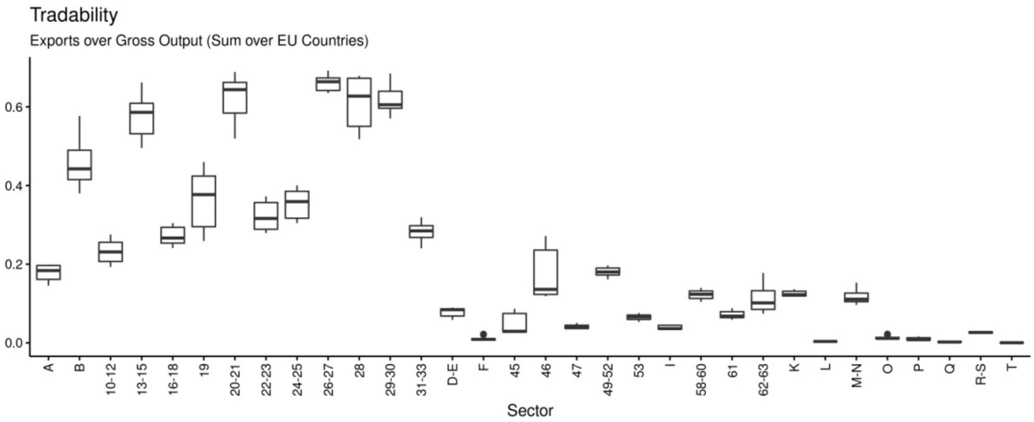
Source: WIOD, WIFO calculations.
Note: Aggregate exports both extra and intra EU.

Figure 2.15: Tradability assignment, exports over gross output shares, Eurostat classification



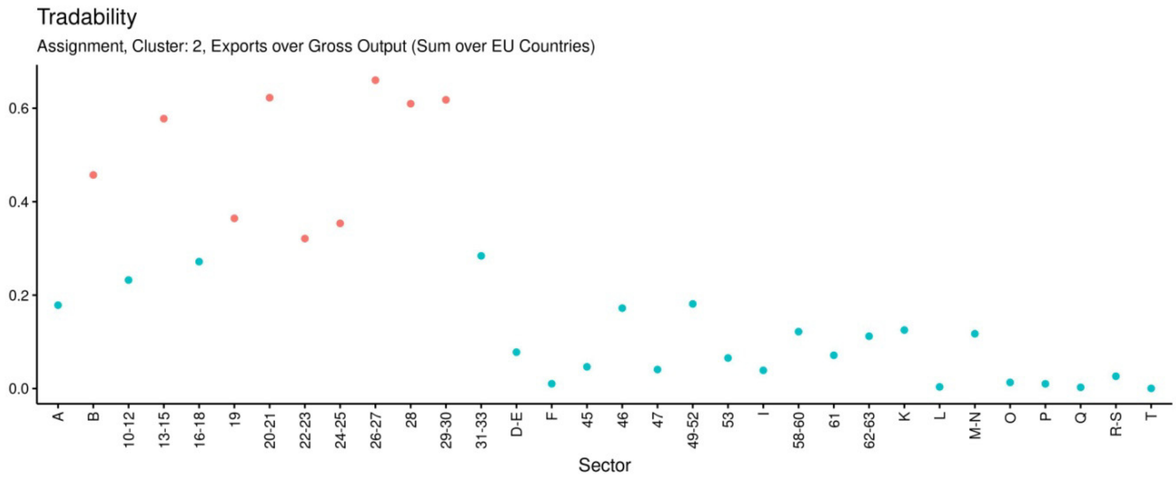
Source: WIOD, WIFO calculations.
Note: Aggregate exports both extra and intra EU.

Figure 2.16: Exports over gross output, EUKLEMS classification, 2000-2014



Source: WIOD, WIFO calculations.
Note: Aggregate exports both extra and intra EU.

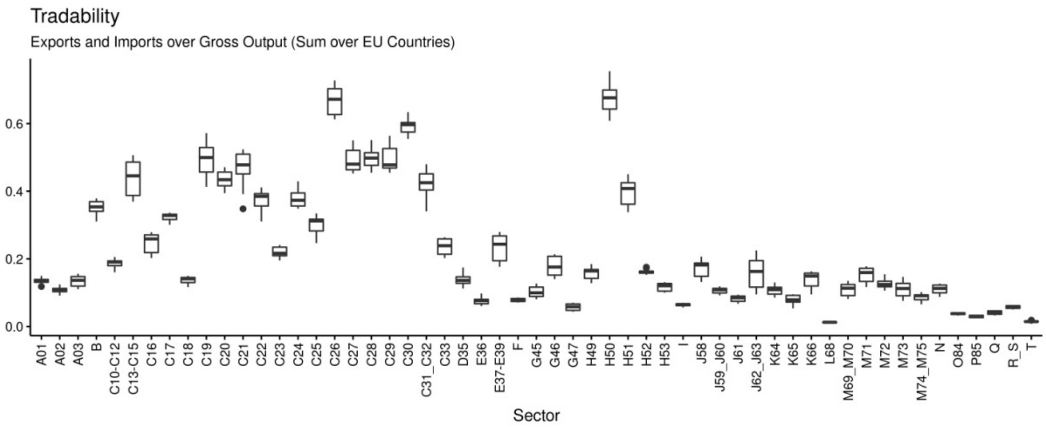
Figure 2.17: Tradability assignment, exports over gross output, EUKLEMS classification



Source: WIOD, WIFO calculations.
Note: Aggregate exports both extra and intra EU.

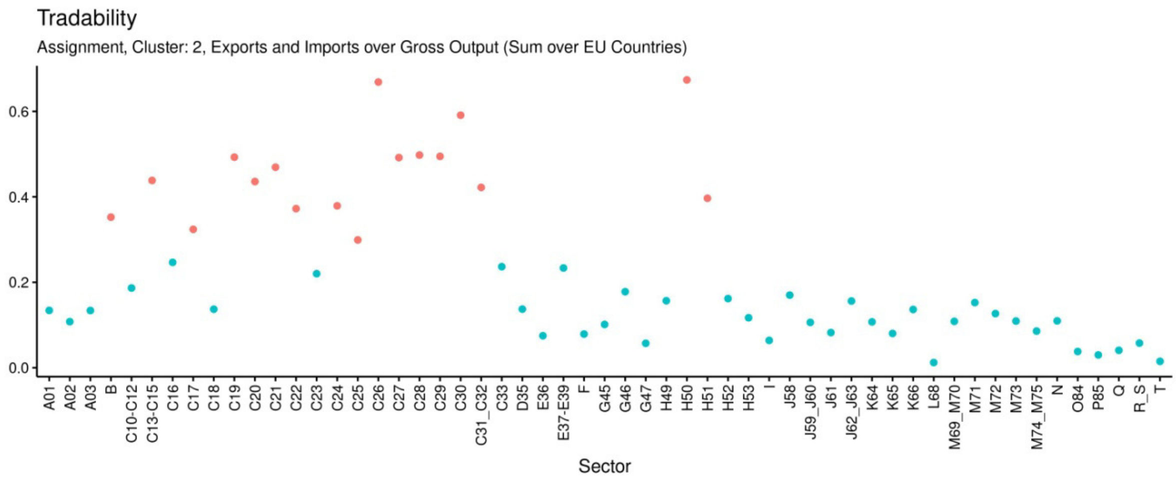
Exports and Imports over Gross Output

Figure 2.18: Exports and imports over gross output, WIOD classification, 2000-2014



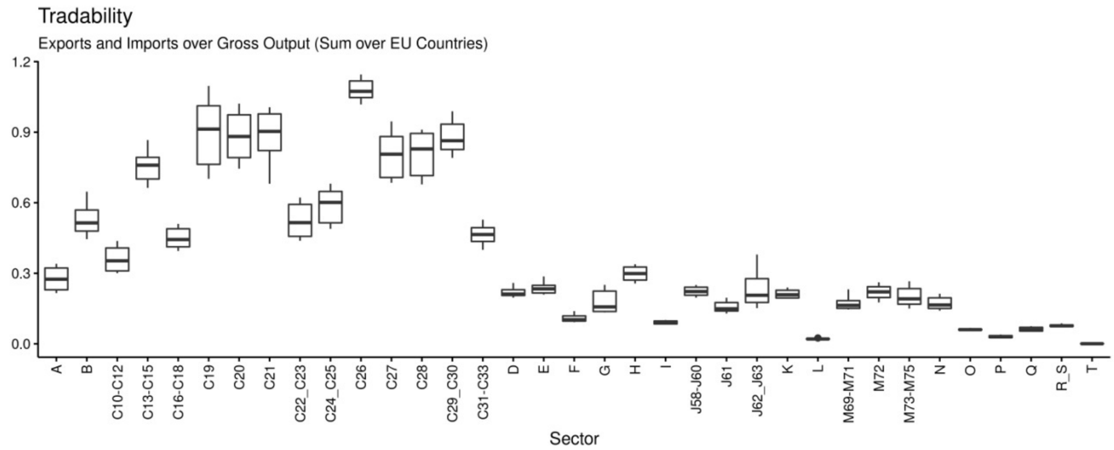
Source: WIOD, WIFO calculations.
Note: Aggregate exports both extra and intra EU.

Figure 2.19: Tradability assignment, exports and imports over gross output, WIOD classification



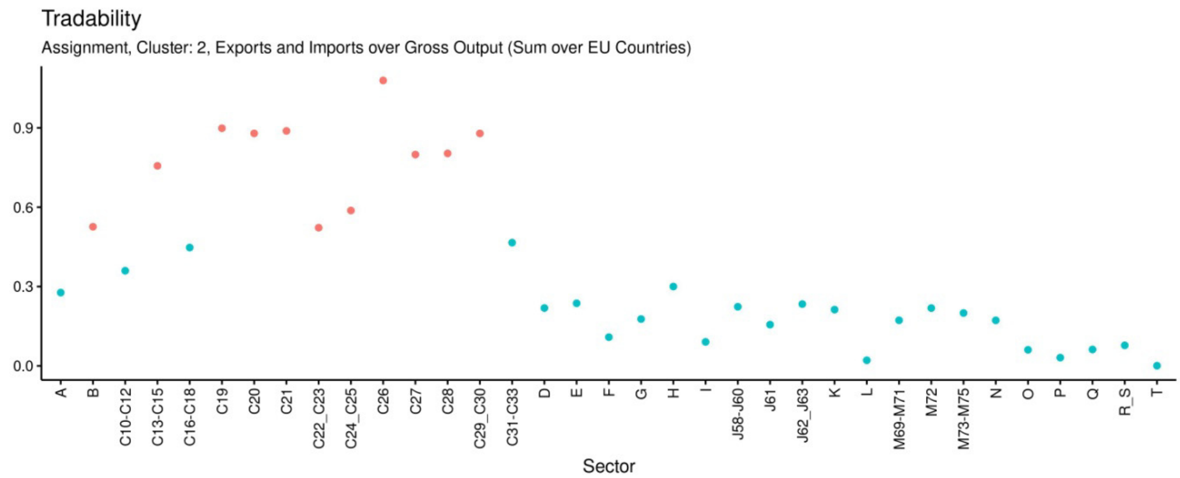
Source: WIOD, WIFO calculations.
Note: Aggregate exports both extra and intra EU.

Figure 2.20: Exports and imports over gross output, Eurostat classification, 2000-2014



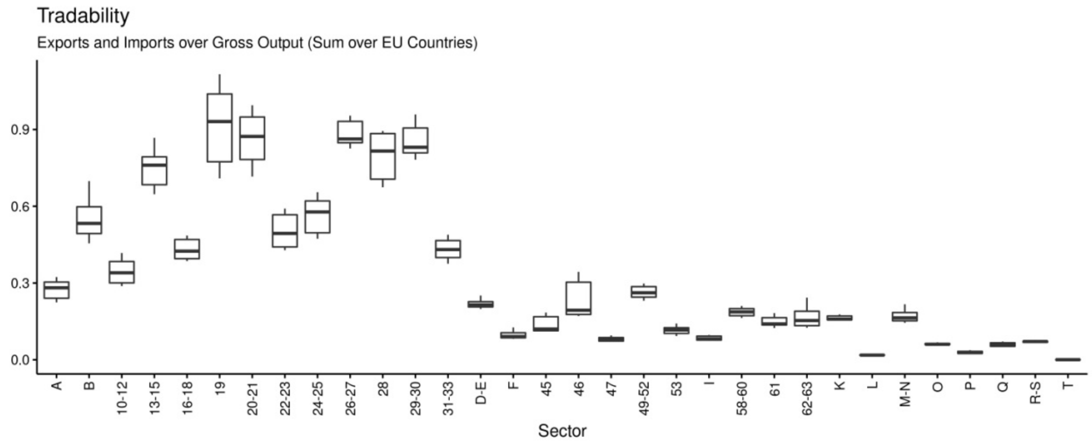
Source: WIOD, WIFO calculations.
Note: Aggregate exports both extra and intra EU.

Figure 2.21: Tradability assignment, exports and imports over gross output, Eurostat classification



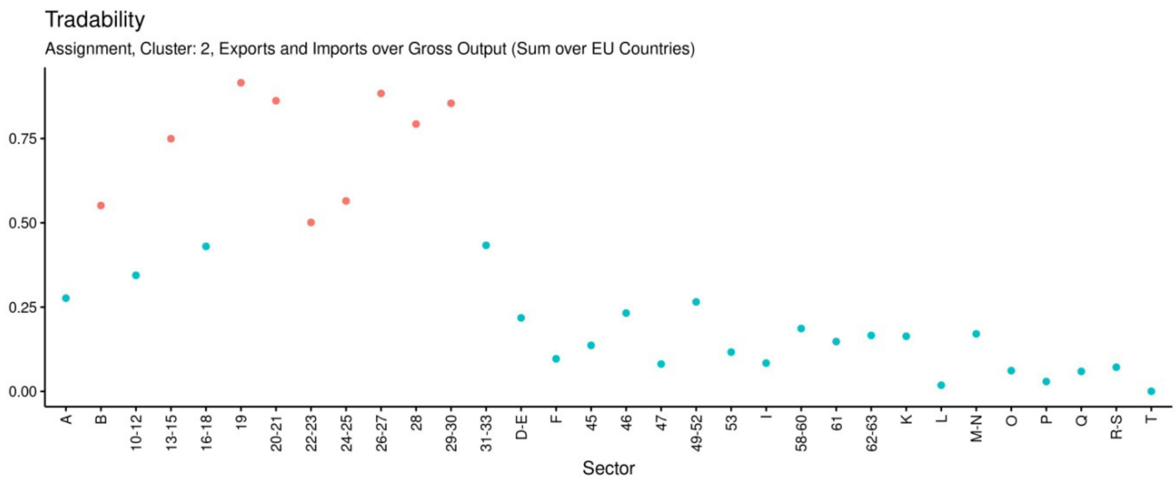
Source: WIOD, WIFO calculations.
Note: Aggregate exports both extra and intra EU.

Figure 2.22: Exports and imports over gross output, EUKLEMS classification, 2000-2014



Source: WIOD, WIFO calculations.
Note: Aggregate exports both extra and intra EU.

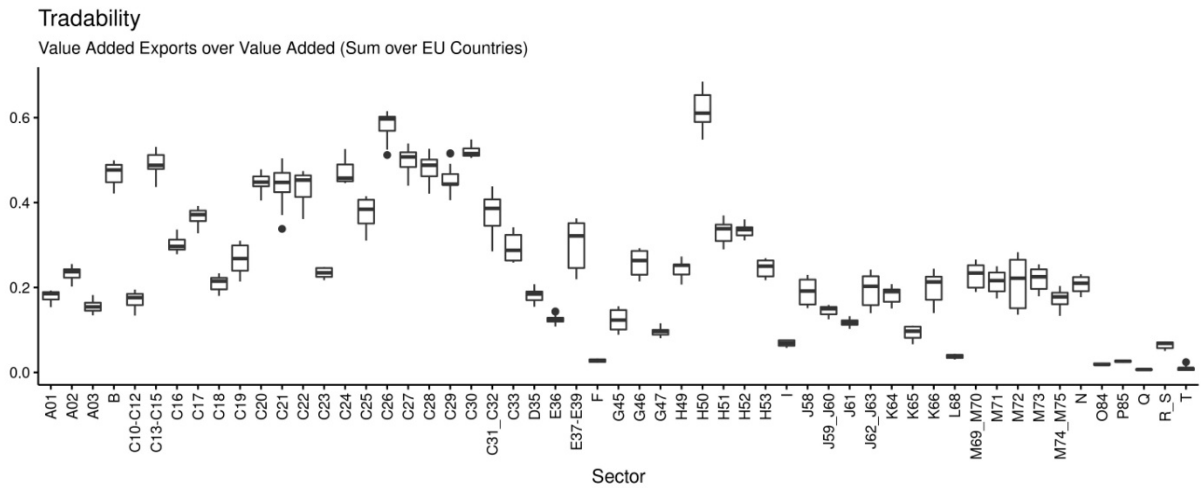
Figure 2.23: Tradability assignment, exports and imports over gross output, EUKLEMS classification



Source: WIOD, WIFO calculations.
Note: Aggregate exports both extra and intra EU.

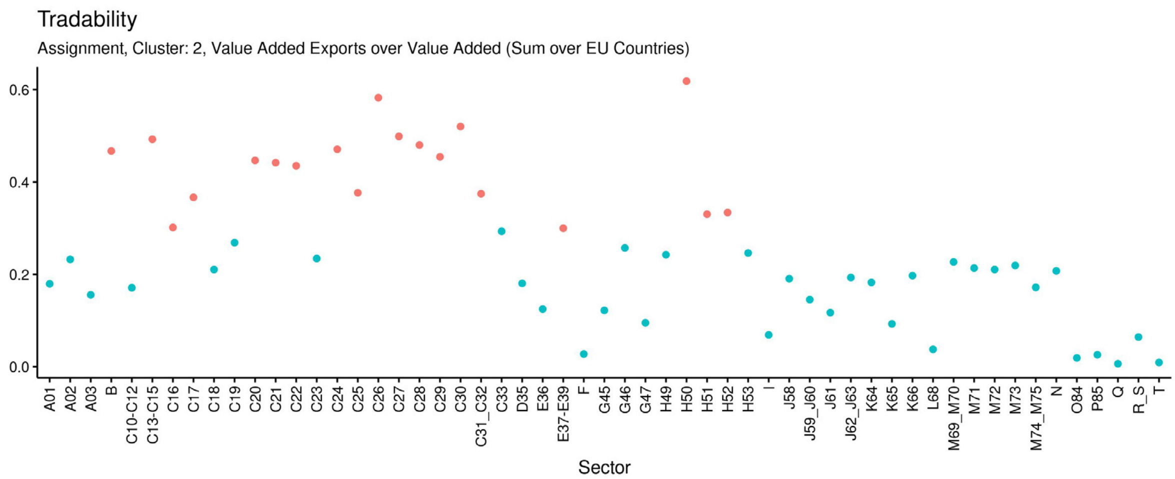
Value Added Exports over Value Added

Figure 2.24: Value added exports over value added, WIOD classification, 2000-2014



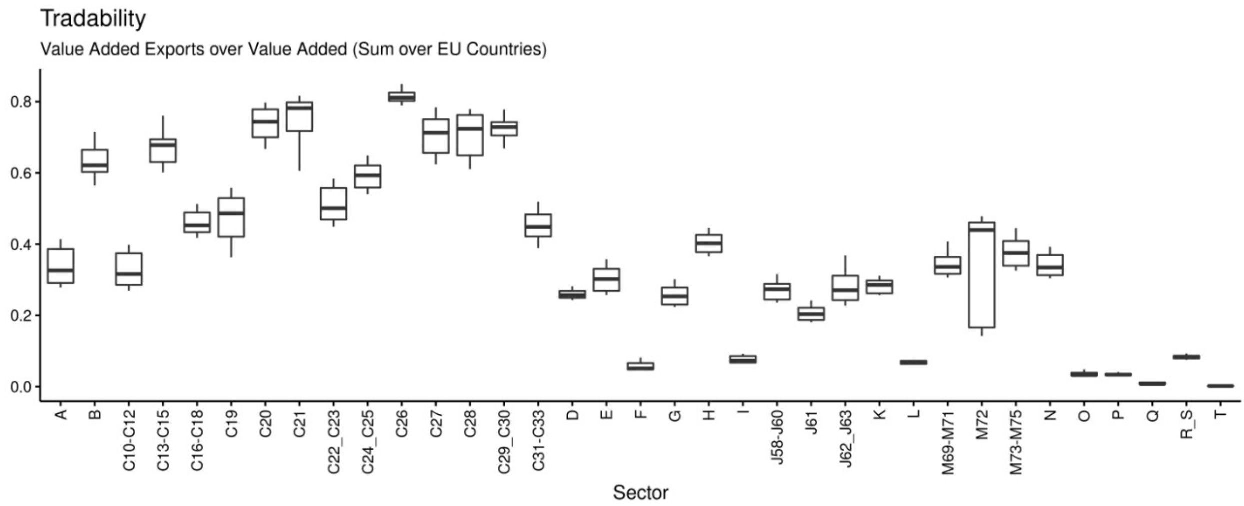
Source: WIOD, WIFO calculations.
Note: Value added exports both extra and intra EU.

Figure 2.25: Tradability assignment, value added exports over value added, WIOD classification



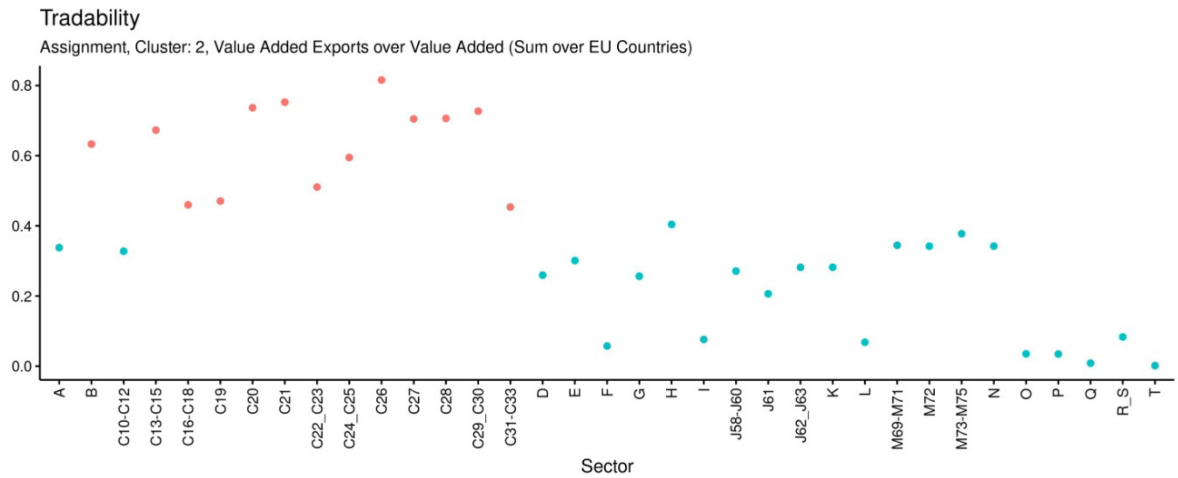
Source: WIOD, WIFO calculations.
Note: Value added exports both extra and intra EU.

Figure 2.26: Value added exports over value added, Eurostat classification, 2000-2014



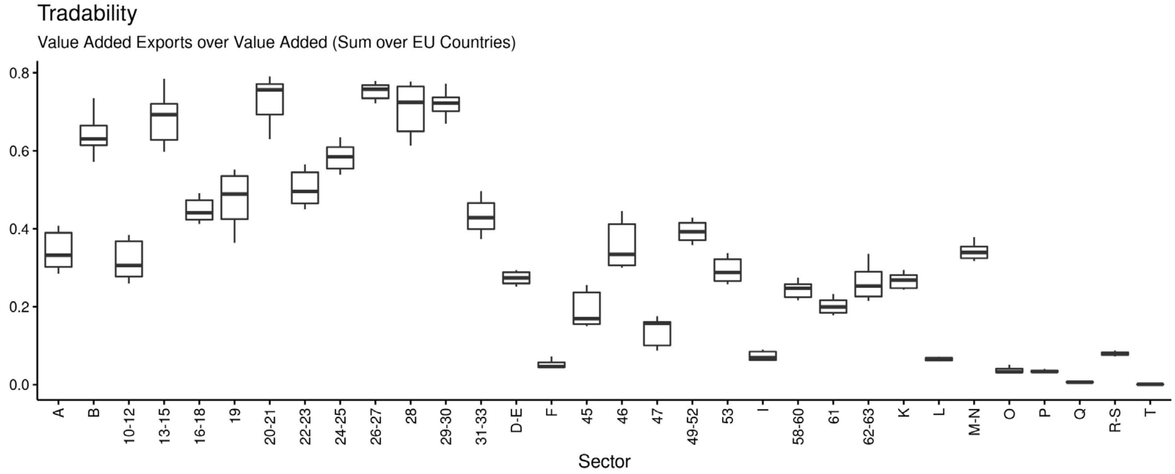
Source: WIOD, WIFO calculations.
Note: Value added exports both extra and intra EU.

Figure 2.27: Tradability assignment, value added exports over value added, Eurostat classification



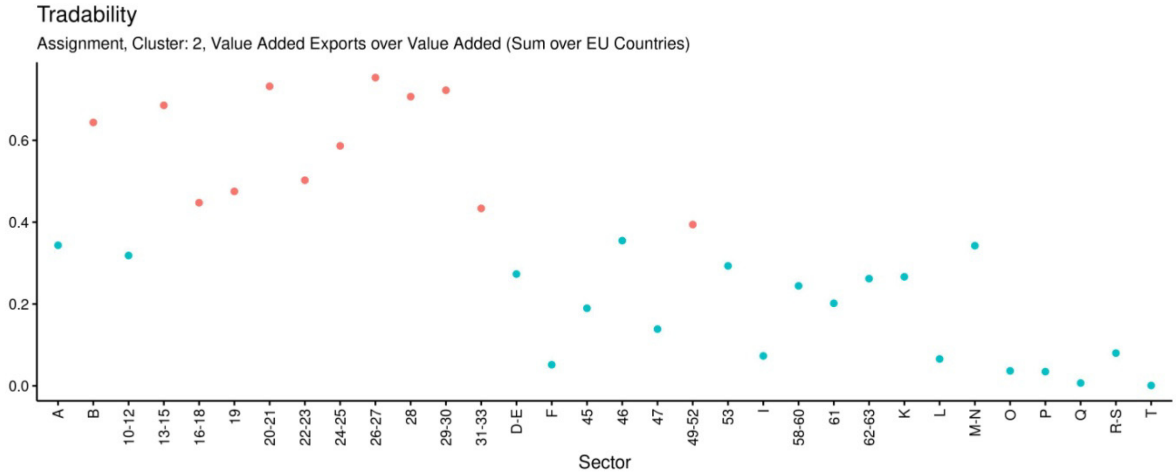
Source: WIOD, WIFO calculations.
Note: Value added exports both extra and intra EU.

Figure 2.28: Value added exports over value added, EUKLEMS classification, 2000-2014



Source: WIOD, WIFO calculations.
Note: Value added exports both extra and intra EU.

Figure 2.29: Tradability assignment, value added exports over value added, EUKLEMS classification



Source: WIOD, WIFO calculations.
Note: Value added exports both extra and intra EU.

3. The Single Market and selected aspects of competitiveness

This chapter expands on the preceding performance diagnostics, which took a structuralist perspective and placed performance differences in a tradability framework. Tradability of goods and services produced by a sector was perceived as an industrial property, and is therefore the precondition for a trade-based perception of the Single Market. Tradability itself is not an integration indicator, and therefore is not a viable indicator with which to study integration. The objective of this chapter is to link the previous findings on economic dynamics to the Single Market on the one hand, and to national and EU policies on the other hand.

The chapter is structured into six parts. First, the national institutional and the Single Market indicators are introduced. Second and third, Single Market integration and institutional indicators are linked to productivity, employment levels and growth. Fourth, the structural change analysis is complemented by industrial turbulence. Fifth, the observed patters are measured on the supply-side, which is why an additional analysis will depict the changes in demand patterns. Sixth, economic adjustments occur not only through structural change, but also through prices. Hence, some findings on producer price dynamics are presented in the final section. Each of these topics is linked to relevant strands of literature, and subsequently explored empirically. The findings are directly relevant for economic policy.

First, a *demand analysis* complements the observations on structural change, which mainly rely on supply side measures. This type of study falls into the intersection of the structural change literature and research on consumption patterns across income levels. The analysis is based on final use tables from WIOD data to answer how the Single Market can be interpreted against the evolution of demand patterns, and how these demand patterns differ from induced import values. This question is relevant for tradables and the Single Market policies. Next, it explores the demand-side drivers of changes within the nontradable sector across Member States. The analysis of this relationship is relevant for national policy making; especially because a look at the sector structure of Member States that later suffered severely rebalancing mechanisms reveals a sharp rise in the share of nontradables.

The second subchapter provides a variable description of the *institutions and the Single Market indicators* that will be analysed. Hence, it sets the stage for the study of selected institutions, which have been found to be central to economic performance. This concerns both the EU and individual Member States. Following institutional literature discussing trade competitiveness, it considers three different aspects of institutional quality that have been linked to industrial performance. The dimensions are the general governance quality, the use of external finance and labour market flexibility. Over and above national policy variables, legal EU membership status is considered individually in the analyses, since it has been shown that EU membership brings about institutional change as the Community Acquis is implemented. Next, value chain trade related measures of market integration are defined. These involve an upstream, backward linkage based integration measure, and a downstream, forward linkage based measure.

The third subchapter links to the previous findings of performance asymmetries. It studies the impact of integration into the *Single Market, national institutions and tradability* on industry level performance indicators. It asks two guiding questions. First, what is the role of Single Market integration on value added and employment? Second, how do the effects of Single

Market integration interact with national institutions? Methodologically, the chapter makes use of panel regression techniques that explain labour productivity and employment over time.

In the fourth subchapter, the previous analysis of the effects of integration on employment and productivity is complemented by an analysis of the results of the performance diagnostics chapter. Both the productivity growth indicators obtained from the shift-share analysis and employment growth are connected to a set of value chain trade measures for the Single Market as well as to institutional indicators, analogously to the previous subsection.

The fifth subchapter supplements the structural change analysis by *industrial turbulence* indicators. Turbulence indicators are available at the industry level. This analysis will shed light on how structural change occurs at the firm level. It has been argued that firm entry and exit play a role in reallocation processes. Also, high growth firms have been found to be a driver of structural change. Both have different policy implications. Linking dynamism indicators to structural change and the Single Market facilitates the prioritisation of policies.

The sixth subchapter provides an exploratory analysis of *producer price developments*. Changes in relative prices pose another important adjustment mechanism in structural change patterns. First, the analysis describes differences between the prices of tradable and nontradable goods. Second, panel regressions are used to explore the channels through which EU market integration and economic policies have affected price developments.

Each subchapter offers a summary of the main findings. To put the respective findings into a bigger picture, the final subchapter offers a joint interpretation against the background of the Single Market and EU integration.

3.1. Demand side aspects of the Single Market

3.1.1. Introduction

The previous findings on the Single market relied – to a large extent – on the tradable-nontradable model (Sachs and Larraine, 1993), in which structural change between the two sectors is the main adjustment mechanism of economic imbalances. Hence, it serves well as a descriptive framework in which the performance of the EU economies and the Single market can be studied. Since aggregate demand equals aggregate supply, it implicitly also considers a change in demand patterns. Nevertheless, the main motivation is driven by supply side competitiveness.

In addition to these – largely supply-side – considerations, there is a long tradition in the analysis of demand. This research reaches back to the 19th century and Engel, who studied the relationship of consumption baskets by household income. The most prominent result became known as 'Engel's law', which states that food and beverages take a larger share in the consumption basket of poorer households (Engel, 1895). This work has triggered a bulk of literature discussing the changes of consumption patterns, which now take a prominent place in modern demand analysis. The findings provide valuable insights into the types of goods and services consumed over the distribution of household incomes and different stages of economic development (Foellmi and Zweimüller, 2008). The empirical results from this literature have implications for other fields of economics, such as the study of structural change (Chai and Moneta, 2010; Lewbel, 2008; Houthakker, 1957).

The results largely suggest that there are saturation points in Engel curves across a wide range of goods and services. Food and certain manufactured products typically show strong saturation effects. The findings for some other expenditure classes such as leisure and personal services only weakly indicate saturation effects. The latter are typically categorised as nontradables, which has implications for supply-side structures. If the demand for nontradables increases as countries grow in wealth, the output share of nontradables is also expected to increase. Even though such a process is conceivable, it needs to be interpreted with caution. Engel curves are conditional on their respective environment, which casts doubt on the generalisability of the declining slope of Engel curves as economies become wealthier (Chai and Moneta, 2010; Buera and Kaboski, 2009). A recent study links the declining share of manufacturing to changes in final demand, which can, as has been argued, be the main cause of de-industrialisation. Interestingly, international trade has been found to have limited impact (Peneder and Streicher, 2017).

However, demand plays a crucial role in the determination of the tradable/nontradable composition of the supply side. Nontradeable demand not least depends on the "wealth of a nation"; tradables, while in this respect less important from a demand side perspective, have undergone a different, but no less fundamental shift: the increasingly global sourcing of both intermediate and final products, with ensuing international interdependencies which manifest themselves in increasing import and export volumes (as a share of GDP, imports and exports have roughly doubled in Europe over the last 40 years, from around 20% in 1970 to 40% in 2010, see Dieppe et al., 2012). Even though trade levels have flattened in the aftermath of the crisis, they certainly remain high and, to various degrees, play a prominent role in the transmission of potential spillovers between regions and countries – with huge variations among countries. As an example, Garbellini et al. (2014) estimate that in most EU countries, both in the Core and the South, domestic components have been the most important determinants of the fall in income levels. However, the drop in the South countries' demand spilled over to the Core countries, leading to about half of their own reduction in GDP – at the same time, these countries were "exporting" more of their own reductions in final demand to their trading partners (Garbellini et al., 2014, p. 355).

Oberhofer et al. (2016) support this point: "According to the results, intra-EU exports dominate their extra-EU counterparts in both manufacturing goods and services. In relative terms, exports from the manufacturing sectors still dominate, but service exports tend to develop more dynamically. A drawback of the strong concentration on intra-EU trade relationships is that negative demand shocks translate into large within-EU export losses and a harsh export downturn for virtually all industries located in all member states participating in the single market. In addition, disaggregated analyses at the country and industry levels, respectively, reveal substantial heterogeneities in intra- and extra-EU trade performance across the EU member states in general and Eurozone economies in particular. Idiosyncratic factors that are not easy to assess by applying a quantitative approach seem to be crucial in shaping these differences".

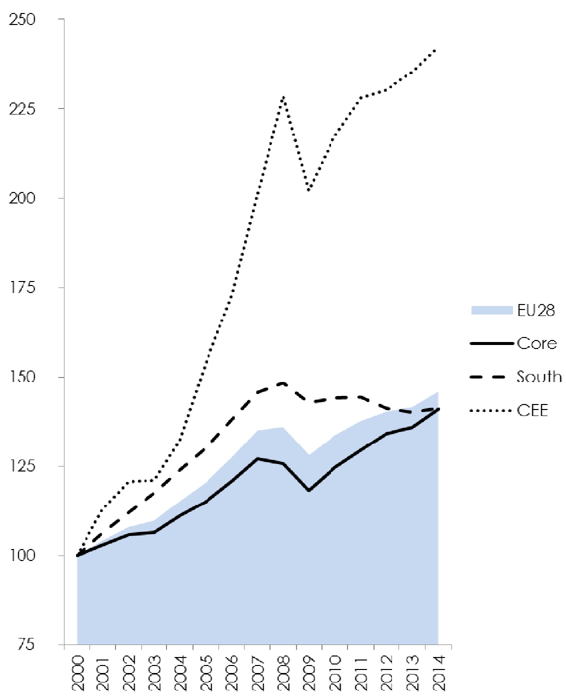
The following provides an empirical analysis of the role of demand in structural change processes against the background of the Single Market. Methodologically, the section relies on decompositions of demand patterns using WIOD data. It splits the analysis into three parts. The first section asks about the demand side evolution of the Single Market with respect to tradables and nontradables. Second, it links these findings to the trade performance of EU countries and hence to the Single Market. Third, it pays respect to differences across countries.

3.1.2.Some descriptive demand side evidence

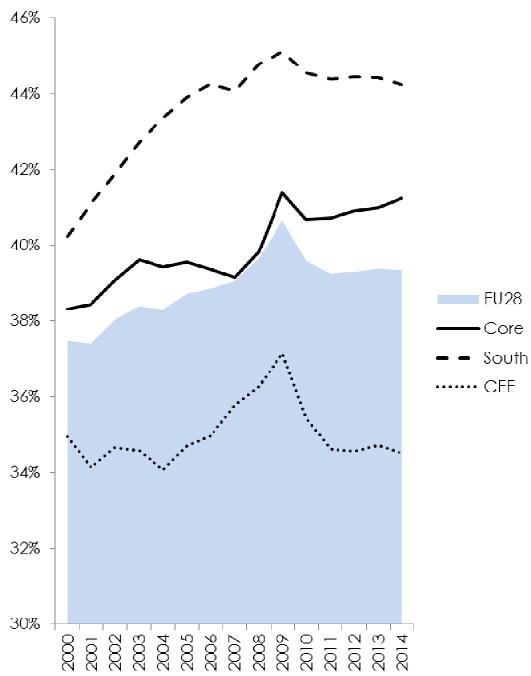
The EU28 shows a marked change in its demand patterns: between 2000 and 2014, total consumption of nontradables has risen markedly, leading to an increase in the nontradables sectors' value added share from 37.5% to 39.3% (EU average). During the same period, consumption of domestic products (defined as within national borders) has fallen, substituted by both intra- and extra-EU imports. As a corollary, intra-EU exports have gone up; but so, have extra-EU exports, completing the picture of rising "globalisation" in production and consumption.

Figure 3.1: GDP development 2000-2014, 2000=100 and VA-share of nontradable sectors

GDP:



VA-share of nontradables:

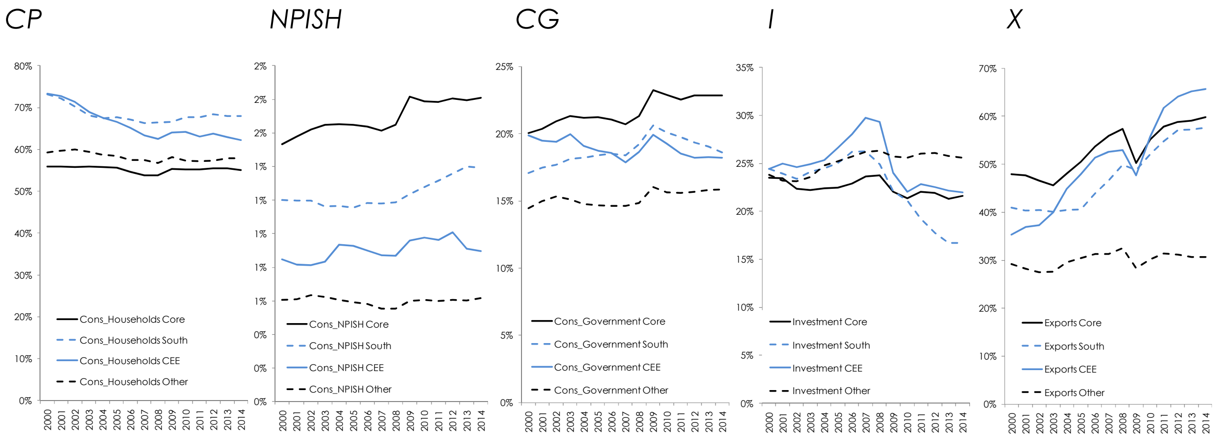


Source: WIOD Release 2016, WIFO calculations.
Note: All indicators are unweighted country averages.

The crisis of late 2008 shows in all country groups (and almost all indicators); what sets apart the South group of countries from the other groups (Core and CEE) is that its influence was much more pronounced and, especially, much more lasting: In 2014, the South's GDP was still around 5% below the level of 2008, and only just levelling out.

Sectors producing nontradable goods show a long-term increase relative to total GDP. In 2009, tradables were hit more than nontradables, leading to an even stronger, but temporary spike. After the crisis, the share of nontradables in most regions continues along the long-term path – with two exceptions: in CEE, nontradable increase set in only around 2005; after a quite pronounced crisis-induced peak, its share seems quite stable at around 35%, about the same as at the beginning of the 2000s. In the South countries, the crisis lead less to a spike but seems to have halted (and slightly reversed) the strong increase observed since 2000 (in at least a few South countries, the booming construction sector was a major player in this increase). A more detailed look at final demand paints a similar picture:

Figure 3.2: Final Demand as % of GDP across country groups



Source: WIOD Release 2016, WIFO calculations.
Note: The country group "other" includes the WIOD countries, which are not EU Member States: AUS, BRA, CAN, CHN, CHE, IDN, IND, JPN, KOR, MEX, NOR, RUS, TWN, USA

Before the crisis, investment and government consumption (as well as NPISH), but especially exports had risen relative to GDP, with a balancing decrease in private consumption. Government consumption peaked during the crisis, but remained somewhere between the pre-crisis level and the crisis peak afterwards – except for the South, where it continued to decrease (also, before the crisis, the increase was more pronounced than in other regions). Exports have surprisingly held up in the South, eclipsed only by CEE exports. Investment, however, has fallen much longer and much further than in all other regions, to below 70% of its pre-crisis level. On the other hand, private consumption has expanded its shares, as have non-profit institutions NPISH.

However, these shifts at the level of total commodity consumption, towards both nontradables and imported tradables, can potentially be brought about by two developments. It can be a shift in demand or a shift in propensities.

To illustrate this point, consider the rise in the consumption of nontradables: first, it could be brought about by a shift in the composition of total demand, away from demand categories which are low in nontradables (investment, for example) towards nontradable-heavy categories such as government consumption. Such demand shifts have indeed happened between 2000 and 2014: intermediate demand has expanded along with total demand, roughly adding 52% between 2000 and 2014. Consumption has lagged a bit, whereas exports have risen much faster. After roughly keeping pace with total demand until the crisis, gross capital formation has severely lagged the other categories' development, and in 2014 was only around 24% higher than at the beginning of the observation period. As a share of total commodity demand, exports have risen from around 14 to 18% of total commodity demand, whereas gross capital formation has decreased from 10 to 8%. Given that these categories exhibit quite diverse propensities for nontradable goods, such heterogeneous developments can imply sizable changes in the overall consumption share of nontradables.

Table 3.1: Commodity demand by user, index and share

	2000=100					Share [%]				
	INTC	**CONS**	**GCF**	**EXP**	**Total**	**INTC**	**CONS**	**GCF**	**EXP**	**Total**
2000	100	100	100	100	100	42%	34%	10%	14%	100%
2001	105	104	102	105	104	42%	34%	10%	14%	100%
2002	107	108	100	107	107	42%	34%	9%	14%	100%
2003	108	111	102	107	108	42%	35%	9%	14%	100%
2004	115	116	109	117	115	42%	34%	10%	15%	100%
2005	123	121	115	127	122	42%	34%	9%	15%	100%
2006	134	127	127	142	132	42%	33%	10%	15%	100%
2007	144	133	139	155	141	43%	32%	10%	16%	100%
2008	147	135	138	161	144	43%	32%	10%	16%	100%
2009	131	131	111	135	130	42%	34%	9%	15%	100%
2010	140	135	120	156	139	42%	33%	9%	16%	100%
2011	149	138	126	173	146	42%	32%	9%	17%	100%
2012	150	142	121	180	148	42%	32%	8%	17%	100%
2013	149	142	120	182	148	42%	32%	8%	18%	100%
2014	152	146	124	188	152	42%	32%	8%	18%	100%

Source: WIOD Release 2016, WIFO calculations.

There is a second possible explanation for these developments. It is conceivable that they are brought about by changes in the user categories' demand structure, i.e. an increase in the share of nontradable consumption at the expense of tradables. This is probably most obvious in private consumption, where nontradables increased their share from 45% in 2000 to 61% in 2014 (EU28). However, it happened and happens in intermediate demand as well, not least due to the phenomenon of outsourcing: between 2000 and 2007, the use of nontradables increased from 16% to 21% of intermediate inputs. Since then, it has diminished again, but at 18% still stands higher than at the beginning of the observation period.

3.1.3.Shift-share analysis

As these two explanations have quite different implications, shift-share analyses are performed to quantify their relative importance. The idea behind shift-share analysis is to compare hypothetical states of the world, by keeping either shares or levels unchanged between two points in time, t^0 and t^1: let's call total consumption in these points of time C^0 and C^1, and the consumption of nontradables NT^0 and NT^1. The share of nontradables over total consumption is then nt^0 and nt^1. Moreover, total consumption is the sum of 5 categories i: intermediate demand (int), private consumption (pc), consumption of non-profit organisations (npish), government consumption (cg), gross capital formation (gcf) and exports(exp)[11]:

(Eq. 3-1) $C^0 = C_{int}{}^0 + C_{pc}{}^0 + C_{npis}{}^0 + C_{gc}{}^0 + C_{gcf}{}^0 + C_{exp}{}^0$

(Eq. 3-2) $NT^0 = NT_{int}{}^0 + NT_{pc}{}^0 + NT_{npihs}{}^0 + NT_{gc}{}^0 + NT_{gcf}{}^0 + NT_{exp}{}^0$,

with share of nontradables $nt_i{}^0 = NT_i{}^0 / C_i{}^0$. (variables for t^1 are defined analogously)

Total change in the consumption of NT between t^0 and t^1, then, is disaggregated into 3 components:

[11] At the level of the EU28, an additional regional dimension can be introduced: shift-share-effects can also be brought about by changes in the relative weights of member states. In the calculations, this effect is implicitly included.

1. within effect ("level effect"): Increase in categories' total consumption, leaving nt_i unchanged:
   $\Delta NT_{level,i} = (T_i^1 - T_i^0) * nt_i^0$
2. between-effect ("share effect"): increase in categories' consumption of nontradables, if only nt had changed: $\Delta NT_{share,i} = T_i^0 * (nt_i^1 - nt_i^0)$
3. interaction effect, considering both changes in levels and nt-shares:
   $\Delta NT_{interaction,i} = (Ti^1 - Ti^0) * (nt_i^1 - nt_i^0)$

These three components sum to the total change in NT-consumption, thus allowing for the calculation of their respective contribution to total change. The within effect represents a "counterfactual", i.e. the demand which would have been observed had structures that remained unchanged. Together, the between-effects as well as the interaction effects sum to 0, i.e. they can be directly interpreted as a "source of deviation" from this counterfactual. In the tables below, these deviations are shown relative to total demand.

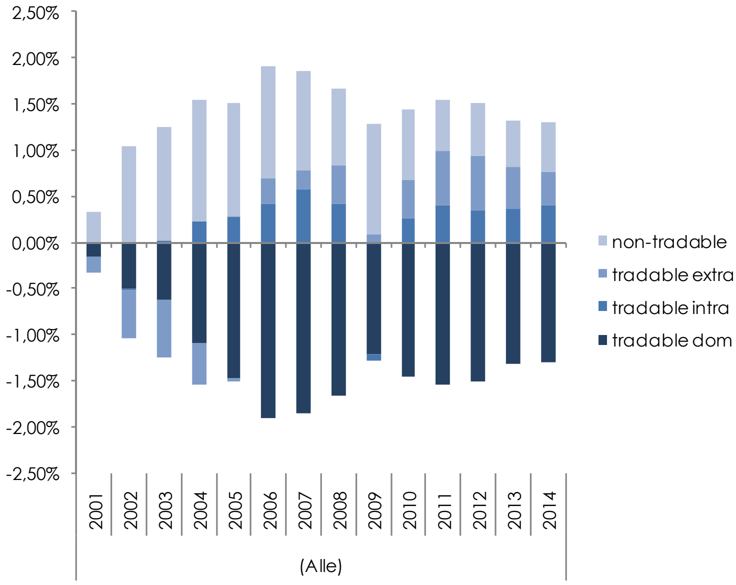
Nontradables are, by definition, neither imported nor exported (at least not in any significant way: to a small extent, these are traded as well, but the trade shares are low and do not show marked upward trends; for example, at the EU level they accounted for 2.7% of exports in 2000, and 2.9% in 2014); thus, their demand is satisfied almost exclusively by domestic production. Demand for tradables, on the other hand, can be met by domestic production or it can be imported; if imported, it can be sourced from other EU members (intra-EU trade) or from outside the common market (extra-EU trade). Thus, the shift-share exercise is expanded to further disaggregate changes in demand for tradables according to their origin (domestic/intra/extra-trade).

The aim of this analysis is to estimate the change in commodity demand which can be attributed to changes in the composition of demand (the break-down to nontradables and nontradables sourced from domestic production or imports); thus, from the three components which result from the shift-share analysis, one examines the sum of between-effect and interaction term (the logic being that the within effect is not influenced by changes in commodity shares).

As "t^0", the respective values for the year 2000 are used. Thus, the results should be interpreted as share-induced changes in each year as compared to the year 2000 (i.e., as cumulative changes).

The results for the EU28 are depicted in the following figure:

Figure 3.3: "Between"-effect for the EU28 countries (members in 2013)



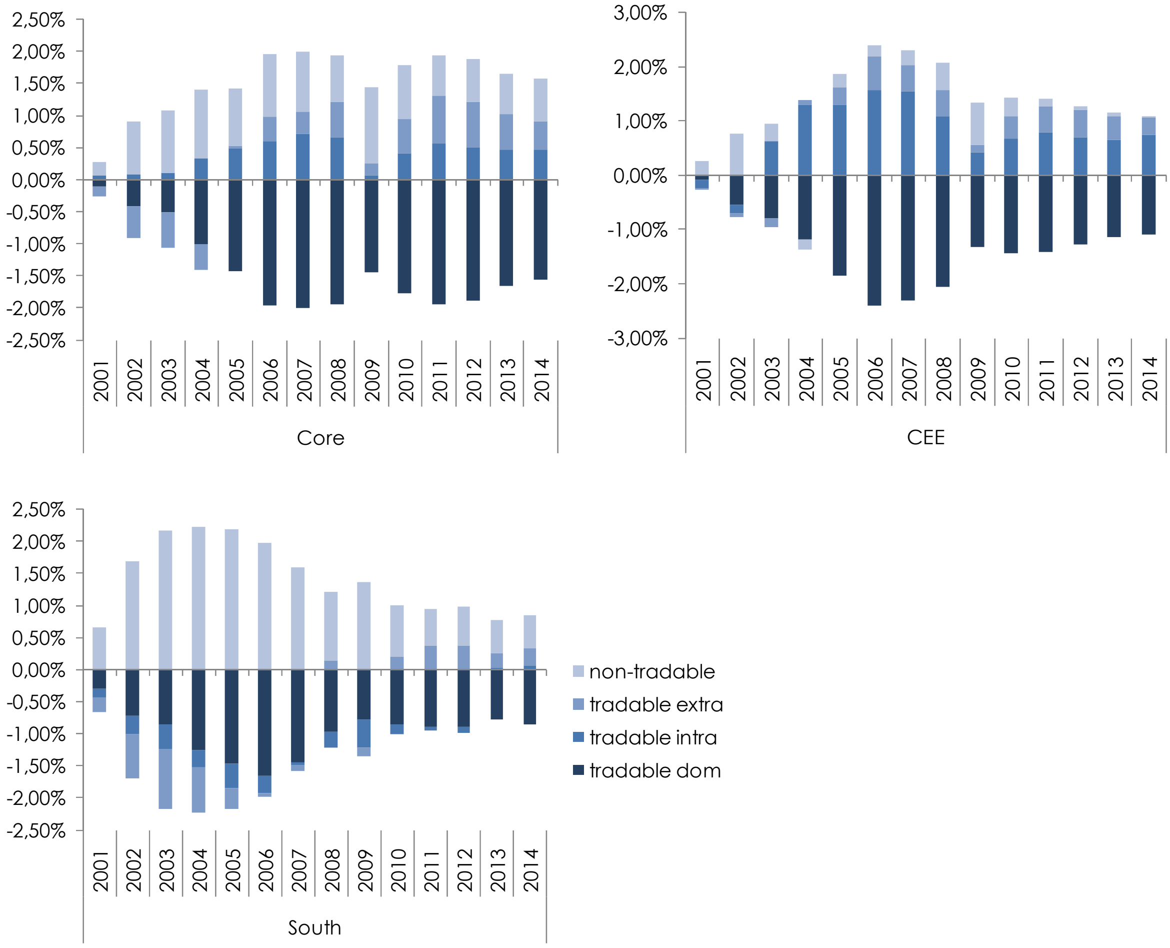
Source: WIOD Release 2016, WIFO calculations.

Until 2005, extra-EU imports were lower than would have been predicted based on use structures observed in 2000 (the base year of the shift-share exercise). The shortfall was sizable, peaking at almost 0.5% of total demand. Demand for domestic tradables was also lower than predicted, by roughly the same amount as imported tradables (imports from other EU countries were almost exactly as predicted). The compensation was brought about by a marked increase in demand for nontradables: their share was more than 1 percentage point higher than would have been expected based on use structures in the year 2000.

In the period after 2004/05, the trend towards consumption of nontradables continued, even if the structural shifts of the first 3 years were partly reversed. After tradables sourced from outside the common market had markedly lost in importance during the first 4 years, they expanded their share until, in the peak year of 2012, their share was more than 0.5% higher than in the counterfactual no-change-scenario; since then, they have again lost some of their increases. Overall, however, the structural shifts remained rather stable in the aftermath of the crisis.

Looking more closely at the different country groups, they exhibit markedly different patterns:

Figure 3.4: "Between"-effect across country groups



Source: WIOD Release 2016, WIFO calculations.

Not least due to sheer size (the Core group is responsible for around 60% of total EU commodity demand), the pattern for the Core is actually quite similar to the EU28's. The other two regions, however, show a completely different picture: in the CEE, the trend towards nontradables was much less pronounced, while the trend away from domestic tradables was stronger, albeit not by much. This was substituted by intra-EU trade, as was the case in the other regions – an outcome of the integration that was to be expected in the run-up and after accession. Over time, extra-trade slowly gained ground, but could not yet overtake intra-EU trade. The new members forming the group of CEE, in any case, seem to have integrated comparatively well into the common market, albeit more at the expense of domestic production: since 2000, the share of domestic products has fallen from around 83 to less than 80%, whereas intra-imports have risen from some 11 to 14% (and extra-EU imports by a percentage point, from 5.7 to 6.6%)

Table 3.2: Demand structures, "old" vs. "new" Member States

EU15:

	domestic	intra	extra
2000	86,5%	8,1%	5,4%
2001	86,7%	8,1%	5,2%
2002	87,1%	8,1%	4,8%
2003	87,3%	8,1%	4,6%
2004	86,9%	8,3%	4,8%
2005	86,4%	8,3%	5,2%
2006	85,9%	8,5%	5,6%
2007	85,7%	8,7%	5,6%
2008	85,4%	8,7%	5,9%
2009	86,7%	7,9%	5,4%
2010	85,4%	8,5%	6,1%
2011	84,6%	8,8%	6,5%
2012	84,6%	8,7%	6,7%
2013	84,7%	8,9%	6,4%
2014	84,7%	9,0%	6,3%

members after 2003:

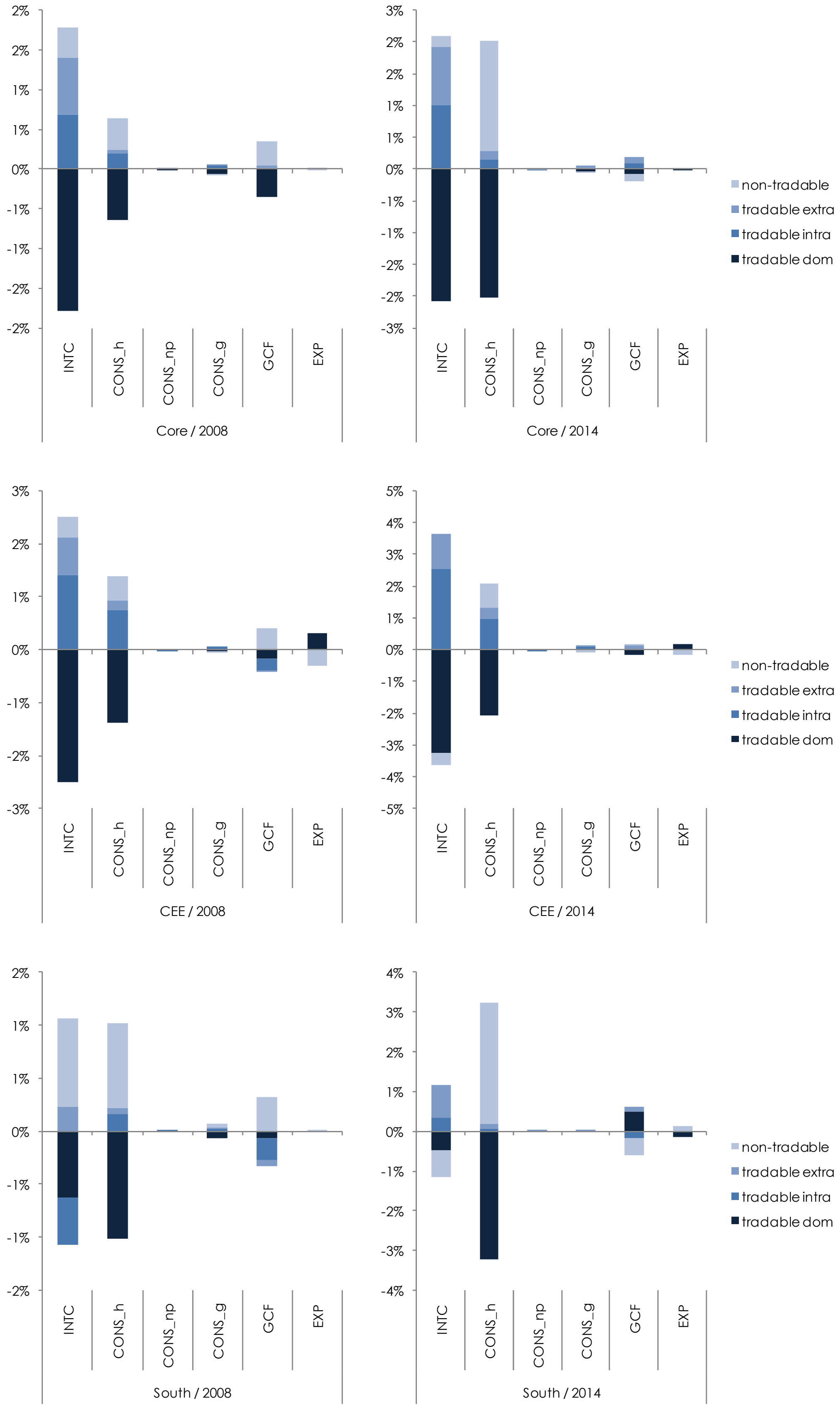
	domestic	intra	extra
2000	82,7%	11,6%	5,7%
2001	83,1%	11,3%	5,7%
2002	83,1%	11,4%	5,6%
2003	82,4%	12,2%	5,4%
2004	81,5%	12,9%	5,6%
2005	81,4%	12,9%	5,8%
2006	80,4%	13,3%	6,2%
2007	80,2%	13,6%	6,2%
2008	80,5%	13,2%	6,3%
2009	82,1%	12,3%	5,6%
2010	80,7%	12,9%	6,3%
2011	79,8%	13,4%	6,7%
2012	79,6%	13,4%	7,0%
2013	79,6%	13,4%	6,9%
2014	79,3%	14,0%	6,6%

Source: WIOD Release 2016, WIFO calculations.

In some ways, the South was the opposite of the CEE: at the peak around 2004, the consumption share of nontradables was almost 2.3 PP higher than in the counterfactual, replacing tradables from all three sources (domestic, intra and extra). After the crisis, nontradables again lost much of their increase; domestic tradables could not regain much ground, being increasingly substituted by imports from outside the common market.

To investigate how the different user categories (intermediate consumption, private, public and non-profit consumption, capital formation and exports) contribute to these shifts in commodity types, the following figure shows a disaggregation of the total effects, splitting the observations into the pre- and post-crisis period.

Figure 3.5: "Between"-effect by region and user category, 2008 and 2014 vis-à-vis 2000



Source: WIOD Release 2016, WIFO calculations.

In all regions, by far the largest weight is attributed to intermediate demand and private consumption. This was to be expected: both public and non-profit consumption are heavily geared towards nontradables, while export demand is the opposite, with a very low content of nontradables. The case of investment is ambiguous, as a sizable part of investment – buildings, both for dwelling and other purposes – is predominantly provided by the (nontradable) construction sector. In fact, all three sub-regions show a relative increase in investment demand for nontradables, which disappeared in the post-crisis period.

All regions and almost all user categories show a marked decline in the use of domestic tradables, which is balanced by an almost universal increase in nontradables and imported tradables. The only decline in nontradable use is shown for the post-crisis period in the South region. The South region is also unique in that the development in intra-EU trade is much more ambiguous than in either the Core or the CEE. In the CEE countries, nontradables gain much less than in the other two regions, while imports from the common market outgrow extra-EU trade.

To sum up the results of the shift-share analysis: changes in the commodity demand structure have been most pronounced in the first half decade of the observation period, witnessing rapid growth in the consumption of nontradables, mostly at the expense of domestically produced tradables (this development is borne to similar a degree by intermediate demand and private consumption). In the latter period, nontradables lost some of their gains to imported tradables, both from within and outside the common market. The South witnessed a massive boom in nontradable consumption, at the expense of tradables from all three sources. After the crisis, the region exhibits a much more "normal" shift-share pattern. Looked at from different users' points of view, the shift towards nontradables is most prominent in private consumption; investment demand showed such a shift before the crisis, which since however has gone into reverse.

3.1.4.Development of the Common Market

The above shift-share analysis has investigated the types of goods as well as their origin from the demand side; one of the results was relative growth in the demand for nontradables, but also for extra-EU imports. The following will look at the coincident development in exports.

Table 3.3: Development of commodity demand (left) and share in total demand (right)

	EU28					EU28				
	Total	Domestic	Import EU	EU28	RoW	Total	Domestic	Import EU	EU28	RoW
2000	100	100	100	100	100	100%	86,3%	8,3%	94,6%	5,4%
2001	104	105	105	105	101	100%	86,5%	8,3%	94,8%	5,2%
2002	107	108	107	107	96	100%	86,9%	8,3%	95,2%	4,8%
2003	108	109	109	109	94	100%	86,9%	8,4%	95,3%	4,7%
2004	115	115	119	116	103	100%	86,6%	8,6%	95,2%	4,8%
2005	122	122	127	122	119	100%	86,1%	8,7%	94,8%	5,2%
2006	132	131	141	132	138	100%	85,5%	8,9%	94,4%	5,6%
2007	141	140	156	141	147	100%	85,2%	9,2%	94,4%	5,6%
2008	144	142	159	143	160	100%	84,9%	9,2%	94,0%	6,0%
2009	130	130	129	130	131	100%	86,2%	8,3%	94,6%	5,4%
2010	139	137	149	138	157	100%	85,0%	9,0%	93,9%	6,1%
2011	146	143	163	145	178	100%	84,2%	9,3%	93,5%	6,5%
2012	148	145	164	146	184	100%	84,1%	9,2%	93,3%	6,7%
2013	148	145	166	147	178	100%	84,2%	9,3%	93,6%	6,4%
2014	152	148	173	151	180	100%	84,2%	9,5%	93,6%	6,4%

Source: WIOD Release 2016, WIFO calculations.

Coincidentally with the increase in nontradables, "globalization" has further expanded international trade: imports and exports have both expanded much more rapidly than overall commodity demand.

Since 2000, total demand for commodities (for intermediate and final consumption) has risen by 52% in nominal terms. Still, 84.2% of demand is satisfied by domestic production (down from 86.3% in 2000). Imports have risen faster than domestic consumption: in total, by 76%. Imports from the rest of the world, though, have risen by 80%, whereas imports from member states have risen by 73% (resulting in the share of RoW in imports rising from 39.2 to 40.1%). The share of EU-imports, therefore, has risen from 8.3 to 9.5%. So, in a way, the "common market" is only weakly reflected in the data: imports from the EU have partially substituted domestic production; but imports from the RoW have risen faster. As a result, the combined share in total consumption of domestic production and imports from the EU28 has fallen by one percentage point from 94.6 to 93.6% –although the development over time was quite heterogeneous: in the first 4 years after 2000, this share had risen to 85.2%. Since that year, the "common market share" has fallen in most years (the most pronounced increase in the common market share happened in the crisis year of 2009, when the share of RoW dropped from 6.0 to 5.4%, only to rise again to 6.1%, in the following year).

However, this is not peculiar to the EU, and might well reflect the heady pace of globalisation, especially during the first decade of the century. In the USA, imports have risen from just over 6% to over 7%; in Japan, they have almost doubled (China shows sideway volatility). Imports from the EU have risen faster than total demand, but markedly slower than imports from RoW. This primarily reflects much faster growth in some of the (now) major economies.

In China, the share of imports has followed an upturned U-shape, rising from 6.3 in 2000 to around 9% in 2004-06. In 2014, the share of imports had dropped again to below 6%. However, the astonishing growth of the Chinese economy during those years implies that in absolute numbers (and measured in Euros), imports to China have risen almost 6-fold – in fact, despite the share of imports falling back to its original value of 0.8% in 2000, imports from the EU28 have risen even more, by nearly 700% – which implies that China is now the EU's second-most important export market, consuming more than 15% of extra-EU exports (up from 4% in 2000). In the same period, the USA's share dropped from almost 40 to less than 27%.

Table 3.4: Commodity demand and shares in total demand for USA, China and Japan (in €)

	USA					CHN					JPN				
	Total	**Domestic**	**Import**	**EU28**	**RoW**	**Total**	**Domestic**	**Import**	**EU28**	**RoW**	**Total**	**Domestic**	**Import**	**EU28**	**RoW**
2000	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
2001	104	105	97	104	96	112	112	112	127	109	90	90	95	103	93
2002	100	101	95	104	92	115	114	128	144	126	82	82	87	99	85
2003	88	89	85	97	83	114	112	148	178	143	74	74	81	89	79
2004	87	87	90	98	88	128	124	183	218	177	74	73	87	94	86
2005	95	94	101	104	101	157	153	214	237	211	75	74	99	96	100
2006	99	99	112	112	112	189	185	255	275	252	73	71	107	96	109
2007	96	95	108	108	108	225	221	282	349	273	68	66	106	96	108
2008	92	91	108	106	108	267	264	313	387	303	72	70	118	94	122
2009	88	88	86	88	86	305	306	296	389	282	72	71	91	80	93
2010	99	98	109	103	110	389	387	429	514	417	84	83	119	95	123
2011	100	98	118	112	119	464	461	513	581	503	89	86	141	105	146
2012	112	111	130	123	132	566	566	570	609	564	97	94	159	117	165
2013	112	111	126	121	127	623	625	588	611	584	78	75	144	104	150
2014	117	116	130	130	130	672	678	581	690	565	73	69	148	107	154

	USA					CHN					JPN				
	Total	**Domestic**	**Import**	**EU28**	**RoW**	**Total**	**Domestic**	**Import**	**EU28**	**RoW**	**Total**	**Domestic**	**Import**	**EU28**	**RoW**
2000	100%	93,5%	6,5%	1,3%	5,2%	100%	93,7%	6,3%	0,8%	5,5%	100%	95,4%	4,6%	0,6%	4,0%
2001	100%	93,9%	6,1%	1,3%	4,8%	100%	93,7%	6,3%	0,9%	5,4%	100%	95,2%	4,8%	0,7%	4,1%
2002	100%	93,9%	6,1%	1,3%	4,8%	100%	92,9%	7,1%	1,0%	6,1%	100%	95,1%	4,9%	0,7%	4,2%
2003	100%	93,7%	6,3%	1,4%	4,9%	100%	91,8%	8,2%	1,2%	7,0%	100%	95,0%	5,0%	0,7%	4,3%
2004	100%	93,3%	6,7%	1,5%	5,2%	100%	90,9%	9,1%	1,4%	7,7%	100%	94,6%	5,4%	0,7%	4,7%
2005	100%	93,1%	6,9%	1,4%	5,5%	100%	91,3%	8,7%	1,2%	7,5%	100%	93,9%	6,1%	0,7%	5,3%
2006	100%	92,7%	7,3%	1,5%	5,8%	100%	91,4%	8,6%	1,2%	7,4%	100%	93,2%	6,8%	0,8%	6,0%
2007	100%	92,7%	7,3%	1,5%	5,9%	100%	92,0%	8,0%	1,2%	6,7%	100%	92,8%	7,2%	0,8%	6,4%
2008	100%	92,4%	7,6%	1,5%	6,1%	100%	92,6%	7,4%	1,2%	6,3%	100%	92,5%	7,5%	0,7%	6,7%
2009	100%	93,6%	6,4%	1,3%	5,1%	100%	93,9%	6,1%	1,0%	5,1%	100%	94,2%	5,8%	0,6%	5,1%
2010	100%	92,8%	7,2%	1,3%	5,8%	100%	93,0%	7,0%	1,1%	5,9%	100%	93,5%	6,5%	0,6%	5,8%
2011	100%	92,3%	7,7%	1,4%	6,2%	100%	93,0%	7,0%	1,0%	6,0%	100%	92,7%	7,3%	0,7%	6,6%
2012	100%	92,5%	7,5%	1,4%	6,1%	100%	93,6%	6,4%	0,9%	5,5%	100%	92,5%	7,5%	0,7%	6,8%
2013	100%	92,7%	7,3%	1,4%	5,9%	100%	94,0%	6,0%	0,8%	5,2%	100%	91,6%	8,4%	0,8%	7,7%
2014	100%	92,8%	7,2%	1,4%	5,8%	100%	94,5%	5,5%	0,8%	4,7%	100%	90,7%	9,3%	0,8%	8,5%

Source: WIOD Release 2016, WIFO calculations.

Table 3.5: Export and import structures of the *EU28*

Exports:

	USA	**CHN**	**JPN**	**CHE**	**RUS**	**Other**
2000	39,9%	4,4%	8,2%	12,3%	3,6%	31,7%
2001	39,5%	5,2%	8,0%	12,5%	4,5%	30,3%
2002	38,6%	5,8%	7,5%	11,8%	5,2%	31,1%
2003	36,9%	7,4%	7,0%	11,7%	5,5%	31,5%
2004	34,6%	8,3%	6,8%	11,5%	5,7%	33,1%
2005	33,4%	8,3%	6,3%	11,3%	6,2%	34,5%
2006	32,9%	8,8%	5,7%	10,8%	7,3%	34,4%
2007	29,8%	10,5%	5,4%	10,7%	8,2%	35,4%
2008	27,9%	11,1%	5,1%	10,8%	9,9%	35,3%
2009	27,1%	13,1%	5,0%	11,9%	8,2%	34,8%
2010	25,9%	14,1%	4,9%	11,2%	8,4%	35,6%
2011	24,6%	13,9%	4,7%	11,1%	9,2%	36,5%
2012	25,3%	13,7%	4,9%	10,7%	9,3%	36,1%
2013	25,3%	14,0%	4,5%	11,0%	9,5%	35,7%
2014	26,7%	15,4%	4,5%	10,7%	8,8%	34,0%

Imports:

	USA	**CHN**	**JPN**	**CHE**	**RUS**	**Other**
2000	22,2%	4,1%	7,1%	6,9%	3,6%	56,0%
2001	22,1%	4,5%	6,0%	7,1%	4,4%	55,9%
2002	21,1%	5,2%	5,6%	7,5%	4,9%	55,7%
2003	18,9%	6,6%	5,8%	7,1%	5,7%	55,9%
2004	17,6%	7,7%	5,7%	6,9%	6,7%	55,4%
2005	16,8%	8,8%	4,9%	6,4%	7,5%	55,7%
2006	15,9%	9,4%	4,3%	6,1%	8,3%	56,0%
2007	15,7%	10,9%	4,2%	6,3%	7,5%	55,5%
2008	14,9%	11,4%	3,7%	5,9%	9,4%	54,6%
2009	16,7%	11,9%	3,2%	6,6%	7,3%	54,3%
2010	15,3%	13,4%	3,3%	6,1%	8,4%	53,6%
2011	14,9%	12,6%	3,1%	5,8%	9,2%	54,3%
2012	14,8%	12,2%	2,8%	5,5%	9,2%	55,4%
2013	16,3%	13,8%	2,8%	5,9%	6,1%	55,1%
2014	17,5%	14,1%	2,6%	5,9%	5,3%	54,6%

Source: WIOD (release Nov 2016).

On the import side, the picture is very similar: though still the EU's number one import origin, the USA's share dropped from around 22 to 17%, whereas China's share rose from 4 to 14%. (The volatility of Russia's share in EU imports, and to a lesser extent the share of "other" regions, largely reflects the price development of oil, gas and minerals, Russia's main export products). Between 2000 and 2014, total imports from extra-EU have risen by 80%, with 21 PP of this increase falling on imports from China. Again, Russia's rising (and then falling) share can most probably be attributed to commodity price developments[12].

Table 3.6: Contributions to EU import development, 2000-2014

	USA	CHN	JPN	CHE	RUS	RoW	Total Imports
2000	0 PP	0 PP	0 PP	0 PP	0 PP	0 PP	0%
2001	0 PP	0 PP	-1 PP	0 PP	1 PP	0 PP	1%
2002	-2 PP	1 PP	-2 PP	0 PP	1 PP	-3 PP	-4%
2003	-4 PP	2 PP	-2 PP	0 PP	2 PP	-3 PP	-6%
2004	-4 PP	4 PP	-1 PP	0 PP	3 PP	1 PP	3%
2005	-2 PP	6 PP	-1 PP	1 PP	5 PP	10 PP	19%
2006	0 PP	9 PP	-1 PP	1 PP	8 PP	21 PP	38%
2007	1 PP	12 PP	-1 PP	2 PP	7 PP	25 PP	47%
2008	2 PP	14 PP	-1 PP	3 PP	11 PP	31 PP	60%
2009	0 PP	11 PP	-3 PP	2 PP	6 PP	15 PP	31%
2010	2 PP	17 PP	-2 PP	3 PP	10 PP	28 PP	57%
2011	4 PP	18 PP	-1 PP	3 PP	13 PP	40 PP	78%
2012	5 PP	18 PP	-2 PP	3 PP	13 PP	46 PP	84%
2013	7 PP	20 PP	-2 PP	4 PP	7 PP	42 PP	78%
2014	9 PP	21 PP	-2 PP	4 PP	6 PP	42 PP	80%

Source: WIOD Release 2016, WIFO calculations.

3.1.5.Regional Structure of Net Exports

The following figures show relative net exports, i.e. exports-imports, divided by total commodity demand in each country or country group[13]. On the trading partner side, the present analysis distinguishes between trade with the four world regions: Core, CEE, South, and Other.

The picture is very different for the EU country groups: the "Core" block has been running a consistent trade surplus, averaging around 1.3% since 2002. Especially pronounced is the trade surplus vis-à-vis non-EU countries, at around 1% of commodity demand (and widening). Until 2011, the trade balance with the South has been positive, with even a slight upward trend until the crisis of late 2008. Since then, however, both CEE and South have improved their trade balances (in the case of the South, however, more through falling imports than through – still rising – exports). A persistent trade deficit can be observed among the group of core countries themselves.

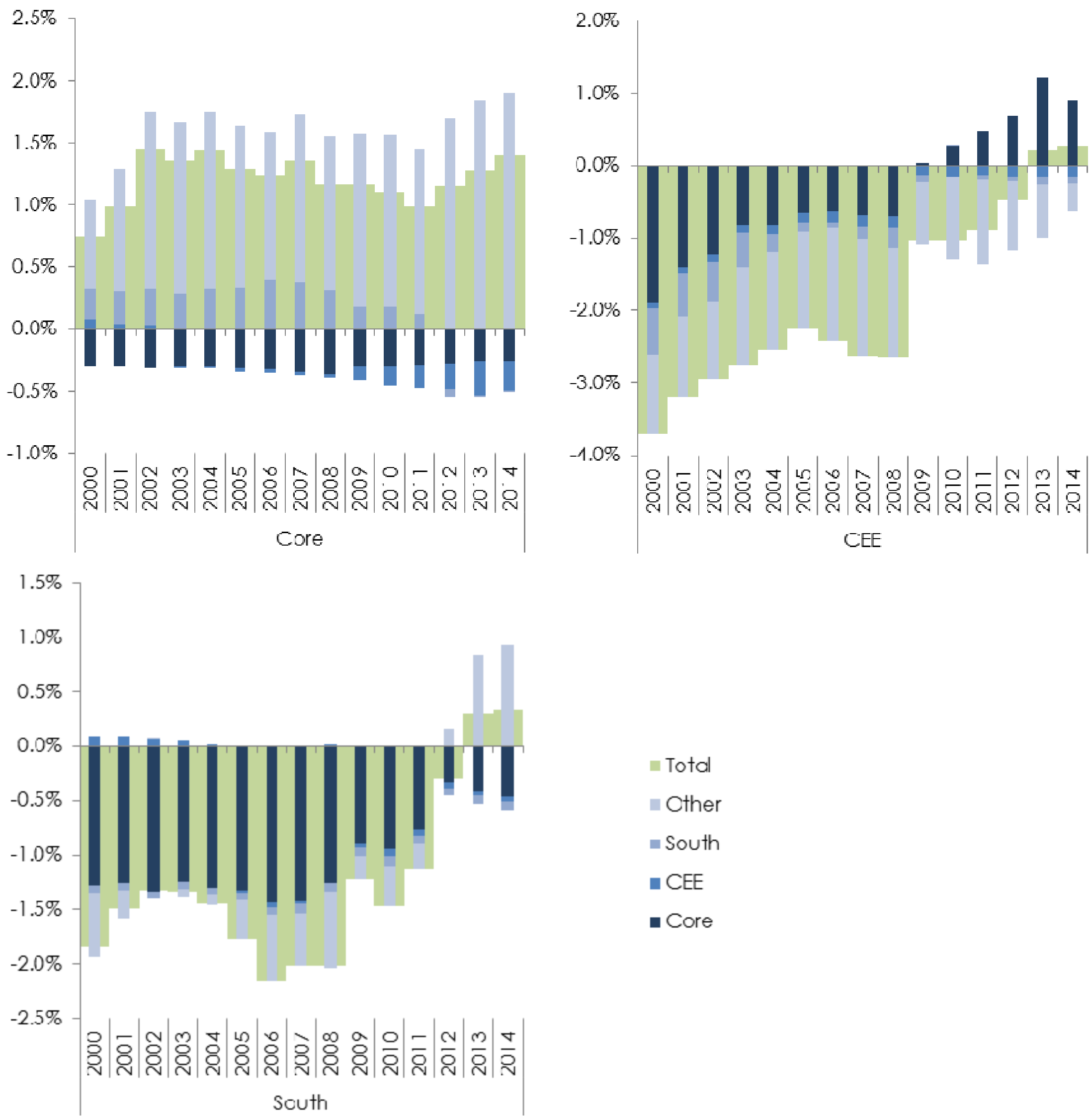
The CEE group shows a steady upward trend in their trade balance (with an "intermission" in the run-up to the crisis): starting in 2000 at -3.5% of demand, trade became balanced in 2013. The biggest driver of this development was trade with the core countries, whose balance turned positive in 2009. Trade balance with the RoW remains negative, although it, too, has narrowed from a low of -1.6% in 2007 to more than -0.5% in 2014.

[12] Commodity "B", mining products (which includes oil and gas), has a share of between 60 and 80% in Russia's exports to the EU; in the "Rest-of-the-World", its share is between 10 and 20%. EU sanctions against Russia following the annexation of the Crimea were implemented in mid-2014, and most probably have not influenced Russian exports into the EU in the same year already – the more so as it was EU exports to Russia that were sanctioned, not EU imports from Russia.

[13] Country groups are aggregates, not averages of their member countries.

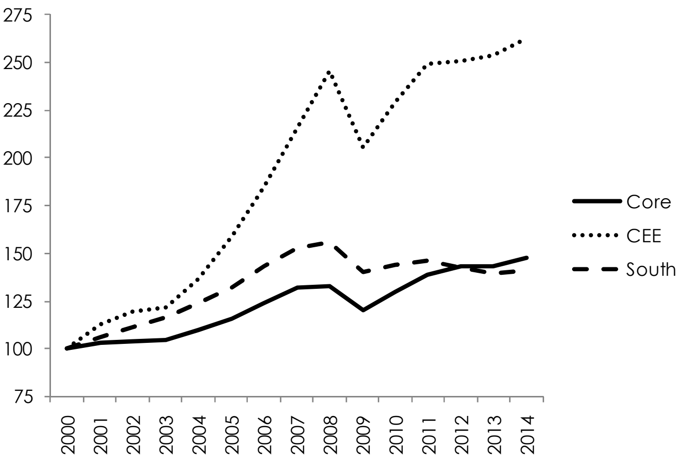
The pattern for the South is different from the CEE in that before the crisis the trade deficit worsened to around -2% of commodity demand. This was mainly brought about by a strongly and rapidly deteriorating deficit in extra-EU trade, from essentially zero in 2002 to -0.7% in 2008. The overall trade deficit turned positive in 2013, but probably more out of necessity due to falling demand, caused by the continuing policy of austerity (see Fig. below).

Figure 3.6: Net exports vis-à-vis country groups



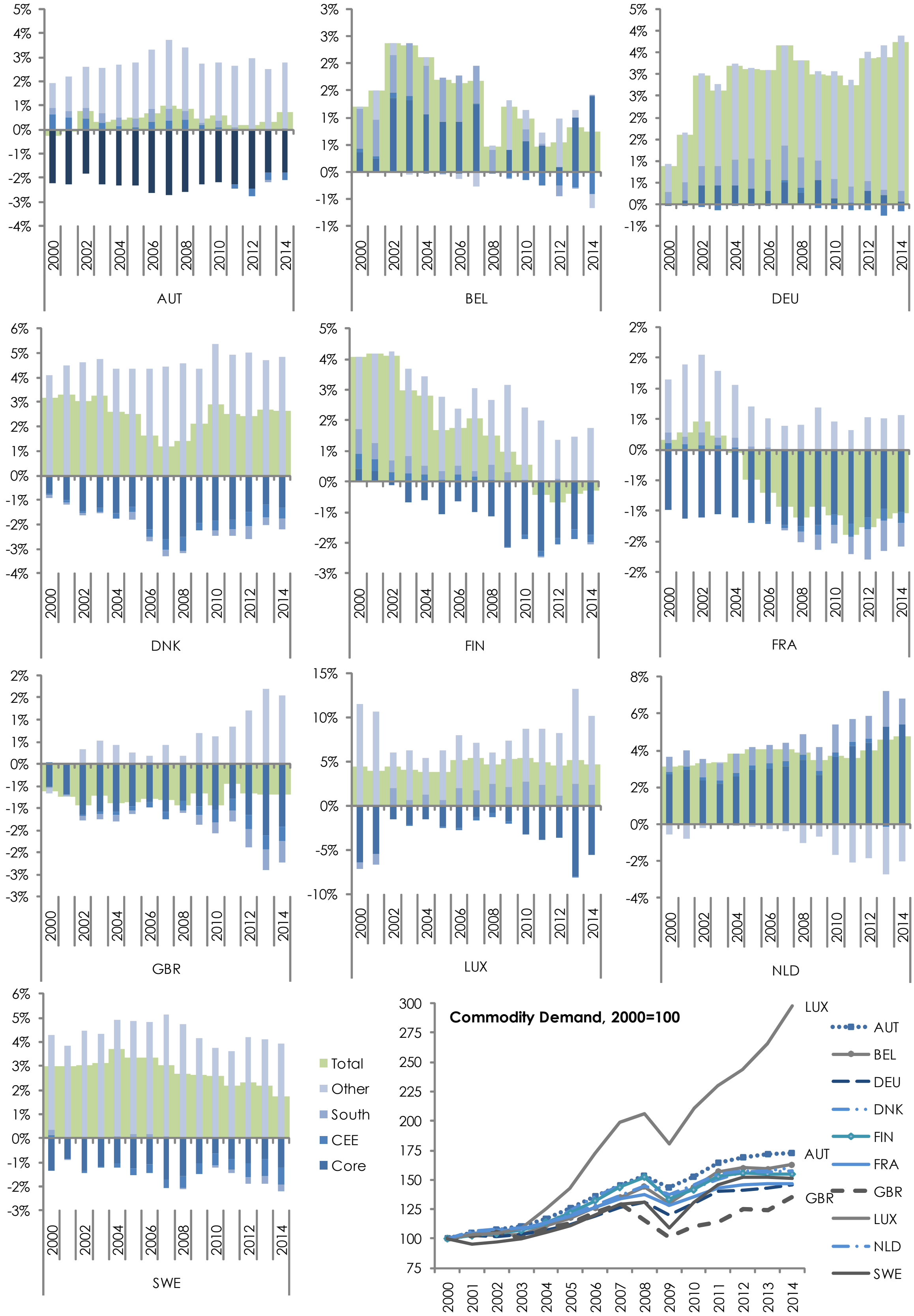
Source: WIOD Release 2016, WIFO calculations.
Note: Share of total demand in percent; country group aggregates.

Figure 3.7: Total commodity demand across country groups (2000=100)



Source: WIOD Release 2016, WIFO calculations.

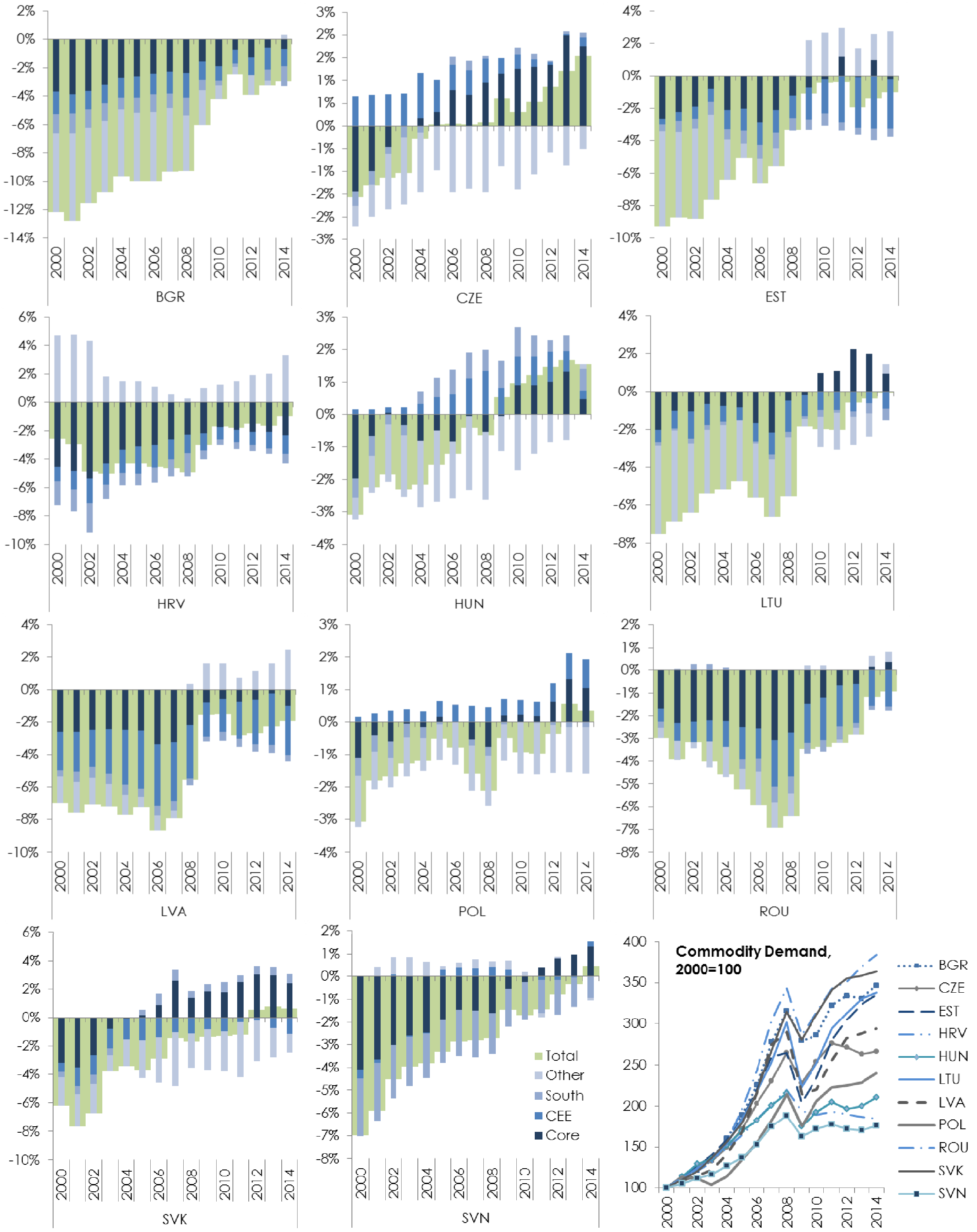
Figure 3.8: Net Exports vis-à-vis Country Groups - % share of total demand – Core Group



Source: WIOD Release 2016, WIFO calculations.

At the individual level, patterns are relatively stable for most Core countries. The most dramatic turn of fortune pertains to Finland, where the missed-out technological developments in the (mobile) communications sector led to the virtual annihilation of a trade surplus that, in 2000, ranked among the highest in Europe. The case of France is somewhat different, where an initial slight surplus has become a pronounced deficit, with a moderately positive development after 2011. Broadly homogenous developments can also be observed in the CEE group.

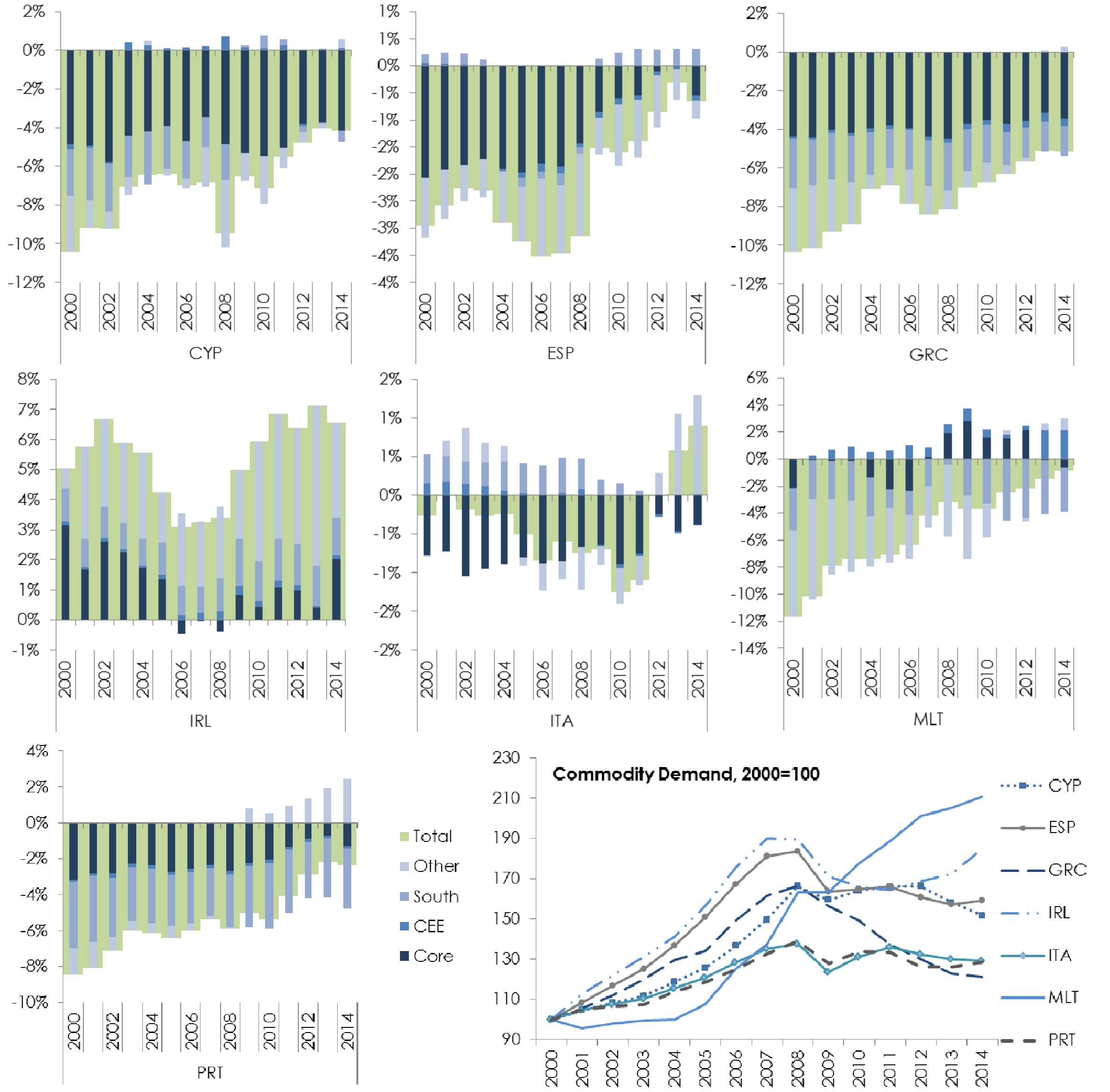
Figure 3.9: Net Exports vis-à-vis Country Groups - % share of total demand – CEE Group



Source: WIOD Release 2016, WIFO calculations.

All CEE countries show markedly improving trade balances. After starting out at deficits equivalent to between -2 and -12% of commodity demand at the turn of the century, after a mostly steady development by 2014 all countries have achieved either surplus or remain with much diminished deficits (better than -2%). The first CEE country to become a net exporter was the Czech Republic in 2005, followed by Hungary in 2009. In almost all countries, it was the trade position vis-à-vis the Core countries (and, to a lesser extent, extra-EU trade) that could most be improved, whereas the within-CEE trade deficit remained mostly unaffected.

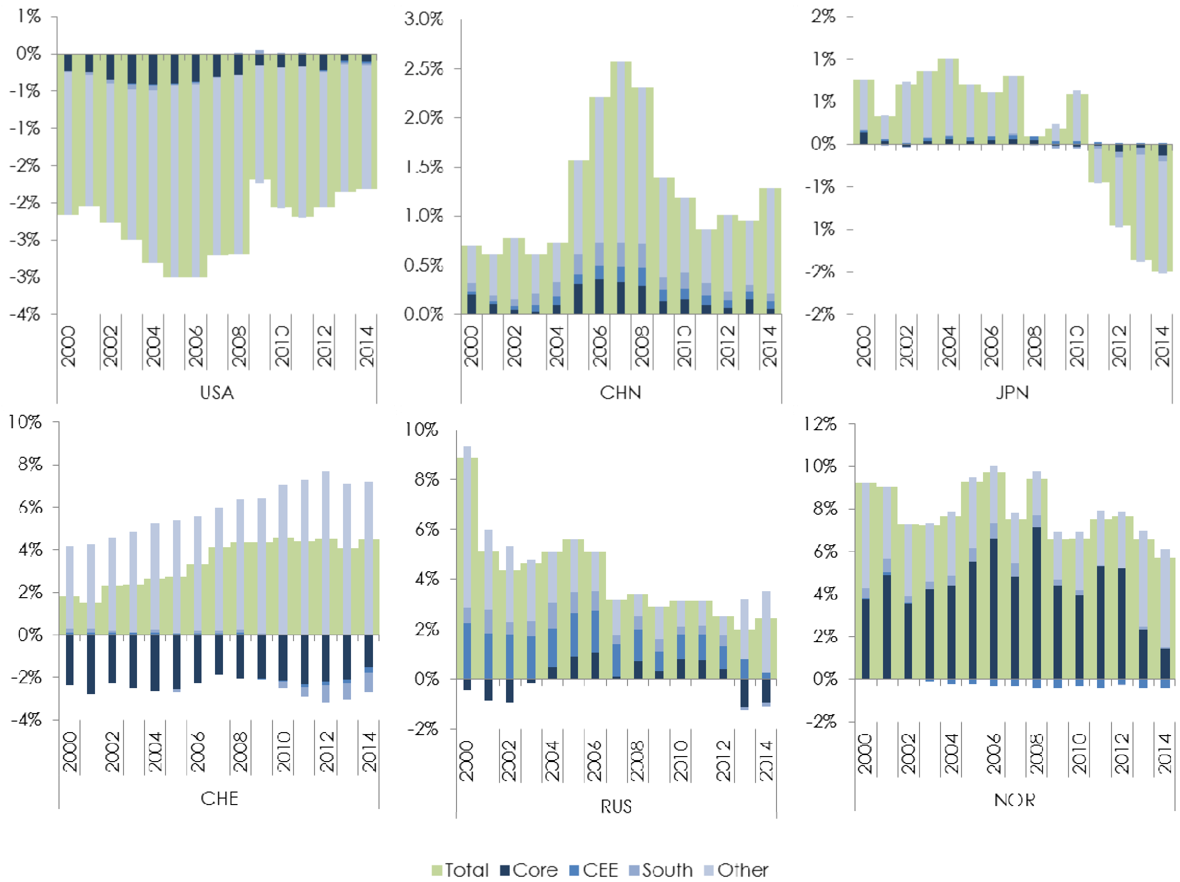
Figure 3.10: Net Exports vis-à-vis Country Groups - % share of total demand – South Group



Source: WIOD Release 2016, WIFO calculations.

More heterogeneity can be observed within the South group: apart from Ireland, which continuously ran a trade surplus, and Italy, which started with balanced trade and, after a marked downturn, achieved surplus after 2012, the other countries remain more-or-less in trade deficit. Also, except for Ireland (and Malta), as of 2014 no country had recovered their respective pre-crisis level of commodity demand.

Figure 3.11: Net Exports vis-à-vis Country Groups - % share of total demand – Other Countries



Source: WIOD Release 2016, WIFO calculations.

Some countries of the group 'Other' are shown mostly for completeness: the USA ran a trade deficit in all years, against the EU28 as well as against the Rest-of-the-World. Switzerland has a sizable trade surplus vis-à-vis the RoW, and a trade deficit with the Core EU countries (and since around 2010 with the other EU country groups as well). Russia's and Norway's patterns are somewhat similar. Both seem to be driven by oil (and raw material) prices. China has a trade surplus with all trading partners, in all years, although China also shows some post-crisis effect.

To sum up, the period between 2000 and 2014 was characterised by increasing international integration. While consumption of domestically produced goods has decreased, both imports and exports have increased more than proportionally (of the major economies, imports increased less rapidly than domestic products, as China developed a more mature economic structure). In Europe, extra-EU imports grew more quickly than intra-EU imports, but extra-EU exports grew more quickly than their intra counterpart as well. The Core countries were even able to expand their positive net exports vis-à-vis the "Rest-of-the-World", while the CEE and the South region could diminish their trade deficits. Since 2000, both these regions were also able to decrease their overall trade deficits, showing a slight surplus in the last 2 years of the observation period.

To complement the analysis of (net) export flows, and as an "intermediate step" to the GVC analysis later in the report, table XX presents regional aspects of backward linkages and their development.

Table 3.7: Backward linkages of regional intermediate production

Tradables

Country	Year	Domestic	Core	South	CEE	Non EU	Gesamtergebnis
Core	2000	78%	10,7%	1,9%	0,6%	9,3%	100%
	2008	73%	11,2%	2,3%	1,5%	12,1%	100%
	2014	71%	11,7%	2,1%	1,7%	13,9%	100%
CEE	2000	76%	9,5%	2,0%	1,9%	11,0%	100%
	2008	73%	9,2%	2,4%	3,4%	12,2%	100%
	2014	71%	9,8%	2,4%	3,8%	12,9%	100%
South	2000	75%	8,6%	2,9%	0,4%	12,7%	100%
	2008	72%	9,5%	3,6%	0,9%	13,9%	100%
	2014	72%	9,1%	3,2%	1,0%	14,8%	100%

Non-tradables

Country	Year	Domestic	Core	South	CEE	Non EU	Gesamtergebnis
Core	2000	91%	4,2%	0,9%	0,3%	4,1%	100%
	2008	89%	4,7%	1,0%	0,7%	4,9%	100%
	2014	88%	4,9%	0,9%	0,8%	5,6%	100%
CEE	2000	88%	4,8%	1,0%	1,0%	5,4%	100%
	2008	87%	4,7%	1,2%	1,8%	5,6%	100%
	2014	86%	4,8%	1,2%	2,0%	5,9%	100%
South	2000	90%	3,6%	1,3%	0,2%	4,9%	100%
	2008	89%	4,1%	1,6%	0,4%	5,2%	100%
	2014	88%	4,4%	1,4%	0,5%	5,5%	100%

Source: WIOD (release Nov 2016); WIFO calculations

Again, the picture is one of increasing international integration: the share of domestic value added induced (IVA) by production of both tradables and nontradables is diminishing, albeit to varying degrees. The decrease is higher in the Core and CEE countries than in the South, by 5 to 7 percentage points (C ore/CEE) vs. only 3 PP (South) in the case of tradables, and to around 71 to 72% in 2014 (down from 75 to 58% in 2000). Nontradables are much more domestically oriented; their domestic IVA-share has decreased by only around 2 to 3 PP. In almost all cases, backward linkages with the CEE region have increased most, if from a rather low base: between 2000 and 2014 the Core almost trebled its IVA share with CEE to 1.7%. In the same period, intra-CEE and South-CEE linkages also increased substantially, by 100 and 150% respectively.

What has been said for tradables can also be observed for nontradables: decreasing domestic IVA is compensated by increases in international linkages, although here the South region is a bit of an outlier: whereas IVA linkages with the Core, the CEE and non-EU show uniform increases, the South's integration deepened between 2000 and 2008, but has again since (although the shares, at between 1 and 2% of IVA, are quite low).

Judging by the development of these backward linkages, therefore, the CEE region seems to have integrated quite well into the EU28, gaining in importance as the source of intermediate inputs, while the South's development in this respect should be judged more nuancedly.

Yet the CEE region gained substantially, not only as the source of inputs, but also as the destination of value added: for the Core region, the CEE is the destination for 2.3% of its VA in tradables, up from 1.5% in 2000 (but down from 2.5%, which it already had in 2008). The crisis seems to have been a kind of break in intra-EU forward linkages, with both the CEE and the South not progressing as a destination for European VA afterwards (in fact, the South fell below the level of 2000 as a destination of Core and South tradable VA). The Core, in contrast, continued to increase its absorption of value added from the CEE, though not from the South, which stagnated through the whole period.

Again, as in the case of backward linkages, the pattern for the absorption of nontradables is similar to that of tradables, but on a lower international level: the South, after expanding slightly between 2000 and 2008, loses importance as a VA destination for the Core and intra-South (though not for the CEE region); CEE roughly doubles its share (which, however, is still markedly below 1%). The Core can hold its position with other Core countries and the South, but shows growing importance for the CEE region (in 2014, 3.3% of the CEE nontradable VA ended up in the Core). In all cases and all regions, for tradables and nontradables alike, non-EU countries have become ever more important destinations, with shares of 21 to 25% of tradable and 3 to 4% of nontradable VA (up by around half since 2000).

Table 3.8: Destination of Value Added by tradability

Tradables

Country	Year	Domestic	Core	South	CEE	Non EU	Gesamtergebnis
Core	2000	63%	12,6%	5,2%	1,5%	18,3%	100%
	2008	57%	12,5%	5,5%	2,5%	22,4%	100%
	2014	55%	12,6%	4,1%	2,3%	25,6%	100%
CEE	2000	67%	13,9%	3,3%	3,0%	13,3%	100%
	2008	58%	15,4%	4,5%	5,6%	16,0%	100%
	2014	50%	18,7%	4,4%	5,7%	21,5%	100%
South	2000	69%	11,9%	3,5%	1,0%	14,3%	100%
	2008	68%	10,7%	3,9%	1,7%	16,2%	100%
	2014	62%	11,6%	3,1%	1,7%	21,2%	100%

Non-tradables

Country	Year	Domestic	Core	South	CEE	Non EU	Gesamtergebnis
Core	2000	95%	1,5%	0,6%	0,2%	2,4%	100%
	2008	95%	1,5%	0,7%	0,3%	2,9%	100%
	2014	94%	1,6%	0,5%	0,3%	3,4%	100%
CEE	2000	94%	1,9%	0,5%	0,3%	3,6%	100%
	2008	94%	2,4%	0,6%	0,8%	2,6%	100%
	2014	91%	3,3%	0,8%	0,9%	4,3%	100%
South	2000	97%	1,3%	0,4%	0,1%	1,5%	100%
	2008	96%	1,2%	0,4%	0,2%	1,8%	100%
	2014	95%	1,4%	0,3%	0,2%	2,9%	100%

Source: WIOD (release Nov 2016); WIFO calculations

Another interesting aspect pertains to the sectoral destination of domestic nontradable VA (see Table 3.9). As seen before, non-domestic destinations have gained in importance in all regions, accounting for close to 10% in 2014. The share of domestic Households' Consumption decreased slightly between 2000 and 2008, but has gained since (in the South, at almost 50%, HH's share is higher in 2014 than it was in 2000). Public consumption is rather stable, except for in the CEE, where it fell 3 points between 2000 and 2008, but regained 2 points by 2014. The largest variations can be observed in gross fixed capital investment: in the Core region, investment has decreased slightly as a destination of domestic nontradable VA, from 14 to 12%. The South is similar, although its reduction from 17 to 10% constitutes a much larger drop than in the Core (and which is certainly attributable to investment in construction, the by far most important "nontradable commodity" in investment demand). The CEE region is different, insofar as it witnessed a substantial increase in the first period, from 17 to 23%, which subsequently returned to a level of around 16%.

Table 3.9: Domestic final user category of destination for nontradable VA

Country	Year	HH	GOV	GFCF	Foreign
Core	2000	38%	41,0%	14,0%	6,6%
	2008	37%	41,0%	14,0%	7,4%
	2014	38%	42,0%	12,0%	8,1%
CEE	2000	38%	39,0%	17,0%	6,3%
	2008	34%	36,0%	23,0%	6,8%
	2014	37%	38,0%	16,0%	9,8%
South	2000	46%	33,0%	17,0%	4,3%
	2008	42%	34,0%	17,0%	7,1%
	2014	48%	33,0%	10,0%	9,1%

Source: WIOD (release Nov 2016); WIFO calculations

Summing up, the backward linkages via induced value added, as well as the changes in the destination patterns for (tradable and nontradable) value added, broadly confirm the results of the export analysis: the CEE region seems to have integrated well (and solidly) into the European economy, especially with the Core ties deepening in both directions. All regions show increasing internationalisation, not least beyond the EU28, with non-EU countries gaining, both as a source and a destination of value added. Even nontradable value added ends up outside the EU28 to a substantially increasing amount; in 2014, this was equivalent to 8 to 10% of domestic NT value added in 2014 (up from 4 to 7% in 2000).

3.1.6.Summary

This chapter complemented the structuralist approach of the previous chapter that linked tradability to structural change. While most models relevant for industrial competitiveness lean on the supply side, the consumption aspect offers an alternative explanation for some of the observed phenomena.

The chapter offered some conceptual thoughts on the demand determinants of nontradables. Structural models such as the tradables-nontradables model tend to focus on external competitiveness and only implicitly consider demand and its changes over time (Sachs and Larraine, 1993). In addition, observations of changes of consumption patterns throughout the economic development also provide valuable insights into the types of goods and services consumed (Chai and Moneta, 2010; Lewbel, 2008). It seems that certain nontradable goods and services are increasingly consumed as countries grow in wealth. Since tradables and nontradables are linked (e.g., the machinery and equipment sector requires the construction sector to build its plants), it is conceivable that the increase in the share of nontradables was partly linked to the increase in tradables. This leads to the question about the evolution of consumption patterns of tradables and nontradables, and how these are linked to the Single Market.

Changes in demand composition are the outcome of changes in total consumption and changes of the types of goods and services consumed. Hence, a shift-share analysis was implemented. The results showed that changes in the commodity demand structure were most pronounced in the first half decade of the observation period, witnessing rapid growth in the consumption of nontradables, mostly at the expense of domestically produced tradables. This development is to a similar degree borne by intermediate demand and private consumption. In the latter period, nontradables lost some of their gains to imported tradables, both from within and outside the common market. The economies in the South witnessed a massive boom in nontradable consumption, at the expense of tradables from all three sources. After the crisis, the region exhibits a much more "normal" shift-share pattern.

To link this to the Single Market, it is next explored how these changes in consumption are reflected by import and export structures. The period between 2000 and 2014 was characterised by increased international integration. On the one hand, consumption of domestically produced goods decreased. On the other hand, both imports and exports increased more than proportionally. In Europe, extra-EU imports grew more quickly than intra-EU imports. At the same time, extra-EU exports grew more quickly than their intra counterpart. The Core countries could even expand their positive net exports vis-à-vis the "Rest-of-the-World", while the CEE and the South region were able to diminish their trade deficits. Since 2000, both these regions were also able to decrease their overall trade deficits, showing a slight surplus in the last 2 years of the observation period. In addition, imports by the largest economies increased less rapidly than domestic products, as China developed a more mature economic structure).

Economic institutions and the Single Market

In this section, the sectoral competitiveness indicators are linked to Single Market indicators, and it is explored how these interact with institutional characteristics and economic policies at the country level. A variety of market integration indicators will provide conceptual channels through which country level measures are linked to sectoral performance. The idea is straightforward. It is argued that industries differ by their degrees of possible market integration, which is an important implication of the tradable-nontradable framework. The importance of national institutions differs between industries depending on their level of market integration. For instance, industries which are more integrated (and/or more tradable) might benefit more from better institutions that enable market integration. In other words, more integrated industries benefit more from integration policies than industries which are rather nontradable, and hence domestically consumed. To implement this type of analysis three different types of variables are required:

1. Outcome indicators need to be chosen. On the one hand, the impact of market integration and national institutional framework conditions on sector level labour productivity and employment are analysed in a panel regression framework. On the other hand, in a second step the results of the shift-share analysis of the previous chapter will be used as dependent variables to differentiate between a within-industry productivity contribution and the structural contribution. The latter is defined as the sum of the between-effect and the interaction effect (McMillan, Rodrik, and Verduzco-Gallo, 2014). The entire period (2000-2014) will be considered to shed light on dynamics for one whole business cycle. In other words, long run growth patterns will be studied instead of splitting the analysis into a pre-crisis and post-crisis period.
2. A definition of market integration indicators at the sector level is required. A set of indicators capturing backward and forward linkages will be identified. These indicators capture the level of economic integration in the EU on the sector level. Additionally, information about the full EU membership of countries is included to cover the legal aspects of Single Market integration separately. The first part of this section can be interpreted as a description of these Single Market indicators.
3. National institutional (policy) indicators need to be identified. Their purpose is to capture domestic policy aspects that can affect the well-functioning of the Single Market, and therefore provide leverage for economic policy adjustments.

3.1.7.Towards a quantification of the Single Market

In a first step, Single Market measures need to be quantified to analyse the channels through which the Single Market affects competitiveness. However, an unambiguous definition of the Single Market does not exist, and many approaches have been explored to assess the state of the Single Market. The point of departure is the four freedoms of the European Union, i.e. the free movement of goods, services, capital and people. In this respect, the EU defines the Single Market as '[…] *one territory without any internal borders or other regulatory obstacles to the free movement of goods and services. A functioning Single Market stimulates competition and trade, improves efficiency, raises quality, and helps cut prices. The European Single Market is one of the EU's greatest achievements. It has fuelled economic* *growth and made the everyday life of European businesses and consumers easier.*' (Cit. DG Growth)[14]

The aim of the Single Market is to provide the four freedoms, and thereby reduce frictions to economic activities across borders. It has been argued that indicators with regard to economic performance, pro-Single Market regulations aimed at reducing formal and informal barriers, sectoral policies and composite indicators can all be used as proxies for the Single Market. Hence, there is no 'silver bullet Single Market indicator', which could address a possible 'Single Market Gap' and related competitiveness issues directly (Pelkmans et al., 2014; Egan and Guimarães, 2017; European Commission, 2015). Therefore, these analyses use a set of different Single Market integration indicators to capture different aspects of market integration.

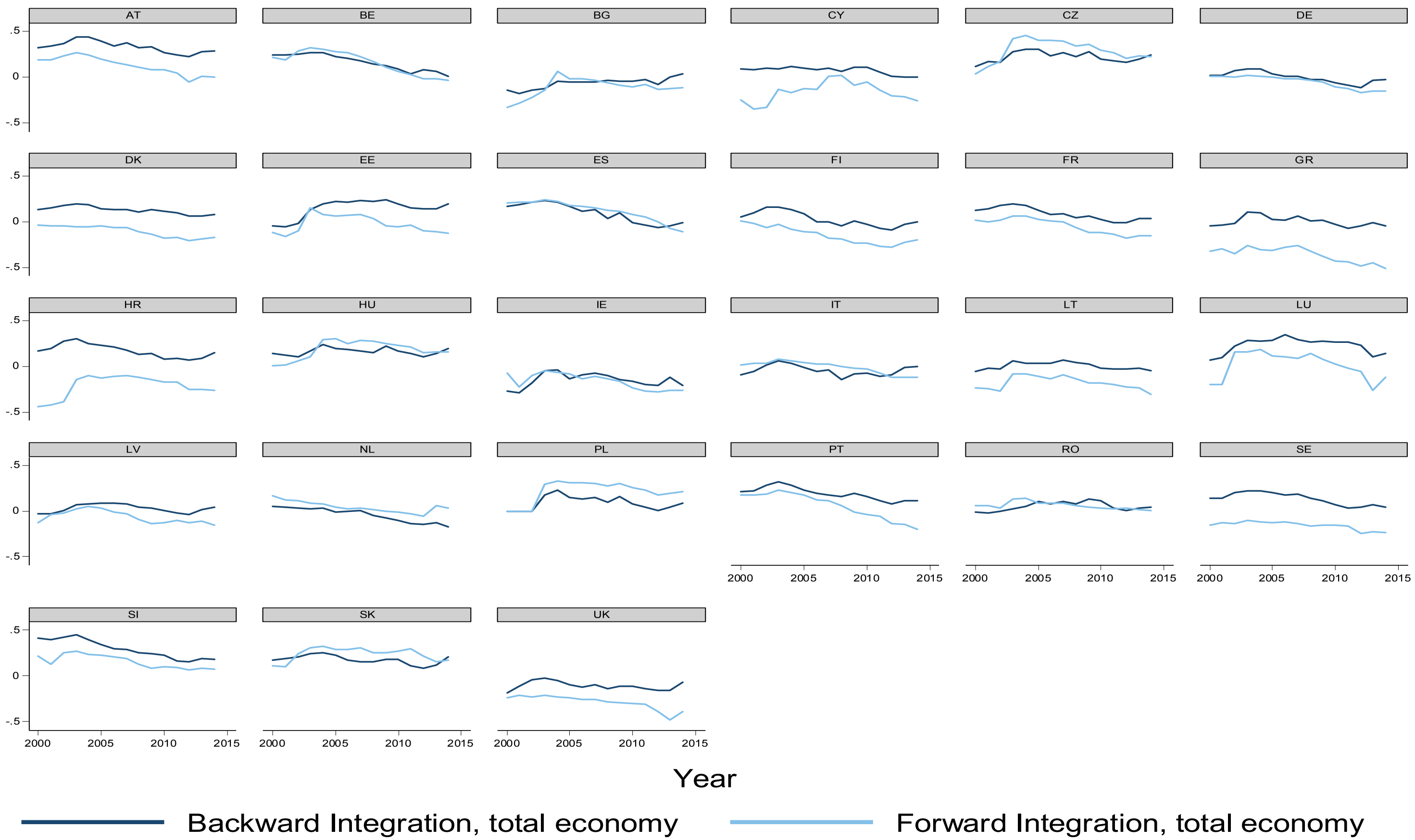
One group of Single Market indicators is based on empirical measures of trade-related market integration that reflect effective economic interrelations within the EU. Integration itself is the outcome of both the regulatory environment and comparative advantages and competitiveness, which may differ across firms and sectors. Hence, these trade-related integration indicators do not reflect legal or institutional aspects, nor do they directly measure industrial capabilities or the stability of ties in supply networks.

The calculation of the trade-related integration of industries is based on the WIOD data. One way to measure industries' levels of market integration is to calculate the difference between the value added share of imported intermediate goods along the value chain from EU member countries and from non-EU countries. The descriptive statistics of this indicator (Backward Integration) is shown in Table 3.12. The larger the difference, i.e. the higher the backward integration indicator, the more the value added contained in foreign intermediates used in domestic production comes from countries within the EU in relation to non-EU countries. The measure disregards the level of international sourcing of a specific sector. Hence the indicators used to calculate the difference are presented as well. They show the share of a sector's use of intermediary goods along the value chain from other EU member states (Backward EU) and non-EU countries (Backward Non-EU) in the industry's total induced value added. These are used to validate the market integration indicator with regard to backward linkages.

Analogously, an indicator for forward integration has been constructed. It relies on the share of a sector's value added that is consumed abroad. It is defined as the differences of the value added share whose final use is either in another EU Member State or in an extra-EU country. If an industry's final demand is in EU Member States rather than in non-EU countries, the indicator is positive. Similarly, to the backward integration indicator, the descriptive statistics of the single components of this indicator (Forward EU and Forward Non-EU) are shown in Table 3.12 as well. To capture the levels of demand from abroad, both the value added share of demand from other EU-countries (Forward, EU) as well as non-EU countries (Forward, Non-EU) are used.

[14] See https://ec.europa.eu/growth/single-market_en (accessed on 19 April 2017).

Figure 3.12: Backward and Forward Integration Indicators across Member States (total economy) and time



Source: WIOD Release 2016, WIFO calculations.
Note: This graph shows the value added weighted backward and forward integration across EU Member States for the total economy over time. The forward indicator is defined as the surplus of final use of value added in other EU Member States over extra-EU countries. Backward integration is measured as the surplus of sourcing from industries in other EU Member States over extra-EU countries.

To give an example of how the indicator has been constructed, one may compare the forward integration indices of the manufacturing sector in Germany and Bulgaria. These two countries have very different legacies, suggesting different developments with respect to integration over time. The starting point is the value added that is consumed domestically, which decreased in Germany from 46% to 29%, and in Bulgaria from 85% to 41%. The remainder of the value added generated in manufacturing was not consumed domestically. This leads to the question of the location of consumption.

Two different destinations are used to compute the Single Market integration indicators: (i) the share of value added consumed by other EU Member States and (ii) the share consumed in extra-EU countries. In Germany, the share of value added generated in manufacturing which was consumed in other EU Member States fell from 54% in the year 2000 to 44% in 2012. The integration indicator is now calculated as the difference of these two, i.e. the (non-domestic) intra-EU share and the extra EU share. Hence, it was approximately eight percent in 2000, and then turned negative (-12%) in 2014, implying that extra-EU destinations became – in relative terms – more important for German manufacturing than intra-EU destinations. The forward integration indicator is nil if consumption in other EU Member States equals the consumption in extra-EU countries.

Table 3.10: Forward integration of manufacturing in Germany and Bulgaria (2000 and 2014)

	Year	Domestic	Foreign	EU	Non-EU	Integration
Germany	2000	45.7%	54.3%	53.8%	46.2%	7.7%
	2014	29.1%	70.9%	43.8%	56.2%	-12.3%
Bulgaria	2000	84.7%	15.3%	52.1%	47.9%	4.1%
	2014	41.3%	58.7%	57.6%	42.4%	15.2%

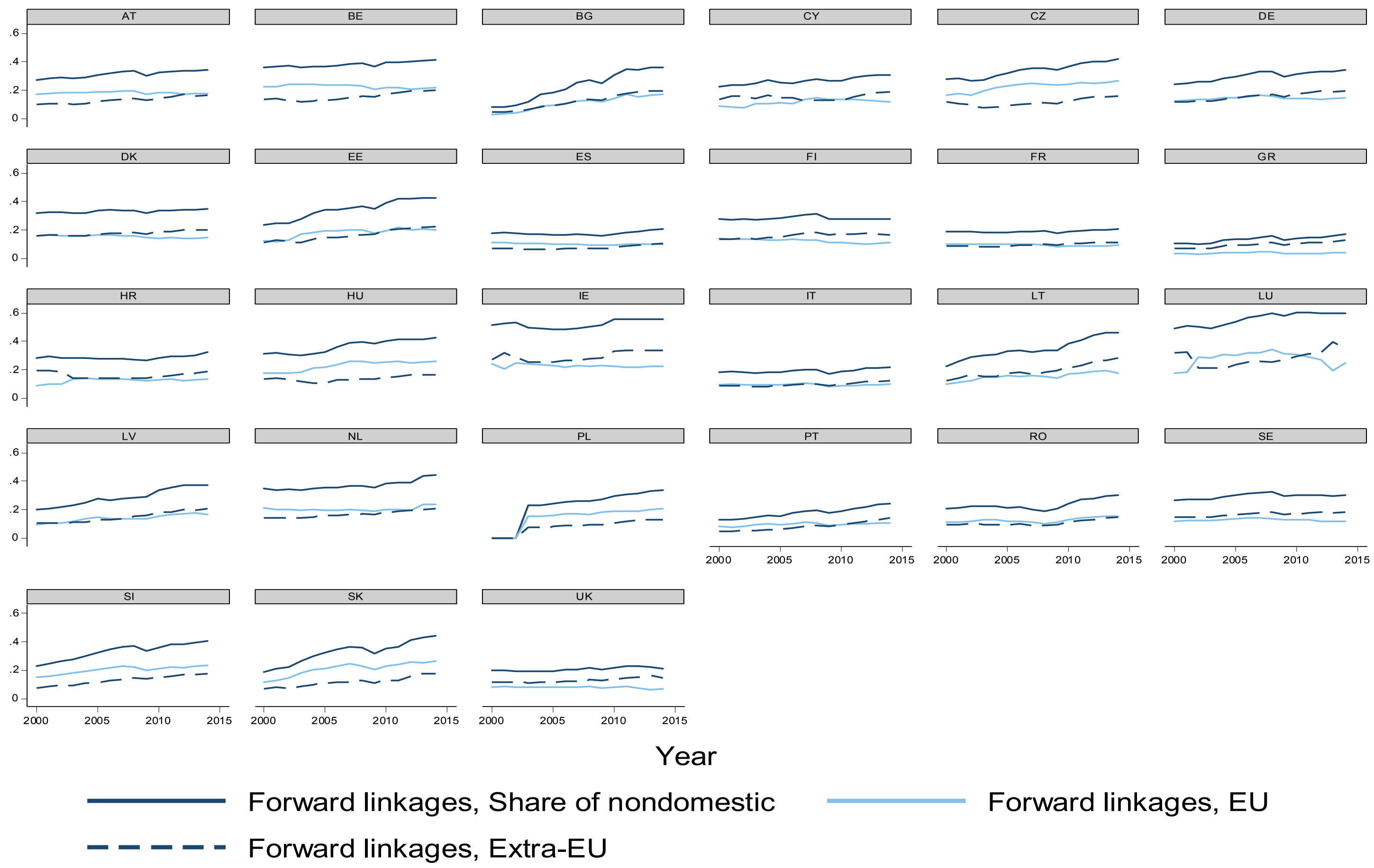
Source: WIOD Release 2016, WIFO calculations.

Note: This table illustrates the forward integration indicators used in the subsequent analysis for Germany and Bulgaria in 2000 and 2014. The integration indicators are 'surplus indicators'. These rely on the value added share that is absorbed non-domestically, and are defined as the difference between the value added share of foreign demand in EU Member States and the value added share absorbed in extra-EU countries.

The picture that emerges for the integration of the manufacturing sector can be summarised as follows. The relative importance of international demand for manufactured goods has increased in either country, but in Bulgaria more so than in Germany. While the relevance of demand from other EU countries has lost some of its importance for Germany, it gained shares in Bulgarian manufacturing.

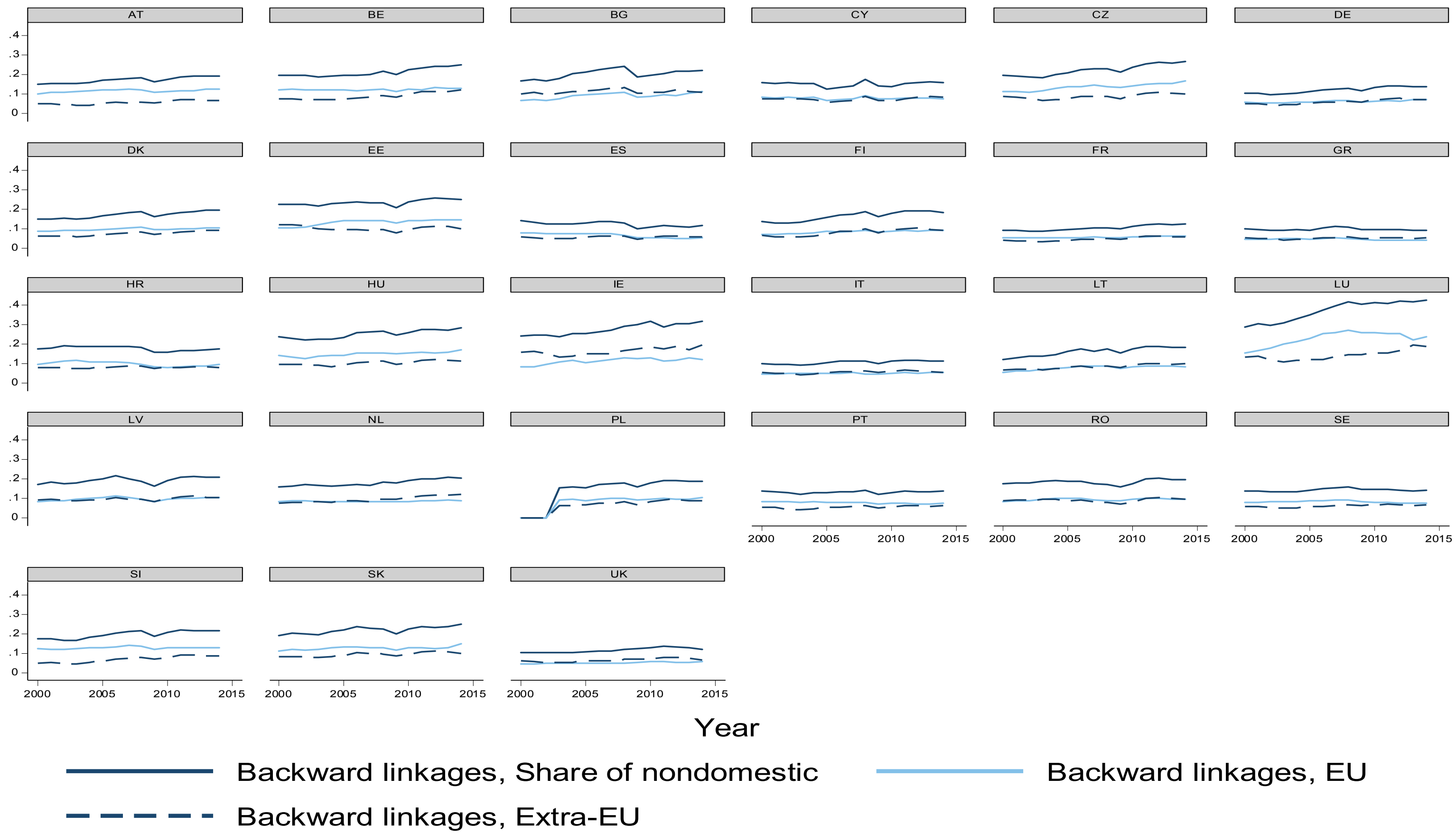
The dynamics of the backward and forward integration indicator may differ from country to country. Since the indicator is defined is a 'surplus' (i.e. the difference between EU and non-EU linkages), the development of the integration indicator needs to be studied due to its components. Hence, the following graphs show the forward and backward integration indicators (see Figure 3.12), the components of the forward integration indicator (see Figure 3.13) and the components of the backward integration indicator (see Figure 3.14).

Figure 3.13: Composition of Forward Integration Indicators across Member States (total economy) and time



Source: WIOD Release 2016, WIFO calculations.
Note: This graph shows the value added weighted forward linkage indicators. These are defined as the share of a sector's induced value added which is found in the final use abroad (share of non-domestic). This indicator consists of the final use in EU and in non-EU Member States.

Figure 3.14: Composition of Backward Integration Indicators across Member States (total economy) and time



Source: WIOD Release 2016, WIFO calculations.
Note: This graph shows the value added weighted backward linkage indicators. These are defined as the share of inputs of a sector's induced value added which is sourced from abroad (share of non-domestic). This indicator consists of the backward linkages from EU and in non-EU Member States.

The components of the integration indicators are rather stable over time, with backward linkages more so than forward linkages. Studying country-sector patterns shows a variation coefficient, defined as the standard deviation over the mean, between 0.13 and 0.26. Forward integration seems to be slightly more volatile than backward integration. The shares of both backward and forward linkages with other EU Member States are more stable than the shares of linkages with extra-EU partners (Table 3.11).

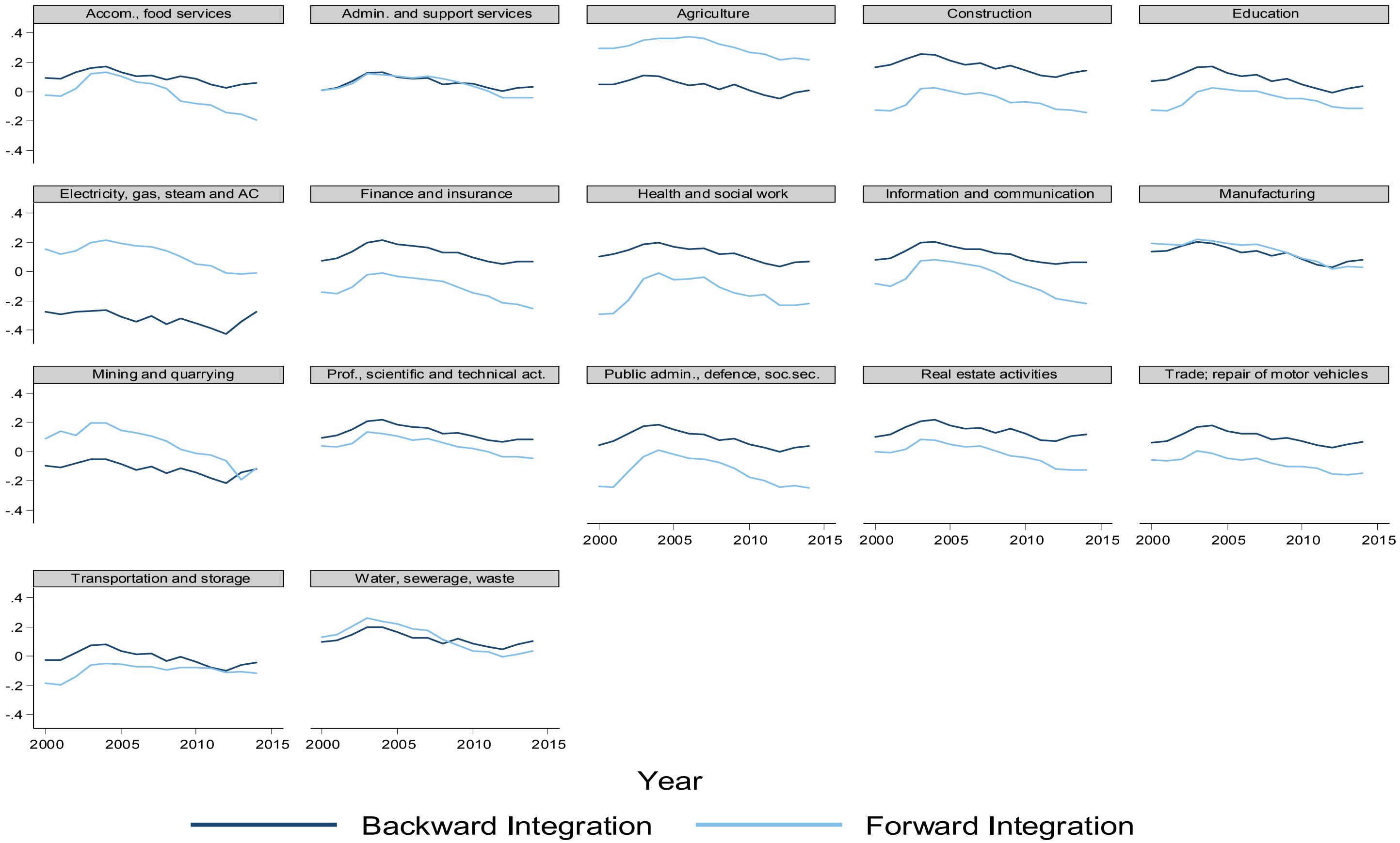
Table 3.11: Descriptive statistics of the components of the Integration indicators

Variable	Obs	Mean	Std. Dev.	Min	Max	Var. Coeff.
B.w. (EU)	6,835	0.09	0.06	0.01	0.45	0.13
B.w. (non-EU)	6,835	0.08	0.06	0.00	0.56	0.18
F.w. (EU)	6,835	0.15	0.13	0.00	0.80	0.19
F.w. (non-EU)	6,835	0.14	0.12	0.00	0.87	0.26

The way the forward and backward integration indicators are constructed implies that the measures for the levels are higher than the integration indices. The mean of the integration indicators suggests a slightly lower degree of forward than backward integration. To some extent the forward indicator provides different information in terms of the positioning in the value chain. While stronger within-EU backward linkages indicate regional sourcing, forward linkages indicate the relevance of global markets for some European countries. There is strong variance in the data, especially with regard to the forward integration indicator (Table 3.12).

In addition, one can analyse these indicators at the sector level. In many sectors, there is a tendency towards more linkages with extra-EU countries. This seems to be more pronounced for the forward integration than the backward integration indicator (see Figure 3.15). The forward integration indicator mirrors the sectoral tradability classification (see Chapter 2), with extra-EU linkages overtaking the shares of intra-EU linkages in ICT (sector "J") and Finance and insurance (sector "K"). This is illustrated in Figure 3.16. Backward linkages are more stable (see Figure 3.17), with manufacturing (sector "C") and Electricity, gas, steam and air conditioning supply (sector "D") taking the highest values.

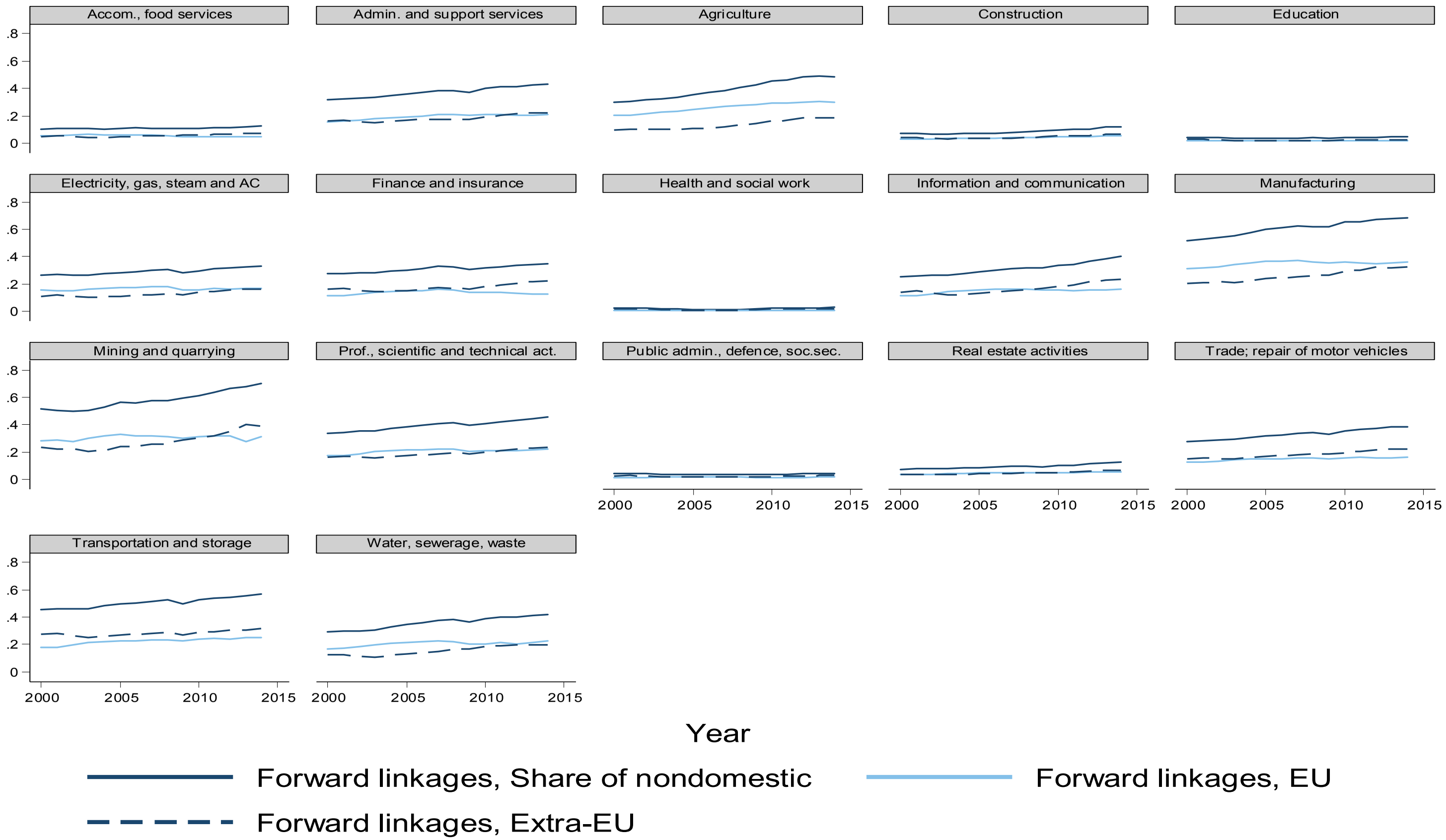
Figure 3.15: Backward and Forward Integration Indicators across Sectors (country mean) and time



Source: WIOD Release 2016, WIFO calculations.

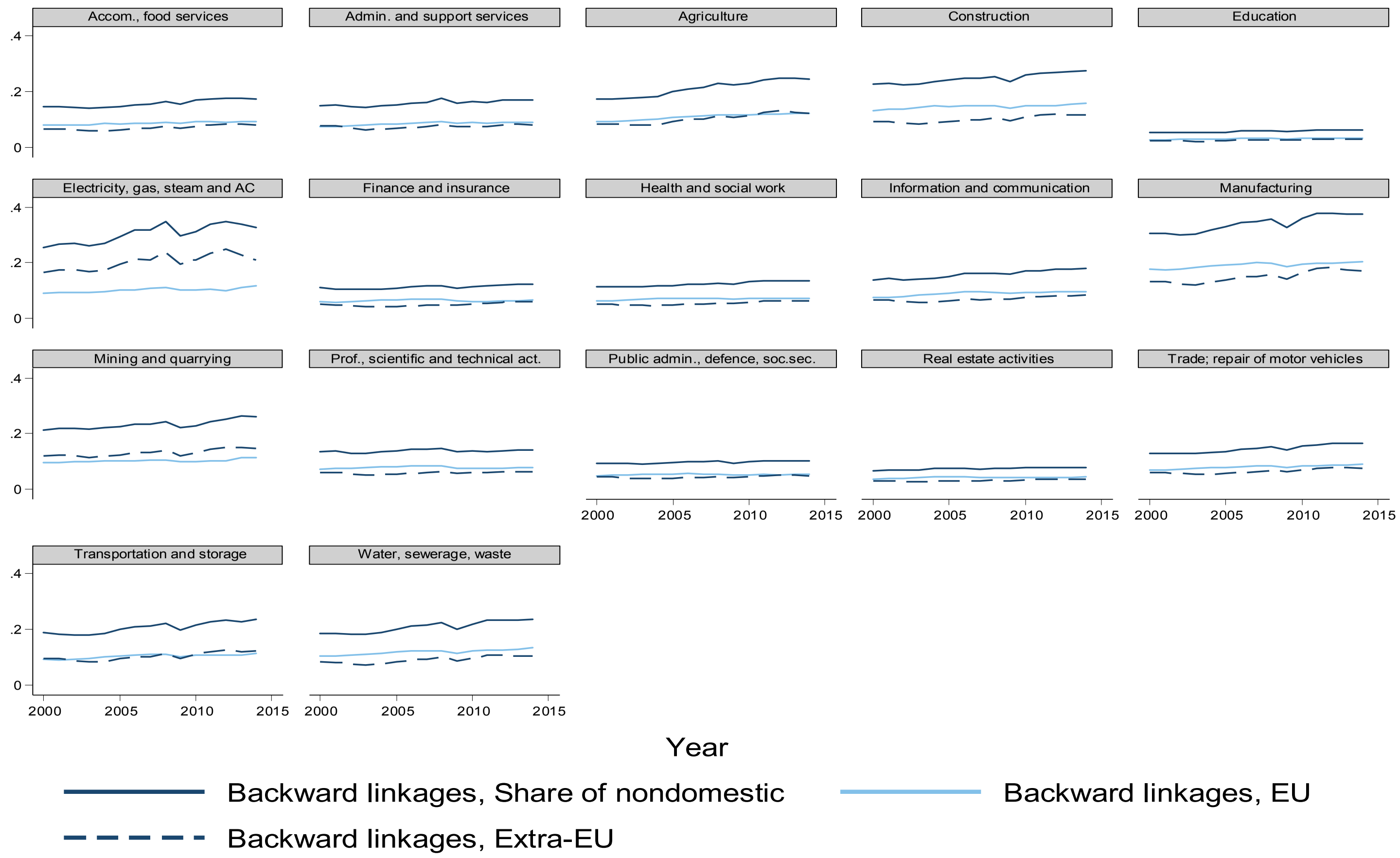
Note: This graph shows the value added weighted backward and forward integration across sectors (mean over all countries) over time. The forward indicator is defined as the surplus of final use of value added in other EU Member States over extra-EU countries. Backward integration is measured as the surplus of sourcing from industries in other EU Member States over extra-EU countries.

Figure 3.16: Composition of Forward Integration Indicators across sectors (country mean) and time



Source: WIOD Release 2016, WIFO calculations.
Note: This graph shows the value added weighted forward linkage indicators. These are defined as the share of a sector's induced value added which is found in the final use abroad (share of non-domestic). This indicator consists of the final use in EU and in non-EU Member States.

Figure 3.17: Composition of Backward Integration Indicators across sectors (country mean) and time



Source: WIOD Release 2016, WIFO calculations.

Note: This graph shows the value added weighted backward linkage indicators. These are defined as the share of inputs of a sector's induced value added which is sourced from abroad (share of non-domestic). This indicator consists of the backward linkages with EU and in non-EU Member States.

Table 3.12: Descriptive statistics of the Single Market indicators (industry level, 2000-2014)

	Forward Integration	Forward EU	Forward Non-EU	Backward Integration	Backward EU	Backward Non-EU	Export Integration	Export EU	Export Non-EU	Import Integration	Import EU	Import Non-EU	Non EU Member
Mean	0.05	0.52	0.48	0.09	0.55	0.45	0.15	0.57	0.43	0.28	0.64	0.36	0.16
Std. Dev.	0.28	0.14	0.14	0.23	0.11	0.11	0.44	0.22	0.22	0.29	0.14	0.14	0.37
Min.	-0.97	0.02	0.02	-0.90	0.05	0.13	-1.00	0.00	0.00	-0.97	0.01	0.03	0.00
Max.	0.95	0.98	0.98	0.74	0.87	0.95	0.99	0.99	1.00	0.93	0.97	0.99	1.00

Source: WIOD Release 2016, WIFO calculations.
Note: N=22591.

Next, a set of indicators referring to the import and export integration of industries is defined. These measures are used as a robustness check for the forward and backward integration indicators and are straightforward, one-step indicators, i.e. trade relations beyond one partner country are not considered. The import integration indicator measures the surplus of value added of imports from industries located in other EU countries over imports from non-EU countries. In other words, it measures the difference in the value added share of imports from within the EU and imports from non-EU economies. Analogously, the export integration indicators are defined to capture integration through exporting channels.

In addition, the analysis uses information about the national EU membership status that captures legal and institutional aspects. This indicator is based on Böheim and Friesenbichler (2016), who have examined the economic impact at the company level of the EU accession process from the beginning of negotiations to final accession. The indicator (Non-EU Member) is constructed as a binary variable and captures the year in which the final step of accession takes place, i.e. after accession countries have implemented the Community Acquis and finally join the Single Market. In using the information about the official full membership status, the legal and institutional aspects of the single Market that directly influence transaction costs can be considered in the analysis.

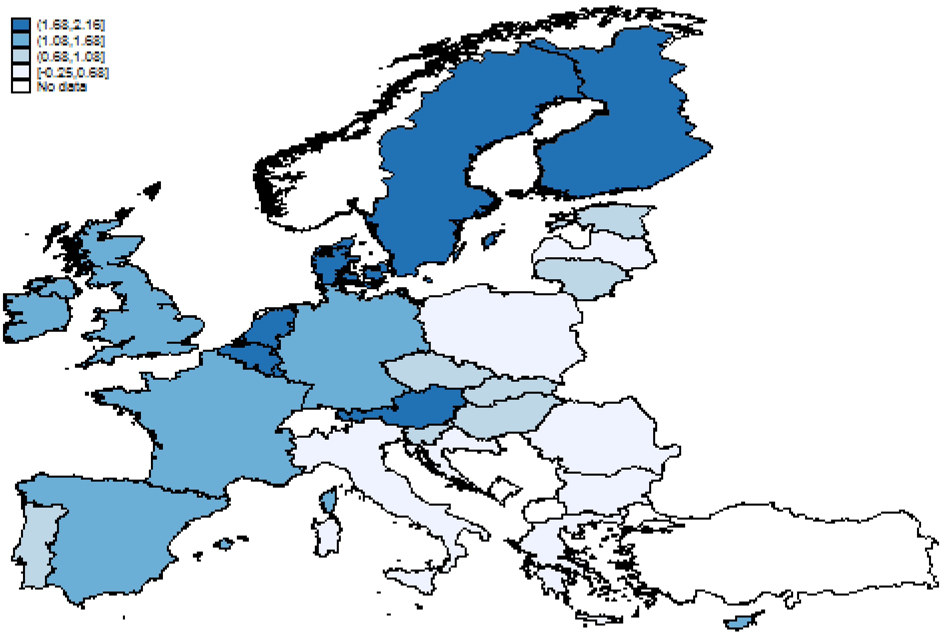
Alternative perspectives of market integration encompass foreign direct investment or cross-border ownership (Helpman, Melitz, and Yeaple, 2003; Oberhofer and Pfaffermayr, 2012; Christen and Francois, 2017, 2010; Keller et al., 2013; Brainard, 1993; Bhattacharya, Patnaik, and Shah, 2012; Navaretti, Venables, and Barry, 2004; Conconi, Sapir, and Zanardi, 2016). Additional indicators of market integration require another research approach, however, and are therefore not within the scope of this study.

3.1.8.Institutional Indicators

The policy indicators used have been derived from the literature on institutional factors of competitiveness (Pitlik et al., 2012), especially focusing on trade (Chor, 2010). The measures cover aspects such as the (i) general rule of law or overall effectiveness of the public administration, (ii) access to external finance and (iii) labour market flexibility. The dimensions analysed aim at wider policy reforms. Over and above these well-established institutional perspectives, two additional aspects will be studied to augment the institutional analysis. A measure of the time to resolve an insolvency provided by the World Bank's Doing Business indicators is also included as a special topic. It will be used in the analysis of industrial dynamics (see 3.4).

The first indicator analysed is government effectiveness, which is provided by the World Bank Governance Indicators. It captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. The indicator encompasses aspects such as the quality of public administration, infrastructure, education and health.[15] This indicator has been argued to be a powerful indicator of the concept of government effectiveness, which is closely associated with per capita income (Lee and Whitford, 2009) and the spread of democracy (Magalhães 2014). Figure 3.18 presents the average government effectiveness within the observation period. The higher the measure is, the better is the quality of public services.

Figure 3.18: Government Effectiveness across the EU (mean of 2000-2014)



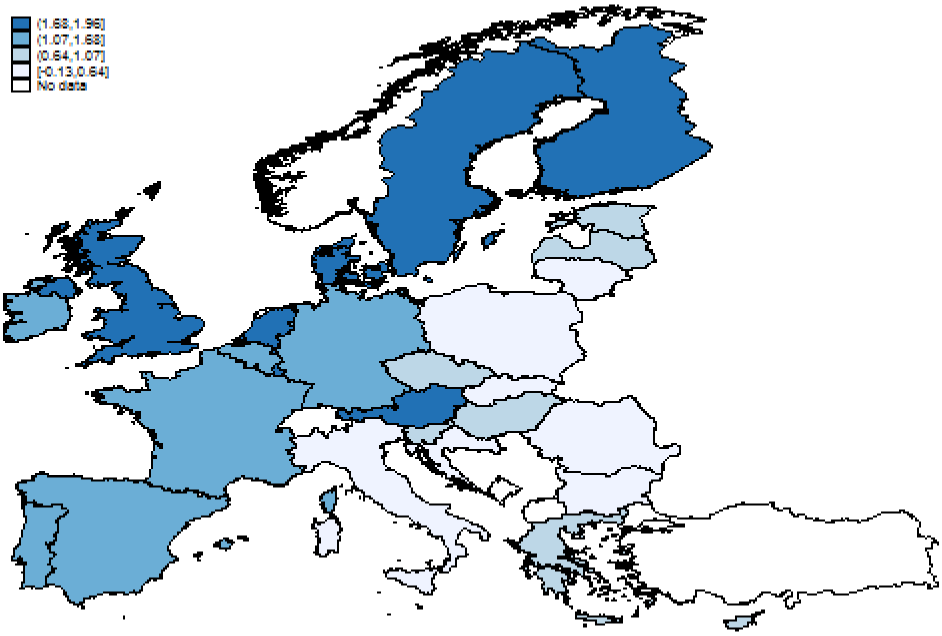
Source: World Bank Governance Indicators, WIFO calculations.
Note: The graph illustrates the mean values of Governance Effectiveness across the EU for the period 2000-2014.

Another indicator capturing a more general aspect is also provided by the World Bank's Governance Indicators – Rule of Law. It captures perceptions of the extent to which agents have confidence in and abide by the rules of society. It captures the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime

[15] See http://info.worldbank.org/governance/wgi/pdf/ge.pdf (accessed on 18 April 2017).

and violence. It measures both de jure and de facto aspects of the rule of law.[16] Like government effectiveness, Rule of Law is a composite indicator that has been linked to economic growth (Haggard and Tiede, 2011). High values indicate better institutions. Mean values of the Rule of Law are shown in Figure 3.19.

Figure 3.19: Rule of Law across the EU (mean of 2000-2014)

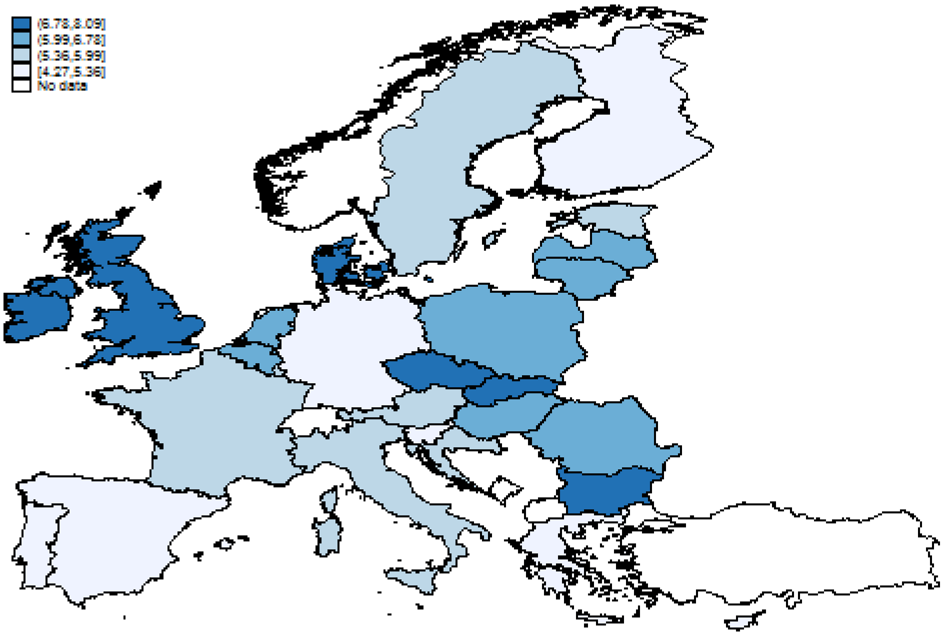


Source: World Bank Governance Indicators, WIFO calculations.
Note: The graph illustrates the mean values of Rule of Law across the EU for the 2000-2014 period.

To capture the level of labour market regulations, a free market index provided by the Fraser Institute quantifies the presence of minimum wage, hiring and firing regulations, centralised collective bargaining, mandated cost of hiring, mandated cost of worker dismissal, working hours' regulations and mandatory conscription. High values of the Fraser Index of labour market flexibility indicate labour markets determined by market forces rather than national regulations. Figure 3.20 presents the mean of the labour market indicator across EU members between 2000 and 2014. Economic freedom is perceived as a value on its own, and institutional or custom regulation is viewed as freedom-reducing (Aleksynska and Cazes, 2014). Even though the directionality of freedom with regard to labour markets may be unclear, the index itself is unequivocal and serves as a viable basis to study labour markets. Sound labour institutions have been shown to reduce the dispersion of earnings and income inequality, which alters incentives, but finds equivocal effects on other aggregate outcomes, such as employment and unemployment (Freeman, 2008).

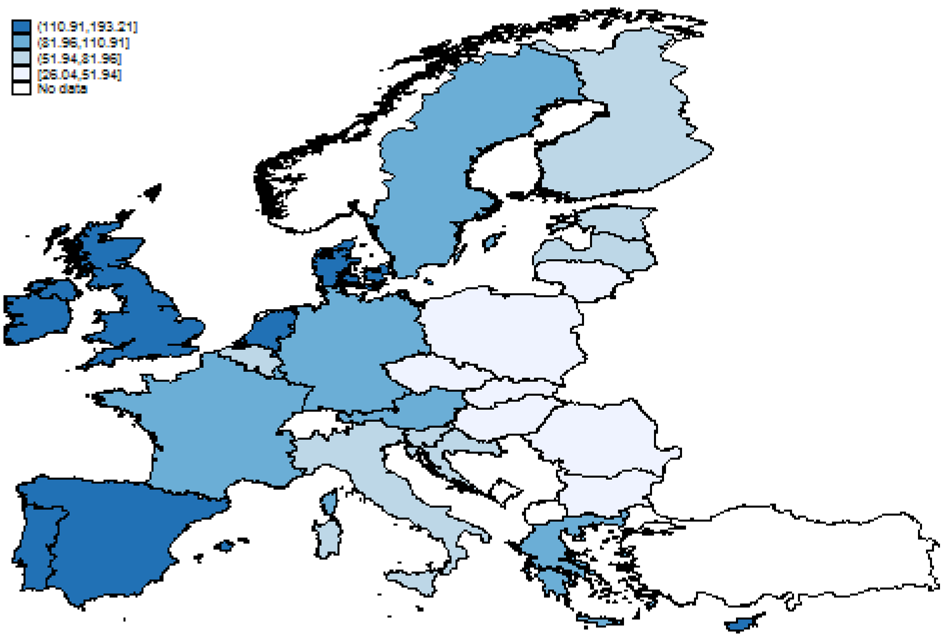
[16] See http://info.worldbank.org/governance/wgi/pdf/rl.pdf (accessed on 18 April 2017).

Figure 3.20: Fraser Index of labour market regulations (mean of 2000-2014)



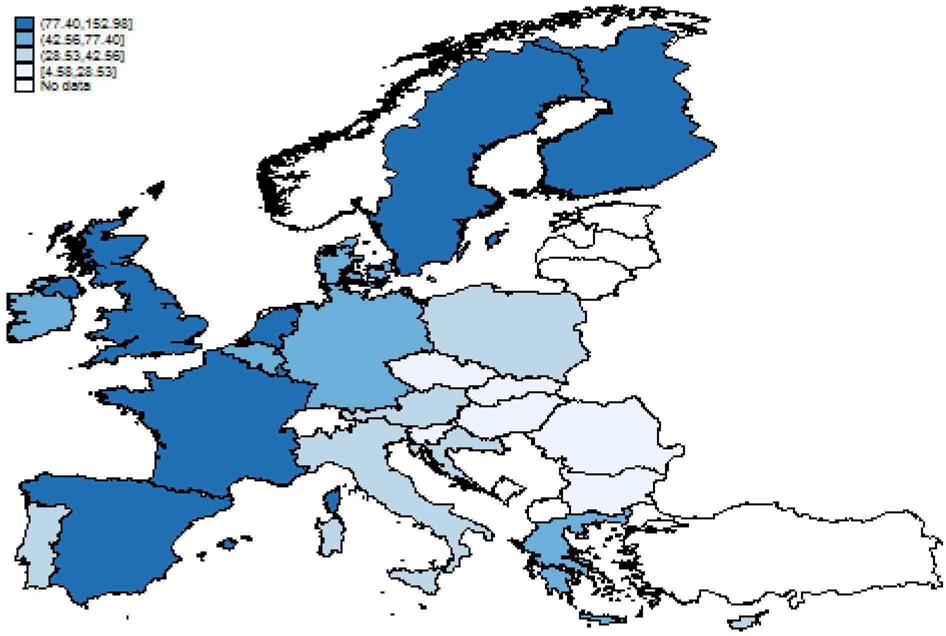
Source: Fraser Institute, WIFO calculations.
Note: The graph illustrates the mean values of labour market regulations across the EU for the 2000-2014 period.

Figure 3.21: Credit to the private sector (% of GDP, mean of 2000-2014)



Source: World Development Indicators, World Bank, WIFO calculations.
Note: The graph illustrates the mean values of domestic credit to private sector (% of GDP) across the EU for the 2000-2014 period.

Figure 3.22: Market capitalisation (% of GDP, mean of 2000-2014)



Source: World Development Indicators, World Bank, WIFO calculations.
Note: The graph illustrates the mean values of the market capitalization of listed domestic companies (% of GDP) across the EU for the 2000-2014 period.

To assess the effect of financial markets two indicators will be used. These are the domestic credit by banks to the private sector as a share of GDP and the market capitalization of listed domestic companies as a share of GDP (Figure 3.21 and Figure 3.22). Two indicators were chosen because financial markets can lean toward a bank based or a market based financing system (Beck, Demirgüç-Kunt, and Levine, 2000). There is a long tradition that links the use of external finance and well-functioning financial markets that select investments with economic performance. Either indicator has been shown to be an important factor of economic development (Rajan and Zingales, 1998; Levine, 2005; Beck, 2003).

Also, the time to resolve insolvency provided by the World Bank's Doing Business Indicators will be used. Generally, a good indicator for insolvency would be recovery rates, which are very case-specific, however, and difficult to measure on an aggregate level. Therefore, this report draws on the time to resolve insolvency rather than using recovery rates. Well-functioning insolvency regimes can directly shape aggregate productivity along the exit margin through a variety of channels (McGowan and Andrews, 2016).

Table 3.13 provides an overview of the national institutional indicators presented above and used in the subsequent analyses. This list is kept concise, and focuses on selected topics commonly studied in the institutional literature. Also, the choice of indicators is discrete, and there are additional indicators available. However, many of these have been shown to be highly correlated with the proposed indicators. For instance, Government Effectiveness and Rule of Law are highly correlated with similar indicators such as Regulatory Quality provided by the World Governance Indicators or the presence of an Independent Judiciary by the World Economic Forum (Pitlik et al., 2012; Friesenbichler et al., 2014). As indicated by the figures above, these national institutional indicators vary greatly across countries.

Table 3.13: Institutional indicators, variable overview

Public Administration Link	Indicator name	Indicator values	Data source	Time coverage
General governance				
	Government effectiveness	Index range -2.5 to +2.5, higher values indicate better performance	World Bank Worldwide Governance Indicators	1996-2015
Rule of Law				
	Rule of Law	Index range -2.5 to +2.5, higher values indicate better performance	World Bank Worldwide Governance Indicators	1996-2015
Labour market				
	Area Vb: Labor Market Regulation		Fraser Insitute - economic-freedom-of-the-world	2000-2014
Access to finance				
	Domestic Credit to Private Sector by Banks (% of GDP)	0 - infinity	World Bank - WDI	1975-2015
	Market Capitalization (size of stock market in % of GDP)	0 - infinity	World Bank - WDI	1975-2015
Insolvency				
	Time to resolve insolvency	0 - infinity	World Bank - Doing Business	2002-2015

3.2. The impact of Single Market integration, national institutions and tradability on employment and value added: An industry perspective

The central role of institutional quality on comparative advantages has been recently highlighted by several authors, in the international economics literature (Chor, 2010; Costinot, 2009a; Levchenko, 2013, 2007). Three main fields of institutions that potentially influence national comparative advantages can be identified: (1) contracting and property rights, (2) labour market regulations and (3) development of and access to financial markets. Moreover, it seems that certain industries are affected by those institutional framework conditions in different ways. First, imperfectly enforced contracting and property rights entail higher costs and uncertainty (Anderson and Marcouiller, 2002; Anderson and Young, 1999). This is particularly important for industries highly dependent on relationship-specific investments or which are characterised by a complex product portfolio and high job task complexity (Levchenko, 2007; Nunn, 2007; Chor, 2010).

Second, employment protection and stable industrial-relation systems support the constitution of industry-specific cumulative knowledge bases and support a comparative advantage in sectors with complex product portfolios and greater export volatility (Bassanini and Ernst, 2002; Costinot, 2009a; Tang, 2012; Cuñat and Melitz, 2010). Third, credit market constraints could be thought of costs that are relatively higher for a certain group of capital-intensive sectors than for others. National financial institutions positively affect export shares and international competitiveness in industries more dependent on external financing (Manova, 2008; Beck, 2003; Chor, 2010; Svaleryd and Vlachos, 2005). Overall, these empirical analyses indicate an industry-specific effect of the quality of institutions on comparative advantages.

The same logic of the dependence of competitiveness on national legal institutions is also applicable, of course, to supranational institutions. Institutional change as the Community Acquis is implemented might result in more stable framework conditions and reduced costs connected to intra-EU trade when countries achieve full EU membership, which in turn can result in significant welfare gains (Levchenko and Zhang, 2012). Again, the effect might be industry-specific and depend on the industry's level of trade openness. To capture different aspects of Single Market integration, in addition trade-related measures of both forward and backward market integration as well as forward and backward linkages (EU and extra-EU) are included in the analysis (see Section 3.1.7). This complements the impact of legal integration by the effect of different forms of global value chains linkages within and outside the EU.

One might assume that the quality of domestic institutions either tames or enhances the impact of measures implemented by supranational institutions. For this reason, in the analysis that follows the interplay between these two policy levels will also be examined.

As the degree of tradability is an industry-specific characteristic, it is, inter alia, used in our specifications to control for sectoral differences of the impact of (supra-)national institutions and Single Market integration. Hence, an industry level tradability indicator is constructed. The index is based on WIOD data covering the period 2000-2014.[17] The measure relies on the aggregate, EU-wide value added exports, regardless of their destination. An average over

[17] A number of neighbouring countries are missing in WIOD data, which may distort some countries' results, especially in Eastern Europe (e.g., Ukraine or Belarus are not included in the data).

the whole observation period is used, i.e. this indicator is time-invariant. Exports are defined as value added exports, i.e. the share fraction of value added at the industry level which is not consumed domestically. This is equivalent to the domestic value added induced by foreign demand. The tradability indicator notably differs from Single Market indicators. It is a broad measure for the industry-level propensity to trade, and does not measure integration itself.

The central determinants affecting economic performance are capital and labour resources as well as knowledge stocks. Although there is no doubt that these inputs are important, in this exploratory section the focus of the analysis that follows lies on the impact of Single Market integration and national institutions on the level of competitiveness. Country and sector specific production factors will be controlled for by fixed effects.

3.2.1. Estimation strategy

This section examines the impact of Single Market integration, national institutions and tradability on industry level performance indicators $\mathrm{Comp}_{i,j,t}$ using panel regression analyses, where the dependent variable $\mathrm{Comp}_{i,j,t}$ is a place-holder for industry level employment and value added over time. The analysis will start from the following four base-line models:

$$\mathrm{Comp}_{i,j,t} = \alpha + \beta_1 \mathrm{MarketInt}_{i,j,t} + \beta_2 \mathrm{Inst}_{i,t} + \beta_3 [\mathrm{Trad}_j * \mathrm{MarketInt}_{i,j,t}] + \beta_4 \mathrm{ProdComplex}_{i,j,t} + \lambda_{ij} + \tau_t + \varepsilon_{i,j,t},$$

$$\mathrm{Comp}_{i,j,t} = \alpha + \beta_1 \mathrm{Linkages}_{i,j,t} + \beta_2 \mathrm{Inst}_{i,t} + \beta_3 [\mathrm{Trad}_j * \mathrm{Linkages}_{i,j,t}] + \beta_4 \mathrm{ProdComplex}_{i,j,t} + \lambda_{ij} + \tau_t + \varepsilon_{i,j,t},$$

$$\mathrm{Comp}_{i,j,t} = \alpha + \beta_1 \mathrm{Linkages}_{i,j,t} + \beta_2 \mathrm{MarketInt}_{i,j,t} + \beta_3 \mathrm{Inst}_{i,t} + \beta_4 [\mathrm{Trad}_j * \mathrm{MarketInt}_{i,j,t}] + \beta_5 \mathrm{ProdComplex}_{i,j,t} + \lambda_{ij} + \tau_t + \varepsilon_{i,j,t},$$

and

$$\mathrm{Comp}_{i,j,t} = \alpha + \beta_1 \mathrm{MarketInt}_{i,j,t} + \beta_2 \mathrm{Inst}_{i,t} + \beta_3 \mathrm{ProdComplex}_{i,j,t} + \beta_4 [\mathrm{ProdComplex}_{i,j,t} * \mathrm{MarketInt}_{i,j,t}] + \lambda_{ij} + \tau_t + \varepsilon_{i,j,t}.$$

where $\varepsilon_{i,j}$ is the usual error term that varies over countries *i* and industries *j*.

Variable $\mathrm{MarketInt}_{i,j,t}$ is the place-holder for the indicators for forward/export and backward/import market integration, as described in detail and with numerical examples in Section 3.1.7. These variables capture whether the value chains of any specific national sector are more geared towards the Single Market or global value chains outside the Single Market, where the indicators distinguish between up-stream (backward linkages) and down-stream (forward linkages) value chains. In addition, in some models, these trade-based integration indicators are used in combination with an indicator on EU membership status that allows discriminating differential effects of forward and backward integration for EU members and non-EU members, as well as capturing the impact of changes of membership status.

To control for different base levels of integration into the Single Market or Global Value Chains outside the EU, the share of forward linkages in total final demand and the share of backward linkages in total induced value added within and outside the EU are included in the baseline specifications as well. Variable $\mathrm{Linkages}_{i,j,t}$ is the place-holder for these indicators.

The measure for tradability ($\mathrm{Trad_j}$) varies over industries only and is a share that indicates to what extent the goods produced in a specific industry are tradable goods. It is calculated as the average share of value added exports in total value added at the industry level between 2000 and 2014, and is therefore a continuous variable with support [0,1].[18] The interaction term $[\mathrm{Trad_j} * \mathrm{MarketInt_{i,j,t}}]$ is used in some models to assess whether tradability strengthens or weakens the impact of market integration on employment and value added at the sector level.

Variable $\mathrm{Inst_i}$ is the place-holder for national measures of contract enforcement and property rights (rule of law, $\mathrm{RoL_{i,t}}$), the measure of labour market regulations ($\mathrm{LMR_{i,t}}$) and the measure for financial intermediaries' development (private credit, $\mathrm{PC_{i,t}}$), as presented earlier in this chapter (see Section 3.1.8 for a detailed description).

The variable $\mathrm{ProdComplex_{i,j,t}}$ is calculated in line with (Hidalgo and Hausmann, 2009) and captures differences in the technological sophistication of sector specific product portfolios across countries, as well as their impact on employment and value added. In some models this indicator is interacted with market integration indicators, $[\mathrm{ProdComplex_{i,j,t}} * \mathrm{MarketInt_{i,j,t}}]$, to examine whether market integration strengthens or weakens the effect of product portfolio complexity on the performance indicators, $\mathrm{Comp_{i,j,t}}$.

In each of these alternative models discussed so far, country-industry fixed effects and time fixed effects, λ_{ij} and τ_t respectively, have also been included to control for unobserved variation at the country-industry level and over time.[19]

While the baseline model is used to examine the direct and indirect effects of Single Market integration on sector performance, an additional extended model has been implemented to verify to what extent domestic economic institutions, $\mathrm{Inst_{i,t}}$, affect industry performance indirectly, either by mitigating or enhancing the effect of Single Market integration on industry value added and employment across countries over time. This is captured through the interaction term $[\mathrm{Inst_{i,t}} * \mathrm{MarketInt_{i,j,t}}]$. The alternative regression models therefore look as follows:

$$\mathrm{Comp_{i,j,t}} = \alpha + \beta_1 \mathrm{MarketInt_{i,j,t}} + \beta_2 \mathrm{Inst_{i,t}} + \beta_3 [\mathrm{Inst_{i,t}} * \mathrm{MarketInt_{i,j,t}}] + \beta_4 \mathrm{ProdComplex_{i,j,t}} + \lambda_{ij} + \tau_t + \varepsilon_{i,j,t}.$$

Focusing on fixed effects, panel regressions have the advantage that all unobserved, time-invariant information specific to domestic markets is captured by the included dummy variables, and the same applies to time-specific shocks faced by all EU members. Therefore, other relevant control variables, like investment levels or human recourses and knowledge stocks, which are rather constant during the observation period, are absorbed by these fixed effects.

Two basic groups of fixed effects specifications are presented in this chapter. One specification accounts for time and industry-country specific effects (see Section 3.2.2) and a second estimation includes time and country fixed effects (see Appendix 3.8.3 as well as a discussion of the results in Section 3.2.4). The preferred specification is the former. The inclusion of finely granulated fixed effects ensures that specific national industry characteristics are controlled for by the country-industry dummies and not accidentally

[18] Value added exports are based on the WIOD data and include exports for foreign final demand.

[19] Given that tradability varies at the sector level only, results for alternative models only including country and time fixed effects (μ_i and τ_t) are presented in Appendix 3.8.3.

captured by other controls. However, the inclusion of time and country fixed effects in the second set of specifications allows explicitly considering general information on industry characteristics, like tradability, that do not vary over time or countries. These specifications are used as a robustness check.

The regressions presented in Sections 3.2.2 and 3.2.3 focus on the effects of Single Market integration, and national institutions on industry level performance indicators. The focus on these key variables implicates that only two variables that vary over all three dimensions – time, countries and industries – are included in the regression, namely $\mathrm{ProdComplex}_{i,j,t}$ and $\mathrm{MarketInt}_{i,j,t}$. Moreover, it is established that $\mathrm{ProdComplex}_{i,j,t}$ is highly correlated with knowledge and capital intensity (Reinstaller et al., 2012). This should not be problematic using country–industry specific fixed effects, but when only country dummies are included, the coefficient of the product portfolio complexity need to be interpreted cautiously because other industry specific characteristics might interfere with the impact of sectoral product complexity on performance.

A thorough discussion of potential caveats of the chosen specification and estimation approach as well as results of alternative model specifications (e.g. including a lagged dependent variable) and econometric regression approaches (e.g. quantile and IV-regressions) are presented in Section 3.2.4 to ensure that our key results are robust.

3.2.1.Descriptive statistics for the industry level regressions.

Table 3.14 presents descriptive statistics of the dependent variables as well as of all explanatory variables included in the subsequent regressions. Comparing the mean and the standard deviation reveals a wide data spread at the industry level. The key performance indicators, value added and employment show a high level of variation (with coefficients of variation larger than 2.5), which should be considered in subsequent analyses.

Table 3.14: Descriptive statistics at the industry level, 2000-2014

	Mean	**Std. Dev.**	**Min**	**Max**	**Observations**
Employment (persons, in thousand)	153.26	386.77	0	5353	21209
Value added (in Mio.)	7890	20200	-1170	277000	20611
Forward integration	0.05	0.28	-0.97	0.95	22538
Backward integration	0.09	0.23	-0.9	0.74	22533
Forward linkages EU	0.23	0.17	0.00	0.96	22238
Forward linkages outside EU	0.20	0.15	0.00	0.92	22238
Backward linkages EU	0.13	0.09	0.00	0.68	22533
Backward linkages outside EU	0.11	0.09	0.00	0.78	22533
Export integration	0.15	0.44	-1	0.99	22537
Import integration	0.28	0.29	-0.97	0.93	22533
No EU member	0.16		0	1	22591
Tradeability	0.26	0.15	0.01	0.62	22591
Rule of Law	1.09	0.63	-0.27	2.12	22591
Labour Market Regulations	6.08	1.21	2.81	8.48	22591
Private Credit	86.33	46.66	0.19	253.57	22591
Complexity	0.042	0.52	-2.54	2.35	20164

Source: Eurostat, WIOD, Fraser Institute, World Development Indicators, Worldwide Governance Indicators, WIFO-calculations.

Although the levels of employment are rather stable over time at the country level (see Figure 3.34), one can observe considerable variation across industries (see Figure 3.36). The highest variation is in crop and animal production, hunting and related service activities (A01 in Nace Rev. 2), and human health and social work activities (Q). A similar variation can also be observed for value added (see Figure 3.37)

Differentiating between country groups reveals substantial differences with respect to data spread in both employment and value added data (see Figure 3.35 and Figure 3.38). On the one hand, this is due to heterogeneous country sizes; on the other hand, it partly reflects heterogeneous industry specialisations across EU countries. While the core European countries reflect large differences regarding the number of persons employed in different industries, the CEE's industries are more homogeneous. [20]

Due to this variation, outlier robust regression methods (Huber, 1973) are used to estimate the fixed effects model with country specific effects to handle those sample peculiarities (see Appendix 3.8.3). In doing so, the potential impact of large variations on the estimated effects is controlled for. In the preferred specification, the variation at the industry level is captured by industry-country fixed effects, and there is no need for robust estimators.

Since logarithms of variables are used in the estimations, cases with zero or negative values of the dependent variables are dropped from the regression.[21] Regarding right side variables, the absolute values of the respective minima have been added to the explanatory variables which range between minus one and one to avoid further problems resulting from taking the logarithm.

3.2.2. The baseline models: industry performance, tradability and Single Market integration

Table 3.15 and Table 3.16 present the results for the baseline model with sectoral employment and value added as dependent variables, respectively. Dependent and explanatory variables have been included in logarithmic form in the regressions such that the coefficients can be interpreted as the percentage change in the dependent variable induced by a one percentage change in the explanatory variable, or in the case of indicator variables such as the EU member status as the percentage change in the dependent variable induced by a change in status.

The columns numbered (1) to (6) in Table 3.15 and (1) through (10) in Table 3.16 present regression results from different model specifications where country-industry dummies as well as time-fixed effects have been used to appropriately control for unobserved heterogeneity. The granular dummies allow controlling for outliers and other unobserved characteristics at the industry level across countries. The interaction effects of the tradability indicator with market integration indicators are included such that the joint impact of tradability with Single Market integration indicators can be assessed. The observed impacts for Single Market Integration in these regressions should therefore be taken as a key reference for the interpretation of effects. In the following the discussion of results will refer to these

[20] The "Core" economies include Germany, France, the UK, the former Benelux countries and Scandinavian countries (Denmark, Sweden and Finland). The countries of the group "South" are comprised as follows: Greece, Italy, Cyprus, Ireland, Portugal, Matla and Spain. And finally the "CEE" countries are the Eastern, and Central Eastern European countries: Bulgaria, Croatia, Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland, Romania, Slovenia and Slovakia.

[21] In total 38 observations have been dropped in the regressions for employment because of zero employment.

specifications. A supplemental discussion of the robustness of the presented outcome can be found in Section 3.2.4.

The columns in Table 3.15 represent different regressions in terms of the used left side variables, as well as in terms of the used right side variables. Columns (1) to (3) concentrate on the effects of Single Market Integration and of value chain linkages within and outside the EU on sectoral employment and columns (4) to (6) focus on the effects on sectoral value added.

Columns (1) and (4) in Table 3.15 use forward and backward integration along global value chains recovered from the WIOD tables, while models (2) and (5) focus on forward and backward linkages within and outside the EU. Instead of the trade-related Single Market integration indicators that are based on the difference between within-EU and extra-EU linkages and do not account for level effects, the shares of foreign demand (EU and extra-EU) in total final demand as well as the shares of non-domestic (EU and extra-EU) backward linkages in total induced value added along the value chain are included. Finally, models (3) and (6) include both the Single Market integration indicators as well as the lagged forward and backward linkages. This allows interpreting forward and backward integration as the variation in the magnitude of Single Market integration while simultaneously considering the existing initial levels of forward/backward linkages within and outside the EU. This approach should ascertain that the results on Single Market integration are not driven by differences in initial levels of intra- and extra-EU linkages along the value chain.

The main results for the trade and value chain based indicators of Single Market integration are presented in columns (1) and (4) of Table 3.15.

Looking at column (1), the results indicate that forward and backward integration both have a positive effect on employment. A difference of one percent in forward market integration increases employment by approximately 0.1 percent, whereas an identical change in backward integration increases it by approximately 0.28 percent. Both effects increase with the tradability of the output of an industry. Thus, forward and backward integration of an industry into the Single Market boosts its employment and with each percentage point difference in tradability between two sectors this effect increases by 0.05 to 0.07 percent. These results indicate positive effects of forward and backward market integration on employment. As would be expected, sectors with higher tradability also benefit more from market integration, i.e. these sectors act as important transmission channels for the benefits of Common Market integration into Member States.

Looking at Column (2) and (3) reveals that the shares of forward and backward linkages outside the EU have negative effects on the level of employment which are reinforced by the level of tradability, while the shares of forward and backward linkages inside the EU do not have any significant effects on industry-level employment.

With respect to value added, column (4) of Table 3.15 reveals that the effect of backward integration on value added is not significantly different from zero, although a significant positive effect of forward integration is observed which is enhanced by the sectoral level of tradability. In contrast, the higher the share of forward linkages is within the EU, the higher is the sectoral value added. Again, the effect is enhanced by the level of tradability of an industry. However, the share of forward linkages outside the EU as well as the share of backward linkages within the EU are negatively related with value added (columns (5) and (6)).

Table 3.15: Estimation results for the basic regression models on sector employment and value added

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable		ln(employment)			ln(VA)	
VARIABLES						
ln(forward integration)	0.109*		0.078	0.164**		0.194***
	(0.096)		(0.163)	(0.021)		(0.000)
ln(backward integration)	0.281***		0.127*	0.030		-0.047
	(0.000)		(0.080)	(0.840)		(0.681)
ln(forward integration) * ln(tradability)	0.051***		0.055***	0.062***		0.066***
	(0.010)		(0.007)	(0.002)		(0.000)
ln(backward integration) * ln(tradability)	0.072*		0.081**	-0.073		-0.086
	(0.063)		(0.030)	(0.278)		(0.135)
ln(forward linkages EU)		0.054			0.191***	
		(0.192)			(0.000)	
ln(forward linkages outside EU)		-0.112***			-0.041	
		(0.003)			(0.284)	
ln(forward linkages EU) * ln(tradability)		0.023			0.064***	
		(0.104)			(0.000)	
ln(forward linkages outside EU) * ln(tradability)		-0.049***			-0.031**	
		(0.000)			(0.018)	
ln(backward linkages EU)		0.023			-0.300***	
		(0.698)			(0.001)	
ln(backward linkages outside EU)		-0.222***			-0.109	
		(0.000)			(0.128)	
ln(backward linkages EU) * ln(tradability)		-0.030			-0.105***	
		(0.251)			(0.006)	
ln(backward linkages outside EU) * ln(tradability)		-0.063***			0.039	
		(0.001)			(0.175)	
ln(forward linkages EU)$_{t-1}$			0.037*			0.057***
			(0.059)			(0.009)
ln(forward linkages outside EU)$_{t-1}$			-0.038**			0.030
			(0.030)			(0.142)
ln(backward linkages EU)$_{t-1}$			0.114***			-0.065
			(0.000)			(0.203)
ln(backward linkages outside EU)$_{t-1}$			-0.116***			-0.081*
			(0.000)			(0.085)
ln(ROL)	0.129	0.119	0.108	1.056***	0.924***	0.921***
	(0.294)	(0.318)	(0.373)	(0.000)	(0.000)	(0.000)
ln(Labour Market Flexibility)	0.039	0.041	0.032	-0.087*	-0.069*	-0.044
	(0.149)	(0.107)	(0.246)	(0.062)	(0.097)	(0.339)
ln(Private Credit)	0.016**	0.020***	0.019***	0.040***	0.036***	0.032***
	(0.014)	(0.002)	(0.002)	(0.000)	(0.000)	(0.000)
ln(Complexity)	-0.109**	-0.104**	-0.086*	-0.060	-0.046	-0.050
	(0.041)	(0.047)	(0.081)	(0.295)	(0.361)	(0.359)
Constant	3.315***	3.198***	3.298***	19.543***	19.190***	19.804***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Sector*Country Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	19,064	18,818	17,569	18,484	18,240	17,047
R-squared	0.031	0.043	0.038	0.130	0.170	0.130

Source: WIFO calculations.
Note: Cluster robust pval in parentheses: ***p<0.01, **p<0.05, *p<0.1.

The results in columns (3) and (6) confirm that the results on the trade-related Single Market integration indicators are not driven by differences in initial integration levels, as the coefficient of forward and backward integration and their interaction terms are rather stable in comparison to models (1) and (3). We will use this evidence, to use more parsimonious models relying only on the $\mathrm{MarketInt}_{i,j,t}$ indicator in the analyses that will follow in this section.

Overall, the results of Table 3.15 hint at positive effects of value-chain-based Single Market integration on sectoral value added and employment levels. With respect to the negative relation between backward integration and value added, the data reveal empirical patterns that do not allow for unequivocal interpretations of the causal chain behind the evidence. The results could be interpreted in such a way that the Single Market also enables less profitable industries to extend their sourcing across national borders and benefit from the resources of other EU member countries. Further research is needed to understand the exact reasons behind this result. That is, however, beyond the scope of this study.

After having established that the inclusion of the levels of forward and backward linkages does not change the main results regarding the size or sign of coefficients, the more complex models shown in Table 3.16 and Table 3.17 are limited to the forward and backward integration indicators for the sake of simplicity.

Analogously to Table 3.15, the single model specifications reported in the Table 3.16 differ in terms of the used dependent variable as well as in terms of indicators of Single Market integration. Models (1) to (5) concentrate on effects on employment, models and models (6) to (11) additionally show effects on value added at the industry level. The specifications in columns (1) and (6) are the same as those used before in Table 3.15 (columns (1) and (4)) and are included for better comparability with subsequent results. Models (2) and (7) use the indicator on EU membership status of the countries in the panel instead of trade-based integration indicators.[22] Models (3) and (8) use these two sets of indicators jointly. This is to account for the fact that sectors in some countries could potentially be strongly integrated in Single Market value chains, but the country may not have EU member status.

To assess whether EU member status enhances or mitigates the effects on employment and value added for any given level of forward or backward integration into the Single Market, an interaction-effect between these two indicators has also been calculated. Models (4) and (9) use an import and export integration indicator which capture only the direct integration of a sector in terms of the share of total imports and total exports that originate from or are exported to other countries of the Single Market. These indicators are therefore similar to the forward and backward integration indicators with the difference that they capture only the direct integration and not the integration along the entire value chain of a sector in a country. Models (5) and (10) finally use the forward and backward integration indicators. These are interacted with a country's complexity score of its sectoral export portfolio to examine whether forward or backward integration enhances or mitigates the effect changes in the sophistication of the export portfolio of a sector have on employment and value added.

[22] This indicator is drawn from Böheim and Friesenbichler (2016).

Table 3.16: Estimation results for the baseline model on sector employment and value added

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent Variable			ln(employment)					ln(VA)		
VARIABLES										
ln(forward integration)	0.109*		-0.063		0.220	0.164**		0.017		0.174
	(0.096)		(0.243)		(0.132)	(0.021)		(0.663)		(0.117)
ln(backward integration)	0.281***		0.210***		0.223**	0.030		0.122		0.329***
	(0.000)		(0.000)		(0.013)	(0.840)		(0.128)		(0.002)
ln(tradeability)										
ln(backward integration) * ln(tradability)	0.072*					-0.073				
	(0.063)					(0.278)				
ln(forward integration) * ln(tradability)	0.051***					0.062***				
	(0.010)					(0.002)				
ln(ROL)	0.129	0.090	0.062	0.146	0.138	1.056***	0.864***	0.863***	1.174***	1.081***
	(0.294)	(0.460)	(0.601)	(0.321)	(0.260)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(Labour Market Flexibility)	0.039	0.035	0.034	0.023	0.040	-0.087*	-0.092**	-0.089*	-0.122**	-0.088*
	(0.149)	(0.200)	(0.201)	(0.508)	(0.132)	(0.062)	(0.042)	(0.051)	(0.015)	(0.058)
ln(Private Credit)	0.016**	0.015***	0.014**	0.012*	0.017***	0.040***	0.034***	0.034***	0.025***	0.041***
	(0.014)	(0.010)	(0.014)	(0.054)	(0.009)	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)
ln(Complexity)	-0.109**	-0.098*	-0.112**	-0.122**	-0.099*	-0.060	-0.065	-0.074	-0.091	-0.092
	(0.041)	(0.062)	(0.033)	(0.034)	(0.059)	(0.295)	(0.247)	(0.188)	(0.188)	(0.147)
No EU member		0.040	-0.050***				-0.193***	-0.110***		
		(0.117)	(0.003)				(0.000)	(0.000)		
No EU member * ln(tradability)		0.054***					-0.046***			
		(0.000)					(0.001)			
ln(forward integration) * No EU member			0.178***					0.008		
			(0.003)					(0.848)		
ln(backward integration) * No EU member			-0.227***					-0.129		
			(0.000)					(0.159)		
ln(Export integration)				0.035***					0.009	
				(0.005)					(0.561)	
ln(Import integration)				0.054***					0.046	
				(0.003)					(0.131)	
ln(Export integration) * ln(tradability)				0.018***					0.002	
				(0.000)					(0.793)	
ln(Import integration) * ln(tradability)				0.017*					0.017	
				(0.062)					(0.204)	
ln(backward integration) * ln(complexity)					-0.060					-0.246**
					(0.518)					(0.043)
ln(forward integration) * ln(complexity)					-0.248*					-0.162
					(0.058)					(0.136)
Constant	3.315***	3.385***	3.444***	3.370***	3.308***	19.543***	19.869***	19.873***	19.443***	19.551***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Country Dummies	No	No	No	No	No	No	No	No	No	No
Sector*Country Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	19,064	19,071	19,064	11,644	19,064	18,484	18,490	18,484	11,437	18,484
R-squared	0.031	0.03	0.045	0.026	0.031	0.129	0.133	0.136	0.123	0.129

Source: WIFO calculations.
Note: Cluster robust pval in parentheses: ***p<0.01, **p<0.05, *p<0.1.

The following results show that Single Market integration has an ambiguous joint effect with tradability on industry employment and value added. Looking at EU member status first, the coefficient calculated for the indicator is significant in the value added regressions across these specifications (see columns (7) and (8)). It should be kept in mind, that this indicator captures the effect of *not* being an EU member. Keeping all else equal, *not* being an EU member has a negative impact on sectoral value added. The difference is between -0.19 and -0.22 percent for value added for sectors with the lowest and the highest tradability values. That is, for value added the negative effect of *not* being an EU member gets more pronounced as the tradability of sectors increases, lowering value added by 0.05 percent.

The effect of EU membership on employment level strongly depends on the sectoral degree of tradability and on the level of forward and backward integration of the industry (see columns (2) and (3)). Looking at the joint effect of membership status and tradability, the coefficient for the interaction effects (no EU Member * ln (tradability)) shows that for employment the insignificant effect of a country not being an EU member is turned positive as the tradability of a sector increases (see column (2)). For each percentage difference in tradability between two sectors employment increases by approx. 0.05 percent. However, assuming the average sectoral levels of forward and backward integration, the total effect of not being an EU member on employment would be slightly negative: in comparison to EU members the difference is about -0.05 percent (see column 3). Looking at column (3) means in other words that the positive effect of backward integration on employment depends on the EU membership status, too, and is even slightly negative for non-EU members.

Overall, these results clearly hint at positive effects of Single Market integration with respect to becoming an EU member; across industries it boosts employment and value added in highly tradable industries. Moreover, trade or value chain integration into the Single Market primarily has a positive effect on industry level employment, too. This would indicate that the market integration process through the implementation of the Community Acquis and the removal of all barriers to trade in the Single Market that comes with EU accession positively affects industry employment and value creation.

That the legal stability that comes with the Single Market may be a principal source of value creation is supported by the results for the Rule of Law indicator, which captures the quality of the legal system and contract enforcement. This indicator has a positive and statistically significant effect on value added across all specifications (see columns (6) to (10). There are no statistically siginificant effects on employment, however.

Looking at other indicators capturing domestic institutional framework conditions, the findings show that financial intermediary development measured by the share of domestic credit to the private sector positively affects employment as well as value added. Labour market flexibility is statistically significant and negative across all model specifications for the value added regressions in Table 3.16. This indicates that higher labour market flexibility in a country negatively affects value creation. Again there are no statistically significant effects on employment.

While at a first glance this seems to contradict standard economic theory, which would postulate that more flexible labour markets have a positive effect on employment and value creation by allowing a more efficient (re-)allocation of labour in the economy, more recent contributions argue that high labour market flexibility creates adverse incentives for employees to accumulate company-specific human capital relative to more generic human capital (Bassanini and Ernst, 2002; Costinot, 2009b; Cuñat and Melitz, 2010; Tang, 2012). While the former process favours companies by boosting their productivity, the latter favours employees by ensuring better re-employability in the labour market. Thus, the consequence is a negative effect on value creation, which is what we observe in the regression results.

Eventually, looking at how the sophistication of the export portfolio of industries across countries affects industry level employment and value added, the results indicate that on the one hand a more sophisticated product portfolio has a negative effect on employment levels of industries which are highly forward integrated along the value chain within the EU (see column 5). This result hints at lower employment intensity and, respectively, high capital intensity related to industries characterized by highly sophisticated product portfolios. On the other hand, column (10) reveals a negative effect of more sophisticated product portfolios on value added for industries which are highly backward integrated. This is somewhat surprising and requires further investigation in future research projects.

3.2.3. The effect of domestic institutions and Single Market integration on industry employment and value added

To examine the interdependencies of Single Market integration and the domestic institutional framework and its effects on industry-level performance in more detail Table 3.17 presents regressions including interaction terms of the two main Single Market integration measures and the three institutional framework indicators. The first two columns represent regressions of the natural logarithm of employment on interactions of market integration measures with institutional framework indicators; the last two columns show regressions using value added as dependent variable. All regressions contain time as well as industry-country specific effects.

Looking at column (1) of Table 3.17 there is a positive effect of backward integration on employment that strongly depends on the quality of the national legal system as well as on the level of labour market flexibility. Assuming sample means of the rule of law and the labour market flexibility indicator, the overall effect of backward integration on employment is slightly positive (0.05 percent). The higher the national institutional quality and the more flexible the labour market is, the higher is the impact of backward integration on employment. Assuming the maximum observed levels of the rule of law (ROL) and labour market flexibility (LMF) indicators, a one percent increase in backward integration would result in an increase in employment of 0.24 percent. In contrast, at very low values of Rule of Law and labour market flexibility, the effect of backward integration on employment is even negative. Assuming the observed minimum levels of the Rule of Law and labour market flexibility indicators in the sample leads to a decrease in employment of approx. 0.3 percent as a result of a one percent increase in backward integration.

However, that the effect of backward integration on employment turns negative is only likely in the case of very low levels of legal quality and contract enforcement. Keeping the level of labour market flexibility constant at the sample mean, the effect of a one percentage change of backward integration on employment ranges between -0.14 and 0.15 percent depending on whether the observed minimum or the observed maximum of the rule of law indicator is used respectively. On the other hand, keeping the level of legal quality constant at the sample mean and varying only the level of labour market flexibility changes the effect of backward integration only within the positive interval of 0.1 (minimum LMF) and 0.05 (maximum LMF) percent.

The effect of forward integration on employment varies with the level of labour market flexibility, although one can always observe a positive overall effect of forward integration on employment within the range of the observed values of labour market flexibility. Depending on the observed range of labour market flexibility, the effect varies between approx. 0.4 (max. level of labour market flexibility) and 0.6 percent (min. level of labour market flexibility). That is, the more regulated a labour market is, the stronger is the positive effect of forward integration on employment. Assuming an average level of labour market flexibility, a one percent increase in forward integration boosts employment by about 0.5 percent.

Column (3) in Table 3.17 shows the joint effects of national institutions and trade-related Single Market integration on sectoral value added. The isolated effect of forward integration on value added, i.e. its effect when the regulation indicators with which is interacted are zero, is statistically not different from zero. In linear combination with the indicator for the rule of law it turns however positive. That is, the national quality of institutions becomes an important factor of trade-related Single Market integration, as high quality levels of national contract enforcement and property rights ensure also that the benefits of integration can be translated into higher value creation. Every percentage point increase in the the Rule of Law index increases the impact of forward integration by 0.36 percent. The opposite can be observed for labour market flexibility. Its negative impact on value creation increases the higher the forward integration of a sector into the common market. The effect is in the order of 0.2 percentage points. Better access of private credit on the other hand has a positive impact on value creation, but this forward integration into EU markets does not seem to affect this. Backward integration does not show significants effects on value added in combination with any of the institutional indicators.

Differentiating the effect of becoming an EU member between institutional framework conditions, there is no significant combined effect on employment (see column 2 in Table 3.17), but rather on value added (see column 4 in Table 3.17). There is a positive and significant impact of financial intermediary development on value added for countries that are not EU members. In comparison to EU member countries a one percentage increase in the share of domestic credit to the private sector leads to a 0.12 percent increase of value added for non-EU members. This effect is driven by countries that were once outside the EU during the observation period (enlargement of the EU in 2004, Bulgaria and Romania in 2007 and Croatia in 2013). For these countries, higher shares of private credit might reflect better working financial systems which alleviate the negative effects of being outside the EU on value added. In general, the lack of significant effects of the national legal framework of Non-EU members could be based on the necessary institutional developments to gain the EU membership status that have been already prepared before the official nomination and are reflected in the national indicators of legal quality, labour market regulations and the use of external finance.

Table 3.17: Estimation results for institutional and Single Market effects on industry employment and value added

	(1)	(2)	(3)	(4)
Dependent Variables	ln(employment)		ln(VA)	
VARIABLES				
ln(backward integration)	-0.891***	0.159***	-0.407	0.063
	(0.005)	(0.000)	(0.368)	(0.428)
ln(forward integration)	0.838***	-0.004	0.156	0.006
	(0.000)	(0.925)	(0.362)	(0.855)
ln(ROL)	0.165	0.090	1.065***	0.790***
	(0.173)	(0.445)	(0.000)	(0.000)
ln(Labour Market Flexibility)	0.033	0.038	-0.118**	-0.079*
	(0.217)	(0.129)	(0.012)	(0.071)
ln(Private Credit)	0.017	0.012**	0.037***	0.007
	(0.111)	(0.036)	(0.009)	(0.256)
ln(Complexity)	-0.108**	-0.107**	-0.063	-0.062
	(0.047)	(0.048)	(0.264)	(0.276)
No EU member		-0.007		-0.330*
		(0.964)		(0.094)
ln(backward integration) * ln(ROL)	0.398**		-0.026	
	(0.017)		(0.922)	
ln(forward integration) * ln(ROL)	-0.235		0.358***	
	(0.165)		(0.010)	
ln(backward integration) * ln(Labour Market Flexibility)	0.243***		0.263	
	(0.008)		(0.157)	
ln(forward integration) * ln(Labour Market Flexibility)	-0.207***		-0.204*	
	(0.000)		(0.055)	
ln(backward integration) * ln(Private Credit)	0.028		0.024	
	(0.495)		(0.616)	
ln(forward integration) * ln(Private Credit)	-0.041		-0.042	
	(0.408)		(0.318)	
No EU member * ln(ROL)		-0.125		0.052
		(0.219)		(0.717)
No EU member * ln(Labour Market Flexibility)		0.015		-0.154*
		(0.761)		(0.068)
No EU member * ln(Private Credit)		0.022		0.115***
		(0.258)		(0.000)
Constant	3.272***	3.412***	19.596***	20.096***
	(0.000)	(0.000)	(0.000)	(0.000)
Sector * Country Dummies	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes
Observations	19,064	19,064	18,484	18,484
R-squared	0.038	0.030	0.129	0.142

Source: WIFO calculations.
Note: Cluster robust pval in parentheses: ***p<0.01, **p<0.05, *p<0.1.

3.2.4. Robustness and statistical caveats

Dynamic regressions

Due to the autoregressive nature of the competitiveness measures, the estimation results of a dynamic panel are also presented (Table 3.18). As an additional robustness check dynamic panel regressions have been implemented based on the LSDV estimator for unbalanced panels suggested by (Bruno, 2005). The key results regarding the effects of Single Market integration on employment and value added are robust with respect to the different model specifications. However, since several of the variables used show only little variation over time, some of these effects are to a certain extent filtered out by the inclusion of a lagged dependent variable and lose significance.

Columns (1) to (5) show the baseline specifications for employment and (6) to (10) for value added, where all regressions include country-industry specific as well as time-fixed effects. Considering that the lagged dependent variables aborb considerable amounts of variation in the regressions, in general the effects of backward integration on the three dependent variables show the same signs as before and remain significant. The impact of ROL on value added is no longer significant in most specifications while the coefficient for private credit remains significant in the value added but not the employment regression.

Table 3.18: Estimation results for the dynamic baseline model on sector employment and value added

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent Variable	ln(employment)					ln(VA)				
VARIABLES										
ln(employment) $_{(t-1)}$	0.887***	0.890***	0.886***	0.888***	0.887***					
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)					
ln(VA)$_{(t-1)}$						0.893***	0.904***	0.898***	0.900***	0.893***
						(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(forward integration)	-0.002		-0.001		0.004	0.020		0.001		-0.005
	(0.313)		(0.371)		(0.307)	(0.289)		(0.925)		(0.834)
ln(backward integration)	0.006**		0.004**		0.010**	0.049*		0.029*		0.102***
	(0.022)		(0.028)		(0.028)	(0.076)		(0.074)		(0.000)
ln(backward integration) * ln(tradability)	0.001					0.019				
	(0.418)					(0.198)				
ln(forward integration) * ln(tradability)	-0.001					0.008				
	(0.381)					(0.352)				
ln(ROL)	0.011	0.002	-0.002	0.015	0.012	0.026	0.031	0.033	0.029	0.033
	(0.701)	(0.940)	(0.959)	(0.590)	(0.673)	(0.538)	(0.443)	(0.416)	(0.483)	(0.436)
ln(Labour Market Flexibility)	-0.013	-0.017*	-0.014	-0.016*	-0.013	0.011	0.013	0.013	0.012	0.010
	(0.115)	(0.053)	(0.124)	(0.060)	(0.124)	(0.401)	(0.305)	(0.331)	(0.375)	(0.456)
ln(Private Credit)	0.001	0.000	-0.000	0.001	0.001	0.009***	0.010***	0.009***	0.010***	0.009***
	(0.774)	(0.915)	(0.991)	(0.729)	(0.786)	(0.007)	(0.003)	(0.007)	(0.003)	(0.007)
ln(Complexity)	-0.018	-0.018	-0.018	-0.018	-0.030**	-0.033	-0.030	-0.032	-0.031	-0.050**
	(0.167)	(0.170)	(0.160)	(0.164)	(0.042)	(0.122)	(0.161)	(0.134)	(0.150)	(0.019)
No EU member		-0.003	-0.003				0.011	0.007		
		(0.717)	(0.593)				(0.296)	(0.222)		
No EU member * ln(tradability)		0.005					0.003			
		(0.255)					(0.652)			
ln(forward integration) * No EU member			0.004					0.008		
			(0.190)					(0.564)		
ln(backward integration) * No EU member			-0.000					-0.012		
			(0.969)					(0.515)		
ln(Export integration)				0.001					-0.001	
				(0.704)					(0.724)	
ln(Import integration)				0.005					-0.002	
				(0.229)					(0.773)	
ln(Export integration) * ln(tradability)				-0.000					-0.001	
				(0.856)					(0.611)	
ln(Import integration) * ln(tradability)				0.001					0.001	
				(0.429)					(0.725)	
ln(backward integration) * ln(complexity)					-0.005					-0.104***
					(0.220)					(0.001)
ln(forward integration) * ln(complexity)					-0.005					0.010
					(0.245)					(0.675)
Sector*Country Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17,505	17,505	17,505	17,505	17,505	17,219	17,219	17,219	17,219	17,219

Source: WIFO calculations.
Note: Cluster robust pval in parentheses: ***$p<0.01$, **$p<0.05$, *$p<0.1$.

Regressions with country- and time fixed effects

Table 3.44 in Appendix 3.8.3 presents regression results from different specifications where country and time dummies have been used to control for unobserved heterogeneity (two-way fixed effect regression framework). These regressions are presented to document the joint impact of tradability and Single Market integration on industry level value added and employment. As the tradability indicator is a sector-specific indicator that does not vary over time, sector dummies were not included in this set up. Hence, these regressions potentially suffer from an omitted variable bias at the industry level. However, the regressions include an indicator for the complexity or sophistication of the product portfolio of the industries. A close examination of this indicator in Reinstaller et al. (2012) has shown that it closely correlates with important indicators on the knowledge and capital intensity (e.g. R&D expenditures, revealed human capital and capital intensity, FDI inflows etc.). So, in models (1) through (5) this indicator captures most of the unobserved heterogeneity at the sector level. This implies that it cannot be interpreted directly in this context. In addition, because the descriptive statistics indicate that outliers in the dependent variables are an issue in these regressions, an outlier robust M-estimator has been used (Huber 1973). For these limitations, these models will only be used to discuss the impact of tradability on industry level value added and employment, and are basically presented as an additional robustness check.

Column (1), (6) and (11) of Table 3.44 in Appendix 3.8.3 show that higher tradability goes along with lower employment and value added. The results indicate that a ten percent difference in the tradability between two sectors goes along with employment being lower by 3.7 to 7 percent and valued being lower by approximately 0.6 percent depending on the specification and keeping all else equal. This is in line with the expectations. More open sectors are also more productive and this is reflected in lower employment levels of open sectors relative to less open ones. This outcome is to some large part driven by differences between the manufacturing and service sectors. The former produce generally tradable goods and experience more significant productivity increases, whereas a large part of services is not directly traded and productivity improvement tends also to be slower in services.

3.2.5.Summary of the results for levels of value added and employment

The focus of this section is on the impact of Single Market integration and economic institutions on employment and value added. It explored various channels through which market integration interacts with national policies to jointly affect these competitiveness measures. An important and robust finding of this section is that EU accession and membership increases employment and value added at the industry level. Forward and backward integration into Single Market value chains positively affect industry level employment. Additionally, a positive effect of forward integration on value added is observed. The effect of backward integration on value added is not significantly different from zero, although the coefficient is positive.

The effects generally tend to increase with the tradability of the industries, which clearly suggests that the effects of market integration get transmitted into the Member States economies through sectors with high tradability. If the value added share of sectors with high tradability drops because of major macro-economic shocks as suggested in earlier sections, then also the economic effects of Single Market integration on Member States' economies are weakened. In other words, the effects of the Single Market on employment and value added are pro-cyclical.

In addition, the extent of the positive effect of market integration – especially on employment – is strongly driven by the quality of institutions, especially with respect to a sound and impartial legal system and labour market regulation. This stresses the importance of a high institutional quality at the Member State level, which moderate the effects of integration into the Single Market.

3.3. The Single Market and long run productivity and employment growth

To complement the previous analysis of productivity levels, this chapter will link the productivity growth indicators obtained from the shift-share analysis (see performance diagnostics analysis in Chapter 2) to a set of trade-based measures for the Single Market (see Chapter 0). Corresponding to the analysis of productivity and employment levels in Chapter 3.2, this section also draws on trade literature discussing institutional aspects and uses a variety of country-level indicators were defined. Next, the estimation technique is described; then data and indicators are presented. The results section precedes the conclusion chapter.

3.3.1. Estimation strategy

A well-established identification method will be implemented (Rajan and Zingales, 1998; Ciccone and Papaioannou, 2007, 2009) to estimate the effect of these dimensions on the Single Market. The chosen estimator requires several conceptual channels through which the institutional aspects work. These comprise the previously described Single Market indicators capturing a set of backward integration and forward integration indicators. These measure the depth of EU market integration through international trade.

Since productivity increases are observable at the country-sector level and performance is measured at the sector level, the question arises how to causally identify factors at the country level. This report implements a method which aims at overcoming identification issues by a quasi-difference-in-difference estimator originally proposed for financial markets (Rajan and Zingales, 1998), and later applied to similar questions regarding industrial performance indicators. These include entry and bureaucratic burden (Ciccone and Papaioannou, 2007) and firm growth and institutional and other macroeconomic aspects (Friesenbichler et al., 2014; Bravo-Biosca, Criscuolo, and Menon, 2016).[23]

The estimator uses both variance of country level indicators and cross-industry variation in the participation in the Single Market. Using industry-level information relies on the thought that not all industries benefit to the same extent from the Single Market. As a result, pro-Single Market policies have a different impact on different industries. For instance, industries which are embedded in international value chains are likely to perform better in an environment where the general governance is more effective and provides low transaction costs for international trade. Hence, low transaction costs are likely to facilitate participation in the Single Market. In other words, if participation in the Single Market is more relevant to an industry's growth potential, good institutional quality is expected to be more relevant to that industry's performance.

[23] Rajan and Zingales (1998) originally used this identification scheme to identify the impact of financial market development on industry growth and entry by using external financial dependence as the industry-level variable. The United States were used as benchmark country. The idea behind this estimation strategy was that financial development should have a stronger impact on industry development and entry in industries that have a higher external financial dependence. The USA was used as the benchmark country, because it was assumed to be the country with the highest financial development. The benchmark was then excluded from the sample.

The key element of the method is the identification of a conceptual link between industry-level indicators which moderates country-level indicators to jointly affect productivity growth. This study will use market integration variables to moderate the impact of institutional characteristics across otherwise heterogeneous industries. This mutual effect is expected to affect the productivity growth performance industries. The basic equation is

(Eq. 3-3) $G_{i,j} = \alpha + \beta\ (INST_i \times IND_{j,bk}) + \mu_j + \mu_i + \varepsilon_{j,i}$

G denotes a growth indicator, which either takes the form of the within productivity growth, the structural change productivity growth contribution obtained from the shift-share analysis, or employment growth. INST denotes a country-level, institutional indicator, and IND is an industry-level measure of the selected benchmark countries posing a conceptual channel through which the institutional variables affect the growth indicator. These include the tradability index as well as market integration indices. j indexes industries and *i* countries; μ_j and μ_i are industry and country specific effects, respectively, and $\varepsilon_{j,i}$ is an i.i.d. error term. The industry characteristics (i.e. the market integration indicator) used is for a benchmark country (or group of countries), which is then excluded from the analysis. These are thought to provide a proxy for a largely frictionless (or least inefficient) economy, which is therefore integrated into the Single Market to an optimal degree. The distribution of the market integration indicators seems to be remarkably stable over time, especially if the measures are expressed as shares (see Appendix of Chapter 2).

This study relies only on the cross-section, which is in line with the philosophy of the estimator implemented, which was originally proposed by Rajan and Zingales (1998) to establish causality of country-level indicators by exploiting the variation across sectors. Sector and country specific unobserved factors are controlled for. The impact of an institutional, and therefore country level variable is estimated in the interaction term $INST_i \times IND_{i,bk}$. This coefficient is identified, because country and industry specific effects are included in the regression.

The estimated coefficient of interest is β. The interpretation of the estimated indicator is straightforward. It indicates whether industries that are more reliant on the Single Market benefit more from sound institutions that facilitate the Single Market. These industries will exhibit relatively higher productivity growth in countries with better institutions. The estimator minimises endogeneity issues regarding institutional quality and productivity. The feature of this methodology is that the interaction term allows inferring the causal effect of institutional quality on productivity growth, while controlling for observable factors that have been omitted from the regression equation, which might however be potentially correlated with national policy characteristics (Bravo-Biosca et al., 2013).

The method proposed by Rajan and Zingales (1998) has been criticised, because it uses a benchmark country to construct a moderator variable. This may introduce bias. The chosen country may exhibit industry characteristics that are affected by other influences. For instance, productivity growth may reflect both global as well as country-specific demand and productivity shifts (Ciccone and Papaioannou, 2009, 2007). Ciccone and Papaioannou (2007) therefore introduced an instrumental variable estimation procedure that will be implemented in the present report. They propose instrumenting the benchmarking industry variable with another indicator, which is correlated with the global component of the benchmarking country's industry values, but is not correlated with the specific component of the benchmarking country. This should lead to an industry indicator that is "purged" from individual countries' effect (for a detailed discussion of the estimator see Ciccone and Papaioannou, 2009, 2007).

This two-step approach is implemented to estimate industry indicators that reflect industry characteristics in a (hypothetical) country facing representative demand, technology and policy shocks. The first step computes the least squares prediction for the industry indicators (IND) based on a regression on country and industry-specific effects, as well as the interaction of the respective country-level institutional indicator with industry effects. This prediction is given by (Eq. 3-3). The benchmarking countries are not used in this estimation to assure that the predictions do not capture specific effects of the benchmark-country. In the second step, the IV is generated by predicting the industry-specific indicators for the averaged values of the benchmark countries. This variable is equal to the estimated industry fixed effect plus the benchmarking country value of the institutional quality variable multiplied by its industry-specific coefficient.

This study selected the average integration structures of Denmark and Sweden as a benchmark. Either country performs well in terms of institutional quality in the bulk of indicators analysed. Using more than one country as a benchmark possible reduces upward and downward bias. This can also be reflected against the criticism articulated by Ciccone and Papaioannou regarding a possible estimation bias that is due to country-specific determinants. Such a bias is particularly large when only a single country is used as a benchmark (Rajan and Zingales, 1998 and Ciccone and Papaioannou, 2007).

For instance, the backward integration indicator of the sector "C Manufacturing" exhibits a sample mean of 12%. Austria's value is 41%, whereas Bulgaria's backward integration value is even negative at -14%, which means that Bulgaria's industries source more from non-EU countries than from EU-countries, perhaps due to its geographic position. Hence, there are differences due to country specific effects. The variation coefficient (i.e. the variance as a percentage of the mean) is 14% in the manufacturing sector. This potential bias is reduced by the idea that the averages of more than one benchmark countries provide a proxy for a largely frictionless (or least inefficient) economy. This implies that the 'good-practice' economy faces average sectoral demand and technology shifts that are not affected by the specific national configuration and policies.

The industry characteristics of these benchmark countries will be used to identify the impact of institutional quality on productivity growth. A series of market integration indicators will serve as channels through which the impact of institutional quality on productivity growth can be identified. The idea is straightforward: Industries with higher degrees of market integration in countries with better institutions contribute more to productivity growth.

3.3.2.Data and indicators

This section draws on data that was generated in the earlier chapters. To remain concise, it will refrain from providing an extensive discussion, and only briefly sketch the indicators used in the previously described estimation technique.

The joint effect of institutions and trade integration are estimated on three dependent variables. The first is the within sector productivity growth contribution. The second is the growth contribution of structural change, which is defined as the sum of the between sector contribution and the interaction effect. Both indicators stem from the shift-share analysis which was performed in the performance diagnostics section (see Chapter 2). In addition, employment growth was used as a third indicator. The growth indicators cover the years 2000 to 2014, and therefore reflect the average sectoral performance over a full business cycle.

The present analysis focuses on the effect of institution. In this respect, the previously used three dimensions are again used. These are (i) the overall governance quality, (ii) use of external finance and (iii) labour market flexibility (Chor, 2010). Over and above these policy aspects, Eurostat data on output gaps are used to capture business cycle effects. The output gap is defined as the deviation of real economic activity from its potential. The output gap can be positive or negative. A negative output gap means that the actual output is less than its potential output, which is also called a deflationary or recessionary gap. In this situation, the economy is producing less than its potential. A positive output gap occurs when actual output is greater than potential output. This will occur when economic growth is above the long run trend rate, e.g. during an economic boom (Jarocinski and Lenza, 2015). The output gap changes over the period analysed. For instance, the output gap (actual GDP minus trend GDP) was positive in Greece in the pre-crisis period, and turned strongly negative in the post crisis period.

Table 3.19: shows the descriptive statistics of both outcome and institutional variables. The arithmetic mean of the within productivity growth measure is at two percent, ranging from minus thirteen to plus thirty percent. The structural change effect – defined as the sum of the between-effect and the interaction term of the shift-share analysis – exhibits a similar range. The same holds for the institutional indicators.

Table 3.19: Productivity increases and Institutional indicators, descriptive statistics

	Within Prod. growth in (p.p.)	**Str. change prod. growth (in p.p.)**	**Hrs. Worked growth (in p.p.)**	**Gov. Eff.**	**Rule of Law**	**Fraser Lab. Market Regulation**	**Bank credit to Private Sector (% of GDP)**	**Stock market cap. (% of GDP)**	**Output gap (trend)**
Mean	1.63	0.13	14.12	1.21	1.14	5.95	89.44	58.44	0.32
Std. Dev.	4.66	4.08	45.91	0.64	0.62	0.92	43.84	41.73	0.35
Min.	-13.28	-25.82	-62.33	-0.25	-0.13	4.27	26.04	4.58	-0.20
Max.	30.40	18.65	415.87	2.16	1.96	8.09	193.21	152.98	1.31

Source: Eurostat, Worldwide Governance Indicators, Fraser Institute, World Development Indicators, WIFO calculations.

Eventually, a series of conceptual, trade-related channels is defined. It is argued that through these sectoral channels each institutional indicator – measured at the country level - takes effect. Each indicator is computed with WIOD data. Notably, only the values for the benchmarking countries are used by the estimator.

The first channel is the general tradability at the sector level (see Appendix of Chapter 2). This forward linkage indicator captures whether a sector's goods and services are on average traded across all EU Member States for the entire period. Hence it can be interpreted as a forward linkage based precondition of market participation.

The second set of indicators refers to its backward orientation. The backward integration indicator is the difference between the value added share of imported intermediate goods along the value chain from EU member countries and from non-EU countries. The larger the difference, i.e. the higher the backward integration indicator, the more foreign intermediates are obtained from countries within the EU in relation to non-EU countries. The measure disregards the level of international sourcing of a specific sector. Hence two additional indicators are used which capture the share of a sector's imports of intermediary goods along the value chain from other EU member states (Backward EU) and non-EU countries (Backward Non-EU) in the industry's total value added. These are used to validate the market integration indicator with regard to backward linkages.

A third set of forward integration indicators is defined in an analogous way. It is calculated as the difference between the value added share of exported goods used as intermediaries along the value chain within the EU and to countries outside the EU. If an industry's demand for intermediate goods occurs rather in EU Member States than in non-EU countries, it is found to be positive. To capture the levels of demand for intermediaries from outside the respective country, both the value added share in intermediate goods of other EU-countries (Forward, EU) as well as non-EU countries (Forward, Non-EU) is used (see Table 3.20).

Table 3.20: Sectoral tradability and trade based integration indicators, descriptive statistics

	Tradability	Backward integration	Backward EU	Backward Non-EU	Forward Integration	Forward, EU	Forward, Non-EU
Mean	0.24	0.07	0.09	0.08	0.00	0.14	0.13
Std. Dev.	0.18	0.19	0.06	0.05	0.21	0.13	0.11
Min.	0.01	-0.64	0.01	0.01	-0.59	0.00	0.00
Max.	0.63	0.48	0.38	0.34	0.61	0.63	0.69

Source: WIOD Release 2016, WIFO calculations.
Note: These descriptive statistics describe the entire sample.

3.3.3.Results

This section describes the results of the estimation method implemented to study gains in labour productivity. Hence, the interplay of the Single Market with institutional indicators is linked to the productivity increases. Gains in labour productivity stem from within and structural effects, and are obtained from the shift-share analysis. The increases in the hours worked are used as an additional outcome variable to validate the results from the productivity increases.

Each section elaborates on the average indicator of the institutional characteristic, and uses Sweden and Denmark as benchmark economies. The choice of benchmark countries is motivated by high values of the measures of institutional quality, high levels of per capita income, and rather strongly integrated markets. The Single Market indicators serve as conceptual channels, and results for all seven possible channels are provided. The coefficient in question is the interaction term, whose sign may change according to the indicator chosen. The expected sign of institutional channel is discussed separately in each section. The descriptive statistics reveal great variance of these indicators across the sample. The estimator controls for country-industry specific biases, and is therefore robust to the country composition. In other words, this result holds for all EU Member States.

The first indicator analysed is government effectiveness, a general measure of the quality of public services, the institutional quality and the availability of infrastructure. The indicator shows great variance across Europe, with the Scandinavian and Benelux countries exhibiting the highest values. The lowest values are found in Romania, Bulgaria, Italy and Greece. The expected sign of the relevant interaction term is positive. In other words, industries with a higher degree of market integration benefit more from good governance, which leads to lower transaction costs which facilitate productivity increases.

The results indicate a positive effect of good governance on within-industry productivity increases. Almost all channels show significant results. Backward integration shows stronger results than forward integration. A particularly meaningful channel seems to be the value added share of inputs sourced from other EU countries, as well as backward market integration indicator. As to the forward linkages, the results indicate that out-of-EU consumption is more important for within-industry productivity growth than consumption in other EU Member States. In other words, the share of VA being consumed out of the EU seem to be slightly stronger, which is also reflected in statistically insignificant results for the forward-linkages based market integration indicator.

The signs for the structural change effect are negative throughout all specification. This means that in countries with better governance the more integrated industries make negative contributions due to structural change to labour productivity. This reflects the unfavourable structural change pattern of the EU, where good institutions and trade openness led to a negative productivity growth contribution to structural change.

The results for increases in the hours worked are mixed and not robust. If countries with a good governance system use more imports from non-EU countries, they show a negative effect on the hours worked. However, this is not confirmed by the other channels of backward linkages, which use the levels. There is a slightly positive effect for the forward market integration indicator. Better governance and more demand from within the EU than non-EU countries weakly facilitate the growth rate of hours worked. Again, this is not validated by the level indicators.

Overall, these findings suggest that good governance and well-integrated markets favours productivity increases in established structures, but rather impedes productivity increases due to structural change. This is an indication of path dependency. The results for hours worked are not sufficiently robust to allow for an interpretation.

Table 3.21: Estimation results for Government Effectiveness

Within	(1)	(2)	(3)	(4)	(5)	(6)	(7)
IND	Tradability	BW integr.	BW, EU	BW, non-EU	FW integr.	FW, EU	FW, non-EU
IND*INST	0.0466**	0.0877***	0.3160***	0.2948*	-0.0280	0.0654**	0.0771***
	(0.020)	(0.028)	(0.112)	(0.160)	(0.021)	(0.030)	(0.027)
Constant	-0.0079	-0.0165**	-0.0368**	-0.0260	-0.0025	-0.0052	-0.0089
	(0.007)	(0.008)	(0.015)	(0.017)	(0.007)	(0.006)	(0.006)
Observations	414	414	414	414	414	414	414
R-squared	0.568	0.567	0.571	0.551	0.556	0.559	0.564

Str. change	(1)	(2)	(3)	(4)	(5)	(6)	(7)
IND*INST	-0.0684***	-0.0714***	-0.5259***	-0.6358***	-0.0206	-0.0995***	-0.0953***
	(0.018)	(0.026)	(0.089)	(0.139)	(0.016)	(0.027)	(0.024)
Constant	0.0268***	0.0266***	0.0771***	0.0735***	0.0063	0.0234***	0.0255***
	(0.006)	(0.007)	(0.012)	(0.015)	(0.005)	(0.005)	(0.005)
Observations	414	414	414	414	414	414	414
R-squared	0.575	0.547	0.599	0.528	0.536	0.563	0.567

Emp. Gr.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
IND*INST	-0.0658	-0.7060***	0.8564	2.6034*	0.3637**	-0.0778	-0.2781
	(0.157)	(0.219)	(0.787)	-1327	(0.179)	(0.250)	(0.277)
Constant	0.1962***	0.3396***	0.0721	-0.0774	0.2544***	0.1906***	0.2243***
	(0.052)	(0.066)	(0.113)	(0.143)	(0.053)	(0.049)	(0.055)
Observations	414	414	414	414	414	414	414
R-squared	0.472	0.466	0.467	0.448	0.469	0.471	0.471

Source: WIFO calculations.
Note: Robust standard errors in parentheses; Significance levels: ***p<0.01, **p<0.05, *p<0.1.

The second public administration indicator analysed is the Rule of Law, quantifying perceptions of the extent to which agents have confidence in and abide by the rules of society. This concerns the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. This indicator complements the previous aspect of the general quality of the public administration and infrastructure availability. The lowest values are found in Romania, Bulgaria, Slovakia and Italy. The highest values of the Rule of Law index are found in Finland, Denmark, Sweden and Austria.

Again, the expected sign of the relevant interaction term is positive. Industries which are better integrated into the common market are thought to benefit more from a better legal system. This interaction should lead to greater productivity gains.

The results are qualitatively the same as for the previous indicator. This is, in countries with higher rule of law scores better integrated industries exhibit larger within-industry productivity gains. This is especially pronounced for the channels general tradability, backward market integration and the VA share of inputs sourced from other EU Member States. The results for forward integration are slightly weaker. A relatively strong effect was found for forward integration to non-EU countries. In other words, within-industry productivity increases were stronger in countries with a sound legal system and industries whose final demand is outside of the EU. This indicates the importance of a legal system for industries partaking in global value chains.

At the same time the coefficients for structural change are negative. The contributions to productivity gains from a change in the sector composition are negative in countries with a better legal system and industries that are better integrated. This can be interpreted as a validation of the previously attested unfavourable structural change pattern. Productivity gains from structural change came from nontradable goods and services. The conceptual channels consider both tradability as a general industrial property and effective market integration using backward and forward linkages. This seems to be independent from institutional aspects such as the overall governance effectiveness or the rule of law.

Again, the results for the growth in hours worked are largely statistically insignificant and not robust.

Table 3.22: Estimation results for Rule of Law

Within	(1)	(2)	(3)	(4)	(5)	(6)	(7)
IND	Tradability	BW integr.	BW, EU	BW, non-EU	FW integr.	FW, EU	FW, non-EU
IND*INST	0.0430**	0.0831***	0.2896**	0.2602	-0.0343	0.0601*	0.0770***
	(0.021)	(0.028)	(0.122)	(0.167)	(0.022)	(0.031)	(0.028)
Constant	-0.0084	-0.0159**	-0.0361**	-0.0247	-0.0041	-0.0058	-0.0108
	(0.007)	(0.008)	(0.017)	(0.018)	(0.007)	(0.006)	(0.007)
Observations	414	414	414	414	414	414	414
R-squared	0.565	0.564	0.567	0.552	0.556	0.558	0.562
Str. change	(1)	(2)	(3)	(4)	(5)	(6)	(7)
IND*INST	-0.0667***	-0.0717***	-0.5163***	-0.6251***	-0.0171	-0.0977***	-0.0978***
	(0.017)	(0.026)	(0.092)	(0.139)	(0.017)	(0.027)	(0.024)
Constant	0.0286***	0.0271***	0.0807***	0.0775***	0.0068	0.0252***	0.0283***
	(0.006)	(0.007)	(0.013)	(0.016)	(0.005)	(0.006)	(0.006)
Observations	414	414	414	414	414	414	414
R-squared	0.571	0.546	0.592	0.527	0.536	0.560	0.563
Emp. Gr.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
IND*INST	-0.0643	-0.7127***	0.7077	2.4416*	0.3374*	-0.0650	-0.2641
	(0.150)	(0.227)	(0.782)	-1321	(0.189)	(0.234)	(0.245)
Constant	0.1979***	0.3449***	0.0843	-0.0812	0.2529***	0.1903***	0.2286***
	(0.054)	(0.068)	(0.119)	(0.152)	(0.056)	(0.051)	(0.056)
Observations	414	414	414	414	414	414	414
R-squared	0.472	0.467	0.468	0.452	0.470	0.472	0.471

Source: WIFO calculations.
Note: Robust standard errors in parentheses; Significance levels: ***p<0.01, **p<0.05, *p<0.1.

Another indicator analysed is the labour market regulation index provided by the Fraser Institute. The higher the index the freer the labour markets are. The index varies strongly across countries. The highest scores are observable in Denmark, the UK, Ireland, the Czech Republic, Slovakia and Bulgaria. The least free labour market regulations are identified in Greece, Germany, Finland and Cypress.

The expected sign of the interaction term is positive. Industries which are better integrated into the common market may benefit more from a freer labour marking, which leads to more productivity growth.

Linking free labour markets to tradability or to indicators of market integration to explain productivity growth did not lead to significant results. Neither the within-industry contributions nor the structural-change contributions to labour productivity growth were found to be statistically significant. The same holds for the growth of hours worked. This might be due to the nature of the indicator. It measures the degree of freedom of labour markets, whose directionality may be unclear. In addition, the indicator may react differently across the business cycle, and an averaging of the indicator to cover the full cycle may render results insignificant.

Table 3.23: Estimation results for the Fraser Labour Market Index

Within	(1)	(2)	(3)	(4)	(5)	(6)	(7)
IND	Tradability	BW integr.	BW, EU	BW, non-EU	FW integr.	FW, EU	FW, non-EU
IND*INST	0.0074	0.0314**	0.0853	0.0299	0.0028	0.0141	0.0116
	(0.013)	(0.015)	(0.080)	(0.095)	(0.016)	(0.021)	(0.017)
Constant	-0.0002	-0.0226*	-0.0279	-0.0049	0.0050	0.0004	0.0003
	(0.008)	(0.013)	(0.030)	(0.026)	(0.011)	(0.006)	(0.006)
Observations	414	414	414	414	414	414	414
R-squared	0.555	0.557	0.556	0.555	0.554	0.554	0.554
Str. change	(1)	(2)	(3)	(4)	(5)	(6)	(7)
IND*INST	-0.0049	0.0021	0.0204	0.0187	-0.0023	-0.0068	-0.0066
	(0.012)	(0.013)	(0.086)	(0.095)	(0.014)	(0.020)	(0.015)
Constant	0.0128*	0.0088	0.0031	0.0054	0.0090	0.0119**	0.0122**
	(0.007)	(0.011)	(0.032)	(0.026)	(0.009)	(0.005)	(0.005)
Observations	414	414	414	414	414	414	414
R-squared	0.537	0.537	0.537	0.537	0.537	0.537	0.537
Emp. Gr.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
IND*INST	0.0239	0.0683	0.4162	0.3277	0.0089	0.0413	0.0514
	(0.067)	(0.197)	(0.378)	(0.745)	(0.101)	(0.105)	(0.095)
Constant	0.1696***	0.1242	0.0286	0.0910	0.1862**	0.1723***	0.1676***
	(0.056)	(0.168)	(0.145)	(0.208)	(0.077)	(0.050)	(0.051)
Observations	414	414	414	414	414	414	414
R-squared	0.472	0.472	0.473	0.472	0.472	0.472	0.472

Source: WIFO calculations.
Note: Robust standard errors in parentheses; Significance levels: ***p<0.01, **p<0.05, *p<0.1.

The next indicator analysed is the availability of financial capital via the capital market. The indicator used is market capitalisation, expressed as a share of GDP. The market capitalisation varies strongly across countries, with Scandinavian countries, the UK, Luxemburg, Spain, France and the Netherlands leading. The lowest degrees of market capitalisation are reported for Slovakia, Romania, Bulgaria and the Czech Republic.

The expected sign of the interaction term is positive. Industries which are better integrated into the common market are thought to benefit more from the availability of equity through financial markets. This may jointly lead to more productivity growth.

The results for within-productivity growth and the growth of hours worked are statistically insignificant. However, there is some evidence that higher degrees of market capitalisation interact negatively with market integration on productivity growth from structural change. Industries that are better integrated in countries with deeper financial markets make a negative contribution to productivity growth that stems from their change in relevance in the sector composition.

Given that much of the structural change related productivity growth comes from nontradables, this could indicate that the selection function of stock markets focuses on tradables. The more prominent stock markets become in the financing system, the less nontradables benefit. This result holds for tradability as a property, the levels of the VA share that is sourced from EU and non-EU countries, and the VA shares that are consumed by other EU and non-EU countries. The results for the market integration indicators (i.e. EU-surplus in backward and forward linkages as opposed to non-EU countries) are insignificant, indicating this to be a general feature of stock markets that does not distinguish by geographic origin.

Table 3.24: Estimation results for Market Capitalisation in percent of GDP

Within	(1)	(2)	(3)	(4)	(5)	(6)	(7)
IND	Tradability	BW integr.	BW, EU	BW, non-EU	FW integr.	FW, EU	FW, non-EU
IND*INST	0.0002	0.0004	0.0013	0.0005	-0.0007	0.0004	0.0007
	(0.000)	(0.000)	(0.002)	(0.003)	(0.000)	(0.001)	(0.000)
Constant	0.0037	0.0009	0.0017	0.0028	0.0010	0.0039	0.0049
	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)
Observations	360	360	360	360	360	360	360
R-squared	0.557	0.555	0.555	0.556	0.559	0.555	0.556
Str. change	(1)	(2)	(3)	(4)	(5)	(6)	(7)
IND*INST	-0.0010***	-0.0003	-0.0072***	-0.0084***	-0.0004	-0.0016***	-0.0015***
	(0.000)	(0.000)	(0.001)	(0.002)	(0.000)	(0.000)	(0.000)
Constant	0.0085**	0.0125***	0.0191***	0.0163***	0.0100***	0.0074**	0.0072*
	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Observations	360	360	360	360	360	360	360
R-squared	0.608	0.578	0.619	0.570	0.575	0.598	0.597
Emp. Gr.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
IND*INST	-0.0017	-0.0071*	-0.0086	0.0051	0.0001	-0.0031	-0.0035
	(0.002)	(0.004)	(0.009)	(0.017)	(0.004)	(0.003)	(0.003)
Constant	0.1794***	0.2214***	0.1930***	0.1802***	0.1838***	0.1763***	0.1744***
	(0.039)	(0.045)	(0.040)	(0.041)	(0.040)	(0.039)	(0.039)
Observations	360	360	360	360	360	360	360
R-squared	0.496	0.492	0.498	0.492	0.495	0.495	0.496

Source: WIFO calculations.
Note: Robust standard errors in parentheses; Significance levels: ***p<0.01, **p<0.05, *p<0.1.

The next indicator analysed is credit made available to the private sector by banks. The indicator is expressed as a fraction of GDP. The highest values are observable in the UK, Ireland, Belgium, the Netherlands, Denmark, Spain and Portugal. The lowest values are found in Romania, Latvia, Czech Republic and Slovakia.

Since the bank credit indicator is also an access to finance measure, the same logic applies as before. The expected sign of the interaction term is positive. Industries which are better integrated into the common market are thought to benefit more from the availability of equity through financial markets. This may jointly lead to more productivity growth.

The results obtained for the bank credit indicator are qualitatively comparable with the results for market capitalisation. The within-productivity growth and the growth of hours worked are – by and large – statistically insignificant. There is again some evidence that deeper capital markets that offer more bank credit interact negatively with market integration on productivity growth from structural change. This link seems particularly robust for the importance of backward linkages, be they from within or outside the EU. In other words, industries that source more inputs internationally in countries with deeper capital markets exhibit a negative productivity growth distribution from changes in the sector composition. Again, a possible explanation for this might be the combination of the selection of lenders, who perhaps favoured tradable sectors and the unfavourable structural change pattern, which largely went into nontradable sectors.

Table 3.25: Estimation results for bank credit to the private sector in percent of GDP

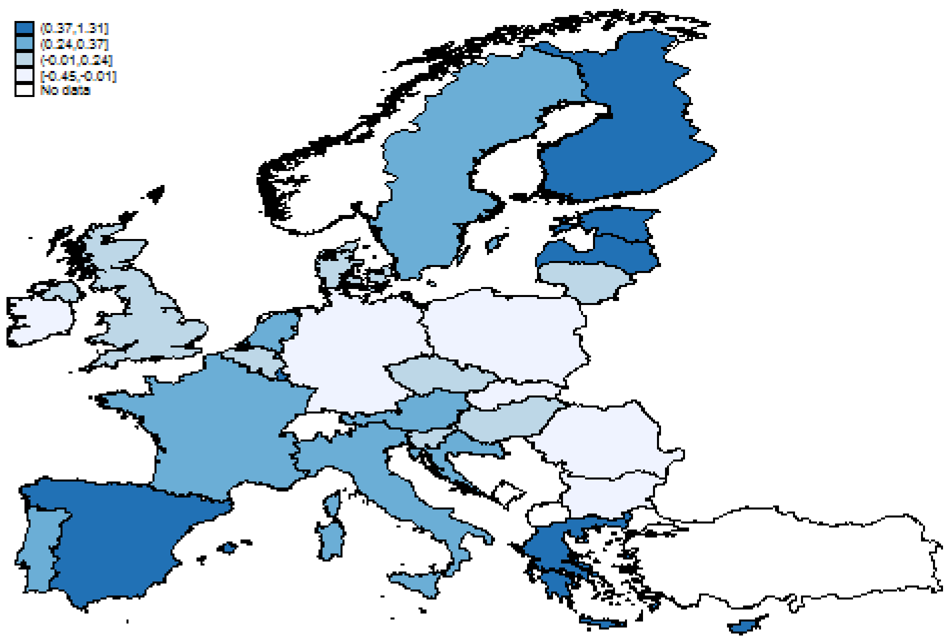
Within	(1)	(2)	(3)	(4)	(5)	(6)	(7)
IND	Tradability	BW integr.	BW, EU	BW, non-EU	FW integr.	FW, EU	FW, non-EU
IND*INST	-0.0001	0.0009**	-0.0002	-0.0022	-0.0007**	-0.0002	0.0001
	(0.000)	(0.000)	(0.002)	(0.002)	(0.000)	(0.000)	(0.000)
Constant	0.0045	-0.0081	0.0045	0.0131	-0.0044	0.0040	0.0027
	(0.006)	(0.007)	(0.014)	(0.012)	(0.006)	(0.005)	(0.005)
Observations	414	414	414	414	414	414	414
R-squared	0.555	0.555	0.554	0.550	0.561	0.556	0.554
Str. change	(1)	(2)	(3)	(4)	(5)	(6)	(7)
IND*INST	-0.0006**	-0.0004	-0.0056***	-0.0053***	-0.0001	-0.0009**	-0.0007**
	(0.000)	(0.000)	(0.002)	(0.002)	(0.000)	(0.000)	(0.000)
Constant	0.0156***	0.0153***	0.0442***	0.0346***	0.0094**	0.0139***	0.0142***
	(0.004)	(0.005)	(0.011)	(0.009)	(0.004)	(0.004)	(0.003)
Observations	414	414	414	414	414	414	414
R-squared	0.552	0.541	0.585	0.558	0.536	0.547	0.550
Emp. Gr.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
IND*INST	-0.0014	-0.0160***	-0.0054	0.0345*	0.0038	-0.0035	-0.0054
	(0.002)	(0.004)	(0.008)	(0.019)	(0.002)	(0.004)	(0.004)
Constant	0.1918***	0.3882***	0.2129***	0.0233	0.2202***	0.1943***	0.2065***
	(0.044)	(0.064)	(0.066)	(0.099)	(0.050)	(0.043)	(0.044)
Observations	414	414	414	414	414	414	414
R-squared	0.472	0.463	0.474	0.447	0.473	0.470	0.470

Source: WIFO calculations.
Note: Robust standard errors in parentheses; Significance levels: ***p<0.01, **p<0.05, *p<0.1.

Eventually, an indicator measuring the demand side is used – the output gap. As described above, a negative output gap means that the actual output is less than potential output. The economy is producing less than its potential. A positive output gap occurs when actual output is greater than potential output. This will occur when economic growth is above the long-run trend rate. The highest average output gaps across the entire business cycle are observable in Estonia, Cypress, France and the Czech Republic. The lowest values are in Greece, the Netherlands, Spain and Latvia.

Since labour productivity growth is lower in recessions (Saint-Paul, 1993; Cette, Fernald, and Mojon, 2016), one would expect a positive sign of the interaction term. The more integrated industries are in economies that are booming the higher productivity growth should become. The findings from the regression analysis are largely statistically insignificant and not robust. This might be due to the averaging of the results.

Figure 3.23: Output gap (trend potential) across the EU (mean of 2000-2014)



Source: Eurostat, WIFO calculations.
Note: The graph illustrates mean output gap using a trend potential GDP across the EU for the period 2000-2014.

Table 3.26: Estimation results for the output gap

Within	(1)	(2)	(3)	(4)	(5)	(6)	(7)
IND	Tradability	BW integr.	BW, EU	BW, non-EU	FW integr.	FW, EU	FW, non-EU
IND*INST	-0.0264	-0.0767**	-0.2652	-0.1466	-0.0395	-0.0512	-0.0254
	(0.036)	(0.035)	(0.217)	(0.264)	(0.051)	(0.059)	(0.048)
Constant	0.0035	0.0061	0.0069	0.0047	0.0022	0.0033	0.0033
	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)
Observations	414	414	414	414	414	414	414
R-squared	0.556	0.561	0.557	0.553	0.556	0.555	0.554
Str. change	(1)	(2)	(3)	(4)	(5)	(6)	(7)
IND*INST	-0.0519	0.0147	-0.4217*	-0.5032**	-0.0249	-0.0855	-0.0797*
	(0.033)	(0.038)	(0.240)	(0.254)	(0.035)	(0.055)	(0.041)
Constant	0.0110***	0.0100***	0.0163***	0.0155***	0.0099***	0.0106***	0.0107***
	(0.003)	(0.004)	(0.005)	(0.004)	(0.003)	(0.003)	(0.003)
Observations	414	414	414	414	414	414	414
R-squared	0.544	0.537	0.552	0.547	0.536	0.542	0.545
Emp. Gr.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
IND*INST	-0.1715	-0.2928	-2.2081*	-16321	0.2743	-0.2372	-0.3804
	(0.233)	(0.522)	-1155	-2099	(0.255)	(0.340)	(0.320)
Constant	0.1820***	0.1915***	0.2109***	0.1966***	0.1877***	0.1807***	0.1812***
	(0.043)	(0.048)	(0.046)	(0.047)	(0.044)	(0.043)	(0.043)
Observations	414	414	414	414	414	414	414
R-squared	0.472	0.471	0.478	0.477	0.473	0.472	0.473

Source: WIFO calculations.
Note: Robust standard errors in parentheses; Significance levels: ***p<0.01, **p<0.05, *p<0.1.

3.3.4.Summary and a growth impact scenario of a hypothetical institutional reform

The section analysed how economic institutions and aspects of the Single Market interact to jointly affect employment growth and contributions to productivity growth. The productivity growth indicators were obtained from the previous shift-share analysis. The results suggest that sound institutions and well integrated markets favours productivity increases in established structures. Especially the backward integration with other EU Member States is a strong contributor to within-industry productivity growth. This is an indication of path dependency: stronger institutions and greater market integration facilitate productivity growth that occurs within given structures. Given that the bulk of productivity growth comes from within-industry contributions, this is an important finding corroborating the reform agenda regarding the rule of law, public services and infrastructure availability.

The contributions to productivity gains from a change in the sector composition are negative in countries with a better legal system and industries that are better integrated. This can be interpreted as a validation of the previously attested unfavourable structural change pattern. Productivity gains from structural change largely came from nontradable goods and services. This was more pronounced in economies struggling with imbalances, and seems to have led to a statistical pattern where good institutions and deeper market integration cause negative labour productivity contributions from changes in the sector composition.

Capital markets – measured by market capitalisation or by bank credit – did not impact within-industry productivity change nor the growth of hours worked. A similar pattern is observable as with the overall governance indicators. Deeper capital markets interact negatively with market integration on productivity growth from structural change. A possible explanation for this might be the combination of the selection of lenders, who perhaps favoured tradable sectors and the unfavourable structural change pattern, which largely went into nontradable sectors.

Another striking finding of the estimated models is a high explanatory power. The R^2 of the models is above 0.45, which is remarkably high for a growth regression. This result is driven by the dummy variables that the method uses to capture country and industry fixed effects, which indicates a high degree of heterogeneity across observations.

The nature of this exercise was exploratory. The results for the output indicator "growth of hours worked", the institutional indicator "free labour markets" and the macroeconomic indicator 'output gap' were – by and large – found to be statistically insignificant and not sufficiently robust to be interpreted.

These results can be used to simulate the effects of a hypothetical institutional reform. Such a scenario requires a conceptual channel through which policies affect productivity growth. In the present analysis, the backward integration indicator is used, which measures the degree of upstream integration into the Single Market. With respect to the reform scenario analysis, the effects on aggregate productivity are of interest. These comprise the sum of within-sector productivity gains on the one hand, and productivity growth contributions from structural change on the other hand.

The scenario asks what will happen to aggregate productivity growth contributions if there was a public-sector reform with respect to the quality of public administration, infrastructure, education and health. These aspects are captured by the government effectiveness index provided by the World Governance Indicators. It assumes that the indicator improved its value from the 25th percentile of the sample, which is observed in Latvia, to the level of the 75th percentile that is observed in Luxemburg. The within-sector contribution to labour productivity growth would increase by 150%. This corresponds to a predicted increase from to 0.6 percentage points to 1.5 percentage points. Using the estimation results from the structural change contribution in the same hypothetical scenario, one obtains a negative contribution of almost the same magnitude (-0.8 percentage points).

The weighted sum of both effects constitutes the estimated aggregate labour productivity growth rate after such a hypothetical policy reform. An optimal ratio between those effects does not exist, which is why this report relies on both the present dataset and findings from the literature (e.g., McMillan, Rodrik, and Verduzco-Gallo, 2014). One may assume a 70-30 ratio of the within to the structural change effect. This leads to an estimated acceleration of labour productivity growth from a policy reform scenario of approximately 0.4 percentage points.

An alternative scenario could be the reform of the legal system, comprising aspects such as the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. The indicator used to this end is the Rule of Law, which is provided by the World Governance Indicators. If the rule of law index improved from its 25th percentile (Lithuania) to the level of the 75th percentile (Netherlands), the within sector growth contributions would increase from 0.5 percentage points to 1.5 percentage points. Using the estimation results for structural change, one again obtains negative contributions to productivity growth. These reduce the positive results from within industry productivity growth by the same magnitude, i.e. one percentage point. Applying the seven to three weighting to these figures shows similar results of a hypothetical institutional reform as above.

Hence, differences in the quality of institutions almost single-handedly explain the long-run productivity growth differential across Member States. Certainly, such a policy reform scenario is hypothetical, and in practice takes time to implement. Also, the magnitude of the effect is driven by the ratio which is assumed. In the present data, the ratio would be nine to one, which is driven by the negative interaction effect that is part of the structural change effect. The ratio applied roughly corresponds to the ratio of within- to between-sector productivity contributions (as opposed to the within versus structural change ratio).

3.4. Industrial Dynamics

3.4.1. Introduction

The processes of firm entry, firm growth but also firm exit have always been an important part of the mechanism of reallocation of resources within and across industries. Especially start-ups and industry turbulence are recognized as important drivers of the structural change through resource reallocation that underlie much of long-run growth processes. This importance derives from at least two interrelated reasons. First, firm entry and firm exit as well as shares of high growth firms have been linked to productivity growth at the industry level (Foster, Haltiwanger, and Syverson, 2008; Foster, Haltiwanger, and Krizan, 2006; Bravo-Biosca, 2010). Second, a related strand of literature discusses institutional frictions to growth, which affect entry and exit decisions and may inhibit industrial reallocation (Restuccia and Rogerson, 2013; Restuccia and Rogerson, 2008).

However, the industrial economics literature highlights the interdependence between entry and exit processes. It is well known that entry and exit are highly correlated and consequently the turnover of firms within (also quite narrowly defined industries) dominates the turnover of firms between sectors that guides structural change. The entry and exit of firms but also the industry share of high growth firms also depends on other factors, such as the state of the business cycle (e.g. Hölzl, 2016), and technological and structural characteristics related to product characteristics and markets. Entry, exit and overall firm turnover are closely related to fixed, capacity-related sunk costs and other mobility barriers. In fact, barriers to firm entry are often barriers to firm exit as well, and barriers to exit discourage entry. The presence of sunk costs makes incumbent firms behave more aggressively towards new entrants, thus increasing entry costs and lowering industrial dynamics by new firms (Hopenhayn, 1992; Sutton, 2001). This is also mirrored by established evidence at the industry level. Industries with high entry and turnover rates are usually service industries (nontradables) – which exhibit lower sunk costs. Industries exhibiting low entry rates are manufacturing industries (important share of tradables) and utilities that have much higher capital requirements.

The present section of the report studies the importance of firm dynamics, measured as the turnover rate of firms and share of high growth firms – using thus two measures that capture different aspects of industry dynamics at the industry level – namely turbulence and growth - to investigate links between industry dynamics and structural change in the EU Single market. The section is organised as follows. The next subsection presents a short review of the relevant literature as well the measures of industry turbulence for the EU countries. In the following, the links between industry turbulence and several aspects are analysed. These include productivity growth and structural change, institutional factors and - most importantly - the link between forward and backward linkages into the Single market. The section is closed by a summary of the most important results.

3.4.2. Industry dynamics: measures and stylised facts

Entry and exit are often considered to be the expression of Schumpeterian entrepreneurship where new more innovative producers replace less entrepreneurial firms that need to exit the industry. The importance of firm entry and firm exit relative to the existing number of enterprises is measured by the entry and the exit rate. Entry (and exit) rates are defines as the shares of entries (exits) in one year relative to the stock of enterprises in the same year.

The turnover of producer identities is often seen as a primary driver of (Schumpeterian) structural change and economic growth. A more appropriate measure of the turnover of producer identities is the firm turnover rate that measures the change of producer identity over two periods of time (usually one year) and is defined as the entries plus exits over total firms, i.e. the sum of the entry rate and the exit rate.

The literature on entry and exit clearly shows that entry can also be the expression of turbulence that concerns only the competitive fringe of the market, but does not affect the behaviour of dominant firms. The survival rates of new firms are strikingly low: according to Bartelsman, Scarpetta and Schivardi (2005), who worked on data for ten OECD countries, about 20-40 per cent of entering firms fail within the first two years of life, while only 40 to 50 per cent survive beyond the seventh year. Moreover, entry and exit rates are positively and significantly correlated across industries. Thus market "churning" emerges as a common feature of industrial dynamics across different sectors and different countries. Many sectors are characterised by a fringe of firms operating at a suboptimal scale where the likelihood of survival is low and where "revolving door" firms are continuously entering and exiting the market. The "revolving door" metaphor due to Audretsch (1991) emphasizes the high turbulence of new ventures that are rapidly selected out at the fringe of the firm population, in contrast to high potential new firms that can survive and displace established firms, and which provide the basis for structural change and economic growth. Santarelli and Vivarelli (2007) argue that industry-specific characteristics, such as scale economies and the endowment of innovative capabilities (Audretsch, 1991; Agarwal and Audretsch, 2001), exert a significant impact on entry, exit, and the likelihood of survival of new firms. Thus, looking only at entry, exit and the turnover of firms does not allow to uncover the importance of industry dynamics as these indicators address only one aspect, namely changes in the identity of firms but do not consider the process of post entry growth and reallocation dynamics that are due to the differential growth of new and established firms. In an important early comparative study of industry dynamics Bartelsman et al. (2009) have shown that most important difference between the USA and (a few) European countries is not related to entry and exit rate but to the post-entry growth performance. This explains together with the greater availability of individual firm data, that attention of researcher and policy makers shifted from industry turnover toward high growth firms. This led also to shift of industrial policies towards growth-oriented enterprise policies (e.g. Mason and Brown, 2014).

High growth firms contribute to productivity growth, job creation and promote innovation, export-orientation and internationalization. However, the most important direct contribution of HGFs is there disproportional employment generation (Coad et al., 2014). There is ample evidence for many European Countries (e.g. Storey, 1994, Anyadinke-Danes et al., 2009, Henrekson and Johansson, 2010) that a small number of fast growing firms create a large share of jobs, while most firms do not grow at all. These studies show that around 3 to 6 percent of the fastest growing firms generate up to 70% of new jobs in established firms. However, given the evidence that highly productive firms coexist with low productivity firms even within narrowly-defined sectors (e.g. Syverson, 2014), recent research has emphasized resource misallocation as an important source of productivity differentials. This research has established that cross-country differences in productivity may be linked to the heterogeneity in firm performance and growth (Andrews and Cigano, 2014, Bartelsman et al., 2013, Hsieh and Klenow, 2009). This evidence suggests that differences in high growth firms may be related to differences in the ability of economies to direct resources to the most productive firms. HGFs may thus play an important role in fostering economic growth that goes beyond the direct impact of job generation.

Even if there exist a variety of approaches to measure the importance of high growth firms, there is mounting evidence about some robust regularities of HGFs at the firm level (cf. Coad et al., 2014, Henrekson and Johansson, 2010).[24] The most important insight from this literature is that only a subset of firms grows fast and that most firms have modest (or even zero) growth rates. Most studies show that most HGFs are small and medium-sized enterprises (with less than 50 employees). Although many high growth firms are young, most HGFs are not start-ups or entrants (Mason and Brown, 2014). Moreover, the available evidence also shows that HGFs are distributed across all sectors (e.g. Bleda et al., 2013; Anyadike-Danes et al., 2009; Daunfeldt et al., 2015; Daunfeldt and Halvarsson, 2015). In this study HGFs are identified with the HGF (10%) definition which measures firm growth over a three-year period and defines those firms as HGFs that have an annualized growth rate of 10% or more over this three-year period and had more than 10 employees at the beginning of the period. The enterprise share is calculated as the ratio of HGFs to number of firms with more than 10 employees at the end of the period.

Cross-country evidence on HGFs is still largely missing. One of the few studies that provide evidence is Bravo-Biosca (2010). Using a dataset of 11 countries for the time 2002 to 2005, Bravo-Biosca (2010) shows that that higher high growth shares and more dynamic firm growth is associated with higher productivity growth at the country level. He also shows that European countries exhibit, on average, a higher share of slow-growing and stagnant firms when compared to the USA. Hölzl (2016) shows that the share of high growth firms is positively correlated with innovation activities. However, the evidence for the USA shows declining HGFs shares over the time 1994-2012 (Clayton et al., 2013). Also, the evidence by Decker et al. (2014) suggests that the business dynamics slowed down in the USA also in high-technology industries. This is confirmed by the comparative evidence provided by Criscuolo et al. (2014) who show that the main differences in firm dynamics between the USA and European countries is not related to the size distribution of firms or their age distribution but to the growth performance of firms, echoing the results by Bartelsman et al. (2005). However, Andrews and Cigano (2014) find that more productive firms are likely to account for a much larger share of employment in the USA and some northern European countries than in Continental and Southern European economies.

Table 3.27 presents averages for industry turbulence at the country level EU countries and country groups. At the country group level, there is no marked difference in the turnover rate between the EU Core country group and the EU Crisis country group, however, the entry rate is higher in the EU Core than the exit rate. In the EU Crisis country group, it is the other way around. The EU CEE country group has higher turnover, entry and exit rates than the other country groups. However, this does not hold for the share of high growth firms. The EU Core country group has the highest share followed by the EU CEE country group and the EU Crisis country group.

[24] The use of the OECD-Eurostat definition of HGFs by statistical offices and the increased use of this definition by researchers increased the comparability of results across studies.

Table 3.27: Industry dynamics across EU countries and country groups

Variable Time period	Turnover rate (2008 - 2014)	Entry rate (2008 - 2014)	Exit rate (2008 - 2014)	Share high growth firms (2012-2014)
EU Core	**16.9**	**9.3**	**7.6**	**10.0**
Belgium	9.5	6.2	3.3	8.27
Denmark	22.2	10.7	11.5	9.61
Germany	16.5	8.2	8.3	10.68
France	17.3	10.9	6.5	8.56
Luxembourg	17.2	9.7	7.5	9.71
Netherlands	18.8	11.0	7.8	9.79
Austria	14.3	7.7	6.6	6.71
Finland	15.9	9.0	6.9	10.78
Sweden	13.5	7.3	6.2	13.15
UK	23.4	12.3	11.1	12.29
EU-Crisis	**16.8**	**7.7**	**9.1**	**8.2**
Ireland	14.6	6.3	8.3	10.83
Spain	17.4	8.1	9.3	8.48
Italy	14.2	7.0	7.2	7.08
Cyprus	12.0	4.7	7.2	3.32
Malta	13.2	6.8	6.4	11.42
Portugal	29.2	13.3	15.9	8.14
EU-CEE	**25.0**	**12.8**	**12.2**	**9.4**
Bulgaria	24.4	13.6	10.9	10.70
Czech Republic	18.2	8.9	9.2	10.19
Estonia	22.5	12.2	10.3	8.35
Croatia	19.1	8.7	10.4	7.78
Latvia	28.2	16.2	12.0	12.63
Lithuania	47.4	21.7	25.7	12.01
Hungary	20.6	9.7	10.9	11.37
Poland	23.7	12.7	11.0	8.79
Romania	26.3	11.8	14.4	2.39
Slovenia	19.1	11.1	8.0	7.87
Slovakia	25.2	14.3	10.9	11.77
Other				
Norway	14.1	8.6	5.4	11.16

Source: Eurostat, Structural Business Statistics, WIFO calculations.

Table 3.27 clearly indicates that there are considerable differences across countries within the country groups for all indicators of industry dynamics. The lowest turnover rate is recorded for Belgium (9.5%) followed by Cyprus (12.0%) while Lithuania (47.4) and Portugal (29.2 %) recorded the largest turnover rates. Regarding employment in HGFs the lowest shares are again observed for Romania and Croatia (both 6.0%) while the largest are recorded for Slovakia (20.6%) and Lithuania (19.6%). Regarding the entry rate, the highest values are recorded for Lithuania (25.7%) and Latvia (16.2%), while the lowest values were found for Cyprus (4.7%) and Ireland (6.3%). Regarding the exit rate the highest values have Lithuania (26.1%) and Portugal (15.9%), the lowest are recorded for Belgium (3.3%) and Sweden (6.1). The highest share of high growth firm is recorded for Sweden (13.1%) followed by Latvia, while the lowest shares of high growth firms are found in Romania (2.4%) and Cyprus (3.3%).

It is important to note that the differences are much more marked across countries than within countries as Table 3.28 shows. The standard deviation across country averages is much larger than the average standard deviation across time at the country level. This strongly suggests that that industry dynamics have a strong country-specific component. This raises also the question whether the efficiency of industry turbulence is an important element in the explanation of country differences in economic performance.

Table 3.28: Dispersion of indicators of industry dynamics across time and countries

	Average standard deviation across countries over time	**Standard deviation across country averages**
Turnover rate	2.5	7.52
Entry rate	1.5	3.58
Exit rate	2.1	4.32
Share of high growth firms	1	2.57

Source: Eurostat, Structural Business Statistics, WIFO calculations.

This descriptive evidence already hints that the indicators of industry dynamics may be able to provide indications about the efficiency of the process of resource reallocation that is very important for growth processes based on structural change. A lack of firm turnover and high growth firms is unlikely to be purely the result of missing entrepreneurial projects and a low willingness to start a business. The structural differences across countries suggest that country-wide institutions, business framework conditions, regulations as well as the specialization patterns and the relative position to frontier economies may matter.

However, it is also important to note that the differences are also marked at the industry level. Table 3.29: reports aggregated descriptive statistics at the NACE one-digit level for the EU countries. The Means are simple averages over time and countries. The highest entry rates are observed for the combined sector arts, entertainment and recreation (NACE code: R) and other services (S) followed by electricity, gas, steam and air conditioning supply (NACE code: D). The lowest entry rates are observed for mining (B) and manufacturing (C). These two sectors have together with sector Q (human health and social work activities) the lowest exit rates and the lowest turnover rates. The highest exit rates are observed for the combined sector arts, entertainment and recreation (NACE code R) and other services (S) and administrative and support service activities (N). These two sectors have also the highest turnover rates. The share of high growth firms is distributed a bit differently. Here, the highest values are observed for K (Financial and Insurance activities), J (Information and communication) and N (administrative and support service activities). The lowest share of high growth firms is observed for the sector L (real estate activities) followed by I (Accommodation and food service activities) and B (mining).

Table 3.29: Industry dynamics across sectors

	Entry rate		Exit rate		Turnover rate		High growth firm share	
Sector	Mean	Stand. Dev.	Mean	Stand. Dev.	Mean	Stand. Dev.	Mean	Stand. Dev.
B	6.52	(3,41)	6.59	(1,19)	12.60	(5,23)	7.86	(5,25)
C	6.78	(2,44)	7.60	(1,25)	14.00	(4,57)	8.60	(2,52)
D	16.63	(6,87)	5.63	(1,49)	22.24	(8,64)	9.10	(2,07)
E	8.34	(3,69)	6.39	(1,29)	14.56	(5,97)	10.25	(3,41)
F	9.66	(3,21)	10.20	(1,77)	19.41	(5,78)	7.98	(2,09)
G	9.16	(2,39)	9.42	(1,30)	18.32	(4,65)	8.10	(1,88)
H	7.76	(2,70)	8.26	(1,23)	16.07	(4,66)	11.37	(2,54)
I	9.85	(2,35)	9.59	(1,35)	19.24	(4,91)	7.19	(1,88)
J	12.54	(2,86)	9.28	(1,45)	21.64	(4,59)	15.25	(3,14)
K	10.95	(3,70)	10.18	(2,16)	20.76	(7,71)	16.04	(4,05)
L	7.84	(2,70)	7.36	(1,60)	14.49	(5,22)	7.16	(2,08)
M	10.37	(2,94)	8.33	(1,37)	18.44	(4,79)	10.41	(2,22)
N	14.70	(5,84)	12.86	(3,55)	26.48	(11,08)	13.06	(2,37)
P	13.40	(4,66)	9.16	(4,73)	22.57	(8,25)	-	-
Q	8.18	(3,32)	5.66	(5,62)	13.83	(7,10)	-	-
R_S	22.82	(6,58)	17.92	(6,57)	40.56	(11,34)	-	-

Source: Eurostat data, WIFO-calculations.

3.4.3. Industry turbulence and country determinants

The striking differences in industry dynamics indicators across EU Member (see Table 3.27:) suggests that country capabilities related to institutions, regulations, labour skills and technological capabilities are important determinants of the long-run differences in industry dynamics. However, indicators of institutions and capabilities at the country level are interrelated and highly correlated. This presents an empirical challenge to identify the exact impact of institutions and capabilities. Simple scatter plots and regression analysis is likely not able to uncover robust associations between country characteristics and indicators of industry dynamics. As in Hölzl (2016) a principal component analysis is used to construct summary variable that capture and summarize different aspects of capabilities.[25] Table 3.30: describes the set of variables used.

Table 3.30: Variable list for analysing the relationship between industry turbulence indicators and indicators of country capabilities

Variable	**Source**
Government effectiveness	Worldwide governance indicator database, World Bank
Regulatory quality	Worldwide governance indicator database, World Bank
Rule of Law	Worldwide governance indicator database, World Bank
R&D intensity (% of GDP)	Eurostat
Researcher intensity (per mio. people)	Eurostat
Labour force with secondary education	Eurostat
Labour force with tertiary education	Eurostat
FDI flows in % of GDP	World Bank
Manufacturing share (% of GDP)	Eurostat
Employment in industry (% of total employment)	Eurostat
Trade in services (% of GDP)	Eurostat
Domestic credit to private sector by banks (% of GDP)	World Bank
Stock market capitalization (% of GDP)	World Bank
Complexity of Exports	WIFO calculations (Reinstaller et al. 2012)

The first indicators capture broad institutional characteristics and government efficiency (government effectiveness, regulatory quality and rule of law). The second set of indicators

[25] The main difference to the analysis in Hölzl (2015) is the use of a different time and that industry turbulence indicators are used in the analysis. Hölzl (2015) uses only the share of high growth firms.

captures innovation capabilities related to R&D (R&D intensity and researcher intensity). The third set of indicators captures education of professional formation (labour force with secondary education, labour force with tertiary education). The indicator on FDI inflows measures the attractiveness of the country for foreign direct investment. The manufacturing share measures the manufacturing base of a country that is often considered a determinant of competitiveness. The indicator of complexity of exports used in chapter in section xxx can be considered to capture latent information on the breadth and depth of the knowledge base of a country. Trade in services covers the export share of services. In addition, broad indicators are used, which relate to the financial system (domestic credit to the private sector and stock market capitalization) as the efficiency of the financial system is generally considered to be relevant for entry and potential high growth firms.

The results of the principal components analysis using time-aggregated indicators for the period 2009 to 2014 are found in the appendix. The analysis shows that there are three distinct principal components that summarize the information contained in the 14 country capability indicators. The three components have a quite clear interpretation.

Principal component 1 (PC1) can be interpreted as a stage of development indicator that combines institutional quality with innovation capacity. The factor loadings and the correlation analysis in Table 3.31 show that PC1 is highly correlated with the governance indicators, R&D intensity, researcher intensity and complexity of exports. This confirms that institutional variables and R&D indicators are highly correlated at the country level. The first principal component explains around 40% of the total variation of the 14 indicators of country capabilities.

Principal component 2 (PC2) captures the industrial base as it is strongly correlated to the variables manufacturing share (% of GDP), employment in industry and labour force with secondary education. Interestingly PC2 (manufacturing base) is weakly negatively correlated to knowledge indicators such as R&D intensity and researcher intensity and strongly negatively correlated to the governance indicators and the labour force with tertiary education, as well as the indicator measuring domestic credit to private sector by banks (% of GDP). This suggests that PC2 captures primarily the low technology and medium-low technology manufacturing activities. This principal component accounts for 26 % of the total variation of the 14 indicators of country capabilities.

Principal component 3 (PC3) is an indicator of FDI inflows and trade in services. Interestingly the correlation analysis shows that PC3 is largely independent of institutional quality. This principal component accounts for 11% of the total variation of the 14 indicators of country capabilities.

Table 3.31: Correlation between principal components and industry dynamics variables

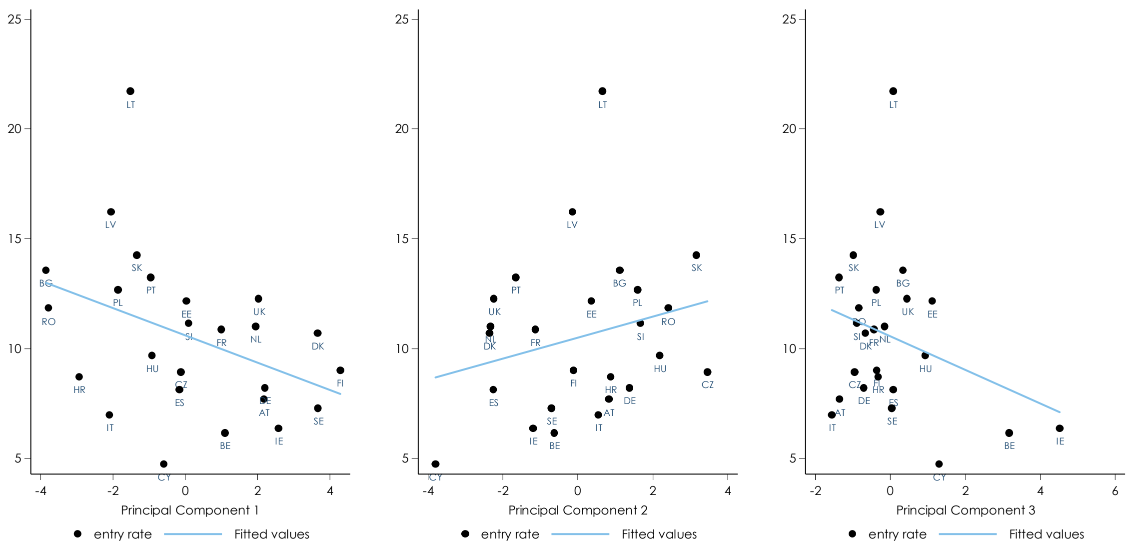
	Principal component 1	Principal component 2	Principal component 3
Entry rate	-0.39**	0.25	-0.29
Exit rate	-0.42**	0.16	-0.19
Turnover rate	-0.43**	0.21	-0.25
High growth firm share	0.33	0.08	0.11

Source: Eurostat, World Bank, BACI database, WIFO calculations.

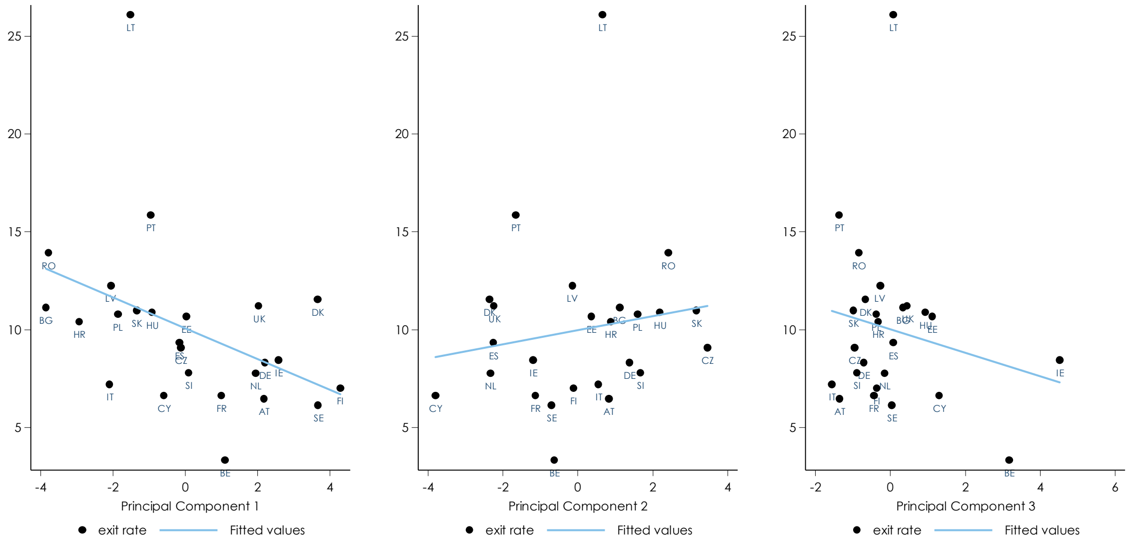
Figure 3.24: provides evidence for the relationship between industry dynamics and the principal components representing country capabilities. For entry, exit and turnover rates (panels (a), (b) and (c) in Figure 3.24) there is a negative relationship between principal component 1 ("institutions and knowledge") that implies that industry dynamics related to the turnover of firms decrease when become more advanced. This relationship is statistically significant. The other two components do not have as statistically significant relationship to entry, exit and turnover rates. However, the association is positive for that principal component 2 ("industrial base") and negative for principal component 3 ("FDI inflows and trade in services"). The share of high growth firms does not show a statistically significant relationship to the three principal components (see Table 3.31). However, the behaviour of this indicator is different from the industry turbulence indicators. While the association between principal component 1 and the share of high growth firms is not statistically different from 0 it is positive. Better institutions and higher knowledge are weakly associated with a higher share of high growth firms. This is in clear contrast to the entry, exit and turnover rate and suggests that high growth firm shares are more related to differences in institutions and innovation capabilities than the other industry dynamics indicators. High growth firms do not thrive in an institutional vacuum but need appropriate framework conditions. However, the results also indicate that principal component 2 ("industrial base") and principal component 3 ("FDI inflows and trade in services") show no strong relationship to shares of high growth firms at the country level.

Figure 3.24: Principal components of country capabilities and industry turbulence indicators

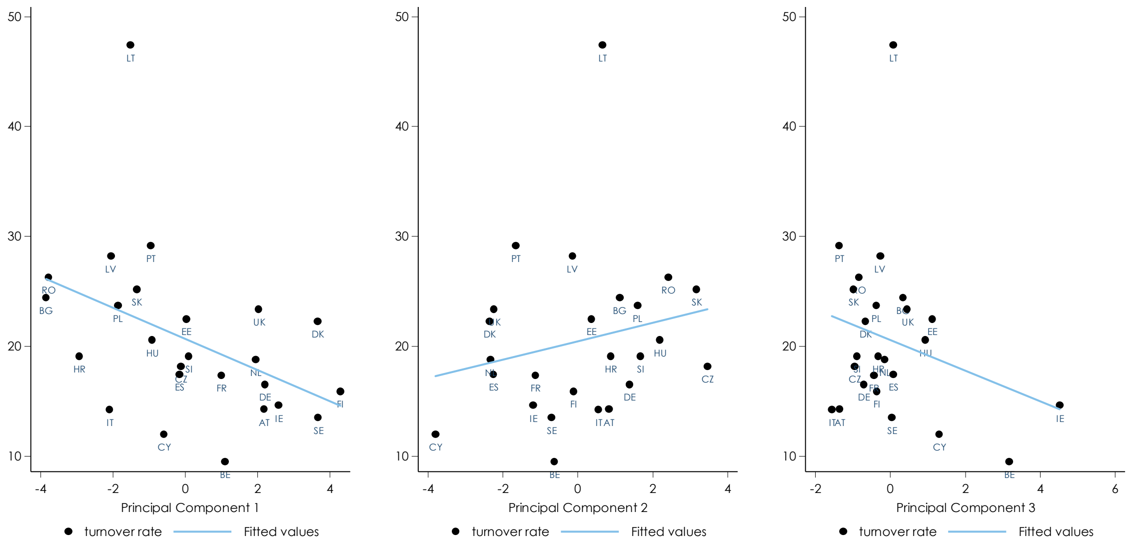
(a) Entry rates



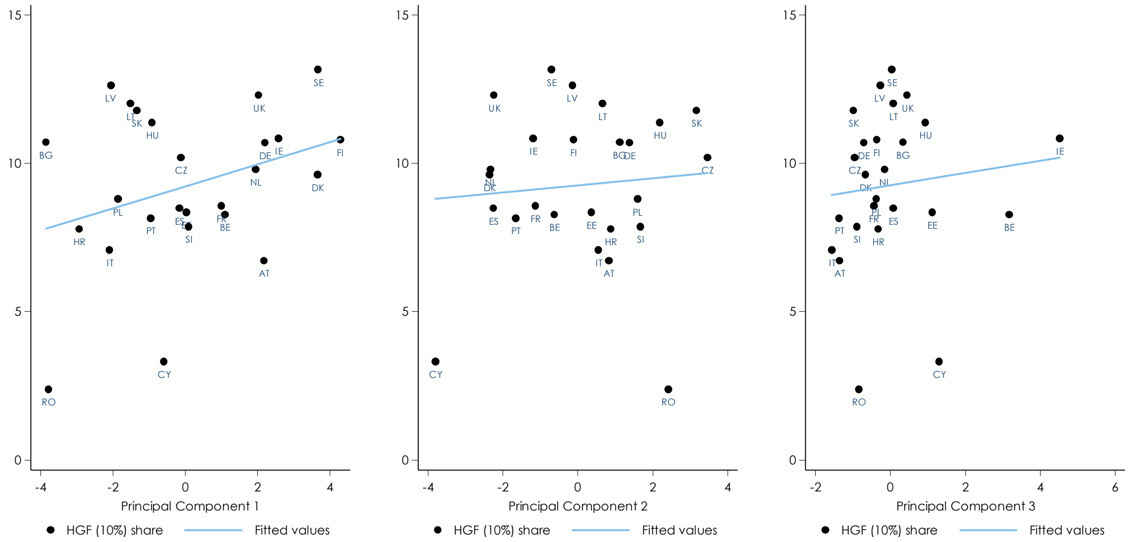
(b) Exit rates



(c) Turnover rates



(d) HGF shares



Source: Eurostat, World Bank, BACI database, WIFO calculations.

3.4.4. Industry dynamics and macroeconomic fluctuations

In aftermath of the economic crisis in Europe, industry dynamics is often considered to be an important ingredient in growth strategies that allow countries to embark on a new sustainable growth path and to create new jobs. However, industry dynamics are also affected by macroeconomic conditions. It is almost a stylised fact that firm turnover is affected by the business cycle (e.g. Lee and Mukoyama, 2012; Casares, 2015). Entry and exit rates differ significantly during booms and recessions. Entry rates are generally pro-cyclical, while exit rates counter-cyclical. Lee and Mukoyama (2012) examine the patterns of entry and exit over the business cycle in terms of employment and productivity and find that differences in productivity and employment are larger for entering plants than for exiting plants. Firms that enter during booms are 25 per cent smaller and 10-20 per cent less productive than the ones that enter during recessions. The authors show that such differences are relatively small for exiting firms, either during booms or recessions. While many studies of firm growth over the business cycle show that the growth rate of firms with extreme growth events is only weakly correlated with the business cycle (Higson et al., 2002, 2004; Hölzl and Huber, 2014), evidence on HGF shares clearly suggests that HGF shares are affected by the dynamics of aggregate demand. Hölzl (2016) studied high growth firm shares in 10 EU member states over the business cycle and finds that high growth firm shares are as sensitive to the business cycle (output gap) as entry rates. A negative output gap (business downturn or economic crisis) is associated with a lower share of high growth firms while positive output gaps are associated with larger shares of high growth firms.

One main issue whether industry turbulence is good for productivity growth depends on the question whether there is a "cleansing effect" of recessions, where low-productivity plants are scrapped during recessions, enhancing aggregate efficiency. Caballero and Hammour (1994, 2005) argue that low-productivity firms can be "insulated" from recessions because fewer new plants are created during recessions. In a later contribution, they provide empirical evidence that recessions reduce the amount of reallocation in the US economy (Caballero and Hammour, 2005). Also, Lee and Mukoyama (2015) by showing that exit rates are similar during both recessions and booms, and that there is no difference between exiting plants in terms of employment or productivity, contribute to the mounting evidence, that reallocation dynamics are lower during recessions. Recent evidence for EU countries shows that the presence of "zombie" firms – defined as old firms that have problems meeting their interest payments – stifles labour productivity growth by constraining the growth of more productive firms and reducing opportunities for the entry of new firms (McGovran et al., 2017).

Using industry data (Nace 2-digit level) it is only possible to establish the relationship between indicators of the state of the economy and indicators of industry dynamics (entry rate, exit rate, turnover rate and share of high growth firms) but not their source. In a first step a simple regression of the output gap on the industry turbulence at the NACE (rev. 2) two-digit level is estimated, even there are data restrictions imposed by the business demography data. Country-industry dummies are used for fixed country- industry effects and the logarithm of the number of active firms is used as control variable for absolute industry size.

Table 3.32: Regression of output gap on industry dynamics indicators

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Entry rate	**Exit rate**	**Turnover rate**	**Share of high growth firms**	**Entry rate**	**Exit rate**	**Turnover rate**	**Share of high growth firms**
Gap to potential GDP	0.0324**	-0.0506**	-0.0213	1.1078**				
	(0.015)	(0.025)	(0.030)	(0.549)				
Lag gap to potential GDP					-0.1037***	0.1484***	0.0431	0.5219
					(0.015)	(0.027)	(0.032)	(0.366)
ln(active enterprises)	1.6768***	2.7706***	4.4797***	65,221	0.8839**	1.9789***	2.9451***	91,806
	(0.313)	(0.507)	(0.617)	(6.858)	(0.365)	(0.669)	(0.787)	(6.722)
Constant	-5.3919**	-12.3262***	-17.9162***	-34.9194	-0.6968	-7.3943	-8.5937	-51.5748
	(2.363)	(3.822)	(4.650)	(43.638)	(2.623)	(4.806)	(5.652)	(42.799)
Observations	6,822	6,711	6,679	2,603	5,878	5,81	5,781	2,603
R-squared	0.748	0.489	0.712	0.358	0.783	0.484	0.714	0.357

Source: Eurostat, WIFO calculations.

Table 3.32: reports the regression results, which also comprises a specification that includes lagged output gap as indicator of the business cycle. However, business cycle influences should lead to a contemporaneous reaction, when annual data is used, as business cycle dynamics are short run phenomena. The results indicate that there is a statistical significant association between the output gap and the industry dynamics indicators except for the turnover rate. The association is positive for the entry rate and the high growth firm share. This implies that a negative output gap (economic crisis or business cycle downturn) is associated with a lower share of high growth firms and a lower number of new firms, while an economic expansion is associated with a larger share of high growth firms and a larger number of start-ups. Exit is countercyclical: a negative output gap increases the number of entries and a positive output gap reduces the number of exiting firms. As the turnover rate is the sum of the entry and the exit rate, the two effects cancel each other out. There is no statistically significant association between the output gap and the turnover rate. For the lagged output indicators, there is a statistically significant effect of the entry and the exit rate, but these have the opposite sign than the coefficients that measure the contemporaneous association. This is because business cycles are short-run phenomena and that annual data are not well suited to uncover the exact temporal interrelationship between industry dynamics and the business cycle.

In addition, Table 3.33 presents regression results where the gap to potential GDP is interacted with four institutional variables, namely rule of law, labour regulations, credit to private sector and insolvency time. The indicator rule of law measures the quality of the overall legal system and property rights, the indicator labour regulations measures the flexibility of the labour market, and credit to the private sector is an indicator of the quality and resilience of the financial system. Finally, insolvency time measures the average time required to resolve a company through the bankruptcy procedure. This indicator is taken from the Doing Business database of the World Bank. Insolvency is a specific kind of judicial procedure that is very relevant for the industry dynamics. Insolvency laws are quite different across European countries. Some countries have more creditor-friendly, others more debtor-friendly insolvency laws. The evidence on whether debtor-friendly or creditor-friendly insolvency laws are better for competitiveness, measured in terms of sustainable firm growth, innovation or employment growth, is mixed (Franken, 2004; Landier, 2006) Therefore information on the duration of insolvency proceedings is used. Duration is related to costs that affect both failing entrepreneurs and creditors, and are at least partly independent of the debtor- or creditor-friendliness of the prevailing insolvency law. The indicator is from the Doing Business survey and records time cost and outcome of insolvency proceedings involving domestic firms. The data are derived from survey responses by local insolvency practitioners and verified through the study of laws, regulations and national information on bankruptcy system. The case is the insolvency of a limited company that runs a hotel and has 201 employees and 50 suppliers. The business is experiencing liquidity problems. The firm is not able to service interest on a bank debt in full. The bank initiates insolvency. It is assumed that out-of-court negotiation is not feasible.

Table 3.33: Regression of output gap and institution interactions on industry dynamics indicators

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Entry rate					Exit rate				
Gap to potential GDP	0.1335***	0.2368*	0.2246***	-0.2949***	0.6092***	0.0237	-1.3351***	0.2552***	-0.0758	-1.3328***
	-0.033	-0.122	-0.031	-0.04	-0.171	-0.054	-0.199	-0.053	-0.065	-0.292
Gap to potential GDP * Rule of law	-0.1099***				0.0614	-0.0812				0.1928***
	-0.032				-0.041	-0.052				-0.07
Gap to potential GDP * labour regulations		-0.0316*			-0.1393***		0.1984***			0.2445***
		-0.019			-0.022		-0.031			-0.037
Gap to potential GDP * Private Credit			-0.0023***		-0.0015***			-0.0032***		-0.0031***
			0		0			0		-0.001
Gap to potential GDP * Insolvency time				0.1640***	0.1810***				0.0229	-0.0776**
				-0.017	-0.021				-0.029	-0.035
ln(active enterprises)	1.7513***	1.6692***	1.5917***	1.6262***	1.2427***	2.8253***	2.8035***	3.0411***	2.8358***	2.9448***
	-0.313	-0.313	-0.309	-0.316	-0.311	-0.508	-0.505	-0.519	-0.52	-0.531
Constant	-5.8872**	-5.3429**	-4.8849**	-5.1486**	-2.802	-12.6899***	-12.5447***	-13.9750***	-12.7236***	-13.2963***
	-2.366	-2.363	-2.311	-2.367	-2.315	-3.829	-3.808	-3.88	-3.891	-3.941
Observations	6822	6822	6739	6780	6697	6711	6711	6628	6669	6586
R-squared	0.749	0.748	0.759	0.756	0.766	0.489	0.492	0.484	0.489	0.487

VARIABLES	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
	Turnover rate					Share of high growth firms				
Gap to potential GDP	0.1648**	-1.1619***	0.4719***	-0.3815***	-0.8000**	3.5711***	-1.5745	1.6910*	-1.8857	-1.607
	-0.066	-0.243	-0.063	-0.079	-0.351	-1.105	-2.507	-0.935	-1.305	-3.944
Gap to potential GDP * Rule of law	-0.2034***				0.2495***	-2.5302**				-1.5036
	-0.064				-0.084	-0.985				-1.323
Gap to potential GDP * labour regulations		0.1762***			0.1161***		0.3949			0.3185
		-0.037			-0.045		-0.36			-0.363
Gap to potential GDP * Private Credit			-0.0054***		-0.0044***			-0.0051		0.0017
			-0.001		-0.001			-0.007		-0.007
Gap to potential GDP * Insolvency time				0.1903***	0.1019**				1.7066**	1.0407
				-0.035	-0.042				-0.675	-0.935
ln(active enterprises)	4.6149***	4.5097***	4.6491***	4.4867***	4.2070***	7.0626	5.8577	6.4563	7.8026	7.1099
	-0.618	-0.616	-0.622	-0.63	-0.637	-6.849	-6.884	-6.859	-6.865	-6.901
Constant	-18.8166***	-18.1153***	-18.9609***	-18.0262***	-16.2208***	-39.3455	-31.0665	-34.4583	-43.2417	-39.668
	-4.655	-4.641	-4.644	-4.707	-4.724	-43.6	-43.777	-43.647	-43.693	-43.89
Observations	6679	6679	6596	6637	6554	2603	2603	2603	2603	2603
R-squared	0.713	0.713	0.715	0.715	0.715	0.361	0.359	0.358	0.361	0.361

Source: Eurostat, World Bank, Fraser Institute, WIFO calculations.

The results in Table 3.33 confirm that institutions have an impact on the industry dynamics. For the entry rate one can observe that the interaction of the gap to potential GDP and rule of law is negative, implying that a better legal is associated with a lower entry rate. The same holds true labour regulations and for credit to the private sector. The more flexible labour markets are or the better the financial system the lower is the entry rate. However, the entry rate is amplified when the insolvency time is high. This is puzzling as it suggests that a less efficient insolvency law is associated with higher entry rates. For the exit rates one observes that the quality of the financial system reduces the impact of the output gap shock on the exit rate but that more flexible markets and a higher insolvency time increase the number of exits. However, when the four interactions are combined in one regression, some of relationships change. A higher quality of the legal system (rule of law) and more flexible labour markets amplify the impact of the output gap, while the quality of the financial system (credit to the private sector) and a higher insolvency time moderate the number of exits.

The results for the turnover rate combine the results for the entry and exit rate. The Rule of Law and the quality of the financial system (proxied by the credit to private sector) moderate the turnover of firms, while more flexible labour markets and a higher insolvency time tend to amplify the turnover of firms. Regarding the share of high growth firms, only the Rule of Law (negative interaction term) and the insolvency time (positive interaction term) show a statistically significant interaction effect with the output gap in the single equation regressions. But when taken together no of the institution indicators carries a statistically significant time.

3.4.5.Industry dynamics and medium-run productivity dynamics

After having established that there is a link between short-run business cycle dynamics and indicators of industry dynamics, the next section studies the contribution of industry dynamics to medium-run productivity growth. As a dependent variable productivity growth is used. The growth indicator has been obtained from the shift-share analysis for the time 2009 to 2014. A simple cross-sectional regression framework is used. The basic equation is:

$$\mathrm{PROD_{i,j}} = \alpha + \beta_1\, IDYN_{i,j} + \beta_2\, INST_i\; x\; IDYN_{i,j} + u_i + u_j + \varepsilon_{ij},$$

where $PROD_{i,j}$ is the productivity growth indicator from the shift-share analysis for country *i* and industry *j* for the post-crisis period. u_i are country-fixed effects, u_j are industry fixed effects. $IDYN_{i,j}$ is a measure of industry dynamics that varies at the industry and country level, $INST_i$ *i*s and institutional variable (fixed at the country level) and $\varepsilon_{\mathrm{it}}$ is the country and sector-specific error term. β_1 and β_2 are the coefficients of interest. β_1 is a measure of the direct association between an industry dynamics indicator and productivity growth, while β_2 measures the effect of industry dynamics that is associated with a specific institution (e.g. rule of law, government effectiveness or labour market regulation). If persistently higher industry dynamics lead to greater productivity improvements then β_1 should be positive and economically and statistically significant.

The use of a full set of fixed effects allows controlling for a large part of unobserved heterogeneity. Country fixed effects, u_i, capture all time-invariant effects varying on the country level, for example constant tax policies, institutional settings that affect industry dynamics or macroeconomic distance to the frontier effects. Industry fixed effects, u_j, capture all effects on a specific industry over all countries, such as sector-specific embodied technical change. In presence of these fixed effects, the results should only be biased by an omitted variable that varied through both countries and industries and was correlated with the industry dynamics indicators. However, as this cannot be excluded the coefficient β_1 should be interpreted primarily in terms of association not necessarily as causal effect of industry dynamics on post-crisis productivity improvements.

The shift-share analysis allows to differentiate total productivity gains into a within and a structural change component. Industry dynamics are not very strongly associated with the within sector productivity improvements. However, one can expect an association between the structural change component and industry dynamics indicators.

As institutional indicators government effectiveness, rule of law, the labour market regulation index provides by the Fraser institute are used, as well as credit made available to the private sector by banks as indicator of the quality of the financial system. These indicators were also used in the previous subchapters. In addition, this study uses insolvency time as an indicator of the efficiency of the insolvency system.

The regression results are in Table 3.34: to Table 3.38. Table 3.34: reports the results for government effectiveness. Government effectiveness is a general measure of the quality of public services, the institutional quality and the availability of infrastructure. The interaction is government effectiveness multiplied with the industry dynamics indicator. It is important to note as an interaction framework is used that the coefficient on the industry dynamics indicator is a baseline estimate, i.e. the estimate when government effectiveness is equal to 0. The interaction term captures the part of the average effect that is due to the interaction between the industry dynamics indicator and the institutional variable. For this reason, the baseline estimation results for the industry dynamics indicator are not comparable across specifications.

Table 3.34: Estimation results for industry dynamics and Government Effectiveness

Government effectiveness	(1) total	(2) within	(3) str. change	(4) total	(5) within	(6) str. change	(7) total	(8) within	(9) str. change	(10) total	(11) within	(12) str. change
Entry rate	-0.0002	0.0006	-0.0008									
	(0.001)	(0.001)	(0.001)									
Exit rate				-0.0003	0.0001	-0.0004						
				(0.001)	(0.001)	(0.001)						
Turnover rate							-0.0002	0.0002	-0.0004			
							(0.001)	(0.001)	(0.000)			
Share of high growth firms										0.0003	-0.0001	0.0004***
										(0.000)	(0.000)	(0.000)
Interaction	0.0007	-0.0007	0.0013**	0.0001	-0.0003	0.0005	0.0003	-0.0003	0.0006*	0.0013	-0.0002	0.0015***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)
ln(active enterprises)	0.0092	-0.0012	0.0104***	0.0093	-0.0011	0.0104***	0.0092	-0.0011	0.0103***	0.0074	-0.002	0.0095**
	(0.006)	(0.006)	(0.004)	(0.006)	(0.006)	(0.004)	(0.006)	(0.006)	(0.004)	(0.007)	(0.008)	(0.004)
Constant	-0.0607	0.0102	-0.0709***	-0.0573	0.008	-0.0653**	-0.0601	0.0093	-0.0694***	-0.0561	0.0141	-0.0702**
	(0.039)	(0.043)	(0.025)	(0.039)	(0.043)	(0.025)	(0.039)	(0.043)	(0.025)	(0.048)	(0.052)	(0.030)
Observations	364	364	364	364	364	364	364	364	364	298	298	298
R-squared	0.213	0.385	0.556	0.212	0.385	0.549	0.212	0.385	0.553	0.216	0.381	0.569

Source: Eurostat, World Bank, WIFO calculations.

The results in Table 3.34: show that industry dynamics indicators have a statistically significant relationship only to the productivity increases that indicate structural change (between industries and interaction term) but not with total productivity increases or within sector productivity increases. This was expected, as most within industry productivity increases are likely due to productivity increases in established firms. Productivity increases associated with Structural change in contrast seems to be associated with opportunities for new firms or fast growing firms. For the entry rate, there is a positive interaction term, i.e. a higher entry rate is associated with a higher productivity increases in counties that have a higher government effectiveness. This puts the results from section 3.4.3 a bit in perspective. In the principal component analysis at the country level, better institutions are associated with a lower entry rate. The present results suggest however, that better institutions are necessary for entry to have an impact on productivity. For the exit rate, no statistically significant results can be observed. Consequently, a weakly statistically significant interaction term for turnover is observed, which is likely driven by the results for the entry rate. For the share of high growth firms there is both a statistically significant baseline effect and a statistically significant positive interaction term. This suggests that high growth firms make an impact on productivity growth associated with structural change when the government effectiveness is high.

The second institutional indicator is the rule of law. This indicator quantifies the perceptions of the extent to which economic agents have confidence in the law system. This indicator is summary indicators of the quality of contract enforcement, property rights, police and the courts. The results are in Table 3.35. The results mirror the results from government effectiveness. There are no statistically significant associations to total productivity gains and within productivity gains and industry dynamics indicators. For structural change a positive statistically significant interaction terms for the entry rate is found, the turnover rate (weakly statistically significant) and especially for the share of high growth firms. In contrast to the results for government effectiveness there is no statistically significant baseline effect of the share of high growth firms. The conclusion is that the rule of law is a relevant factor for industry dynamics to translate productivity dynamics associated with structural change.

Table 3.35: Estimation results for industry dynamics and the Rule of Law

Rule of Law	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	total	within	str. change	total	within	str. change	total	within	str. change	total	within	str. change
Entry rate	-0.0003	0.0005	-0.0008									
	(0.001)	(0.001)	(0.001)									
Exit rate				-0.0002	0.0002	-0.0004						
				(0.001)	(0.001)	(0.001)						
Turnover rate							-0.0002	0.0002	-0.0004			
							(0.001)	(0.001)	(0.000)			
Share of high growth firms										-0.0001	-0.0001	0.0000
										(0.000)	(0.000)	(0.000)
Interaction	0.0008	-0.0005	0.0013**	-0.0001	-0.0005	0.0004	0.0003	-0.0003	0.0006*	0.0015	-0.0001	0.0016***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)
ln(active enterprises)	0.009	-0.0011	0.0101***	0.0094	-0.0011	0.0104***	0.0092	-0.0011	0.0102***	0.0074	-0.0021	0.0095**
	(0.006)	(0.006)	(0.004)	(0.006)	(0.006)	(0.004)	(0.006)	(0.006)	(0.004)	(0.007)	(0.008)	(0.004)
Constant	-0.0618	0.0097	-0.0715***	-0.0563	0.0091	-0.0654**	-0.0608	0.0098	-0.0706***	-0.0575	0.0137	-0.0712**
	(0.039)	(0.043)	(0.025)	(0.040)	(0.043)	(0.026)	(0.040)	(0.043)	(0.025)	(0.048)	(0.052)	(0.030)
Observations	364	364	364	364	364	364	364	364	364	298	298	298
R-squared	0.214	0.385	0.556	0.212	0.385	0.549	0.212	0.385	0.553	0.215	0.381	0.567

Source: Eurostat, World Bank; WIFO calculations.

Let us turn next to labour market regulations as proxied by the index provided by the Fraser institute in Table 3.36: A higher value indicates freer labour markets. There are no statistically significant results for the entry, exit and turnover rate. Labour market regulations seem not to be associated with the translation of entry into structural change. However, for the share of high growth firms statistically significant results are found for both the baseline and the interaction term. Interestingly a positive baseline effect is observed that is moderated by a negative interaction term. This suggests that very high labour market regulation has a negative baseline effect on structural change that decreases in importance when the share of high growth firms is high. This is a bit in contrast to the conventional wisdom that holds that freer labour markets help to spur high firm growth. This may be associated to the fact that labour market regulation has a positive impact on the dynamics of knowledge acquisition by worker. This should be especially relevant in industries that rely on cumulative knowledge.

Table 3.36: Estimation results for industry dynamics and labour market regulation

Labour market regulations	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	total	within	str. change	total	within	str. change	total	within	str. change	total	within	str. change
Entry rate	-0.0034	-0.0044	0.0009									
	(0.004)	(0.005)	(0.003)									
Exit rate				-0.0052	-0.0033	-0.0019						
				(0.006)	(0.006)	(0.004)						
Turnover rate							-0.0023	-0.0023	0.0000			
							(0.003)	(0.003)	(0.002)			
Share of high growth firms										0.005	-0.0062	0.0112**
										(0.008)	(0.009)	(0.005)
Interaction	0.0006	0.0006	-0.0001	0.0007	0.0005	0.0002	0.0003	0.0003	0.0000	-0.0007	0.0009	-0.0016**
	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
ln(active enterprises)	0.0094	-0.0008	0.0102***	0.0095	-0.0011	0.0106***	0.0095*	-0.0009	0.0104***	0.0078	-0.0017	0.0095**
	(0.006)	(0.006)	(0.004)	(0.006)	(0.006)	(0.004)	(0.006)	(0.006)	(0.004)	(0.007)	(0.008)	(0.005)
Constant	-0.0568	0.0071	-0.0639**	-0.0549	0.0079	-0.0629**	-0.0562	0.0075	-0.0638**	-0.05	0.0141	-0.0641**
	(0.039)	(0.042)	(0.025)	(0.039)	(0.042)	(0.025)	(0.039)	(0.042)	(0.025)	(0.048)	(0.052)	(0.030)
Observations	364	364	364	364	364	364	364	364	364	298	298	298
R-squared	0.214	0.386	0.55	0.213	0.385	0.549	0.213	0.386	0.549	0.209	0.382	0.563

Source: Eurostat, Fraser Institute, WIFO calculations.

Table 3.37: reports the results for the interaction of industry dynamics indicators and private credit to the private sector. Here there is no statistically significant relationship between

industry dynamics and the credit to the private sector. However, the indicator of credit to the private sector is not a perfect measure of the quality of the banking system in the period after the crisis.

Table 3.37: Estimation results for industry dynamics and credit to the private sector

Private Credit	(1) total	(2) within	(3) str. change	(4) total	(5) within	(6) str. change	(7) total	(8) within	(9) str. change	(10) total	(11) within	(12) str. change
Entry rate	-0.0009	-0.0005	-0.0004									
	(0.001)	(0.001)	(0.001)									
Exit rate				-0.0003	-0.0003	0.0000						
				(0.001)	(0.001)	(0.001)						
Turnover rate							-0.0004	-0.0002	-0.0002			
							(0.001)	(0.001)	(0.000)			
Share of high growth firms										-0.0008	-0.0004	-0.0005
										(0.001)	(0.001)	(0.000)
Interaction	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(active enterprises)	0.0105*	-0.0006	0.0111***	0.0094	-0.0011	0.0105***	0.0099*	-0.0009	0.0108***	0.0079	-0.0023	0.0101**
	(0.006)	(0.006)	(0.004)	(0.006)	(0.006)	(0.004)	(0.006)	(0.006)	(0.004)	(0.007)	(0.008)	(0.005)
Constant	-0.0658*	0.0036	-0.0694***	-0.057	0.0062	-0.0632**	-0.0619	0.0046	-0.0665***	-0.0524	0.0121	-0.0645**
	(0.040)	(0.043)	(0.025)	(0.039)	(0.042)	(0.025)	(0.039)	(0.043)	(0.025)	(0.048)	(0.052)	(0.030)
Observations	364	364	364	364	364	364	364	364	364	298	298	298
R-squared	0.217	0.385	0.552	0.212	0.385	0.549	0.214	0.385	0.55	0.213	0.381	0.558

Source: Eurostat, World Bank, WIFO calculations.

Finally, Table 3.38 reports the results for industry dynamics and insolvency time as interaction variable. A higher value indicates a longer duration of resolving a business in a bankruptcy procedure. Here one observes again no statistically significant effect on total or within productivity improvements in the post-crisis period for the industry turbulence indicators (entry, exit and turnover rate), and for the exit rate and the turnover rate there is no impact also for the structural change term. Interestingly for the entry rate one observes a positive baseline effect but no statistically significant interaction effect. Regarding the share of high growth firms more meaningful results are obtained. First the interaction term is statistically significant and negative for the total productivity gains. This implies that a longer time to resolve a business affects total productivity growth via the share of high growth firms. In the case of the structural change productivity growth component a positive baseline effect is observed. A higher insolvency time, however, reduces the structural change effect.

Table 3.38: Estimation results for industry dynamics and insolvency time

Insolvency time	(1) total	(2) within	(3) str. change	(4) total	(5) within	(6) str. change	(7) total	(8) within	(9) str. change	(10) total	(11) within	(12) str. change
Entry rate	0.0016	-0.0002	0.0018*									
	(0.002)	(0.002)	(0.001)									
Exit rate				-0.001	-0.001	0.0000						
				(0.002)	(0.002)	(0.001)						
Turnover rate							0.0004	-0.0002	0.0007			
							(0.001)	(0.001)	(0.001)			
Share of high growth firms										0.004	0.0007	0.0033**
										(0.002)	(0.003)	(0.002)
Interaction	-0.0005	0.0001	-0.0006	0.0003	0.0003	0.0000	-0.0002	0.0001	-0.0003	-0.0012*	-0.0002	-0.0010**
	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)
ln(active enterprises)	0.0087	-0.0021	0.0108***	0.0089	-0.0021	0.0110***	0.0088	-0.0021	0.0109***	0.0073	-0.0034	0.0107**
	(0.006)	(0.007)	(0.004)	(0.006)	(0.006)	(0.004)	(0.006)	(0.006)	(0.004)	(0.007)	(0.008)	(0.005)
Constant	-0.0562	0.0154	-0.0716***	-0.0498	0.017	-0.0667**	-0.0545	0.0158	-0.0703***	-0.0543	0.0201	-0.0745**
	(0.041)	(0.044)	(0.026)	(0.041)	(0.044)	(0.026)	(0.041)	(0.044)	(0.026)	(0.050)	(0.055)	(0.031)
Observations	348	348	348	348	348	348	348	348	348	285	285	285
R-squared	0.211	0.38	0.538	0.209	0.381	0.533	0.209	0.38	0.535	0.215	0.377	0.548

Source: Eurostat, World Bank, WIFO calculations.

Table 3.39: Estimation results for industry dynamics and all institutional variables

	(1) total	(2) within	(3) str. change	(4) total	(5) within	(6) str. change	(7) total	(8) within	(9) str. change	(10) total	(11) within	(12) str. change
Entry rate	-0.0117*	-0.0067	-0.005									
	(0.007)	(0.008)	(0.005)									
Exit rate				-0.0101	-0.0026	-0.0074						
				(0.010)	(0.011)	(0.006)						
Turnover rate							-0.0063	-0.0028	-0.0035			
							(0.004)	(0.005)	(0.003)			
Share of high growth firms										-0.0041	-0.0064	0.0023
										(0.013)	(0.014)	(0.008)
Interaction with rule of law	0.001	-0.0005	0.0015*	0.0006	-0.0009	0.0015	0.0004	-0.0005	0.0009	0.0014	-0.0013	0.0028*
	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)	(0.002)
Interaction with labour regulation	0.0015*	0.0009	0.0006	0.001	0.0003	0.0007	0.0008	0.0004	0.0004	0.0006	0.0011	-0.0005
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.002)	(0.001)
Interaction with private credit	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Interaction with insolvency time	-0.0001	-0.0001	-0.0001	0.0006	0.0001	0.0005	0.0001	0.0000	0.0001	-0.0001	-0.0007	0.0006
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.002)	(0.002)	(0.001)
ln(active enterprises)	0.0103*	-0.0005	0.0108***	0.0094	-0.0018	0.0112***	0.0102*	-0.0008	0.0110***	0.0068	-0.0023	0.0091*
	(0.006)	(0.007)	(0.004)	(0.006)	(0.007)	(0.004)	(0.006)	(0.007)	(0.004)	(0.008)	(0.008)	(0.005)
Constant	-0.0661	0.0101	-0.0762***	-0.0518	0.0186	-0.0704***	-0.0617	0.0139	-0.0756***	-0.052	0.0196	-0.0716**
	(0.041)	(0.045)	(0.026)	(0.041)	(0.045)	(0.026)	(0.041)	(0.045)	(0.026)	(0.050)	(0.055)	(0.031)
Observations	348	348	348	348	348	348	348	348	348	285	285	285
R-squared	0.222	0.384	0.543	0.212	0.381	0.536	0.216	0.383	0.54	0.217	0.381	0.557

Source: Eurostat, World Bank, WIFO calculations.

Finally, Table 3.39 reports regression results where the interaction terms for all institutional variables are used in one regression. The correlation between the institutional variables likely leads to a reduction other precision of the estimates. Only few results from the single regressions discussed earlier are recovered. First, more flexible labour markets in interaction with a high entry rate increases total productivity gains; however, the baseline effect of the entry rate is negative. About structural change one can observe a positive coefficient on the interaction between the industry dynamics indicator with the Rule of Law for entry and the share of high growth firms. Overall the results suggest that industry dynamics are associated with productivity improvements that stem from structural change and that the quality of institutions plays a central role in this process when it comes to start-ups and high growth firms. There is no statistically significant relationship with the exit rate.

Overall the results suggest that industry dynamics are associated with productivity improvements that stem from structural change and that the quality of institutions plays a central role in this process when it comes to start-ups and high growth firms. There is no statistically significant relationship with the exit rate.

3.4.6.Industry turbulence and Single Market integration

After having investigated the association of industry dynamics with business cycles, with country capabilities and the contribution of industry dynamics to medium-run productivity improvements, the relationship between industry turbulence and the Single Market indicators are studied. The present interest is in the association between Single Market integration and industry turbulence and its interaction with institutions and tradability of output as mediating factors.

The analysis follows the specifications used in sections 3.2 and 3.3 using a panel regression analyses. However, since industry dynamics indicators are available only for the years starting with 2009 for a broad set of EU countries the analysis concentrates on the time 2009 to 2014. Moreover, the focus is not on employment growth but on the industry dynamics indicators. The analysis departs from two models. The first model studies the relationship between industry dynamics and Singe market integration regarding the tradability of the industry output:

$$\mathrm{IDYN}_{i,j,t} = \alpha + \beta_1 \mathrm{MarketInt}_{i,j,t} + \beta_2 \mathrm{Trad}_j + \beta_3 [\mathrm{Trad}_j * \mathrm{MarketInt}_{i,j,t}] + \beta_4 \mathrm{complexity} + u_{ij} + u_t + \varepsilon_{i,j,t}.$$

This first model is used to examine the direct and indirect effects of Single Market integration on industry dynamics. The second model studies the relationship between industry dynamics and institutional characteristics of countries in more detail

$$\mathrm{IDYN}_{i,j,t} = \alpha + \beta_1 \mathrm{MarketInt}_{i,j,t} + \beta_2 \mathrm{Trad}_j + \beta_3 \mathrm{Inst}_{i,t} + \beta_4 [\mathrm{Inst}_{i,t} * \mathrm{MarketInt}_{i,j,t}] + \beta_4 \mathrm{complexity} + u_{ij} + u_t + \varepsilon_{i,j,t},$$

where the dependent variable $\mathrm{IDYN}_{i,j,t}$ is a place-holder for an indicator of industry dynamics over time. $\varepsilon_{i,j,t}$ is the error term that varies over countries *i*, industries *j* and time *t*. Different Single Market integration indicators described earlier are used in the analysis. $\mathrm{MarketInt}_{i,j,t}$ denotes these indicators. The indicators for forward and backward market integration are used, which capture the difference between the value added share of intermediate inputs within the EU and outside the EU and account for direct trade integration and indirect integration via value chains. In addition, export and import integration are used as measures that only capture the direct effects of trade integration.

The measure for tradability (Trad_j) is a characteristic of industry output and varies only over industries. It is defined as a share that indicates to what extent the goods produced in a specific industry are tradable goods. The interaction term $[\mathrm{Trad}_j * \mathrm{MarketInt}_{i,j,t}]$ is used in some models to assess whether market integration strengthens or weakens the impact of tradability on indicators of industry dynamics at the sector level. Variable Inst_i denotes national measures of contract enforcement and property rights (rule of law, $\mathrm{RoL}_{i,t}$), the measure of labour market regulations ($\mathrm{LMR}_{i,t}$) and the measure for financial intermediaries' development (private credit, $\mathrm{PC}_{i,t}$), as well as, duration of the insolvency proceedings (insolvency time, $INS_{i,t}$) as used in the previous section.

Table 3.40: presents the results for the entry and exit rate and Table 3.41: the results for the turnover rate and the share of high growth firms as dependent variables respectively. The columns in the table represent the different regression equations. Five were estimated for each of the industry dynamics indicators. The first three regressions refer to specification 1 and the last two regressions correspond to the second specification. Models (1), (2) and (4) ((6), (7), (9) (11), (12), (14), (16), (17) and (19)) use forward and backward integration along global value chains recovered from the WIDO tables as indicator of Single Market integration. Models (3) and (5) ((8), (10), (13), (15), (18) and (20)) use export and import integration, which captures only the direct integration of a sector in terms of the share of the total imports and exports that come form or are exported to the Single Market. As mentioned before, these indicators are similar to the forward and backward integration with the difference that they capture only the direct integration but not the integration along the entire value chain of a sector in a country.

Table 3.40: Industry dynamics and Market Integration, 2007 – 2014: entry rate and exit rate

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
			Entry rate					**Exit rate**		
VARIABLES										
Forward integration	-0.3291	-0.1746		-2.0937		-3.4998***	-7.3957***		-4.9109	
	(0.588)	(1.153)		(2.002)		(0.982)	(1.927)		(3.336)	
Backward integration	-5.1511***	-6.1326***		-9.1940***		0.0192	-0.5562		-3.6203	
	(0.783)	(1.595)		(2.490)		(1.308)	(2.657)		(4.156)	
Tradeability	1.4048	1.5706	-0.8869	6.6413	-2.8215	-58.2794***	-61.2983***	-63.2643***	-53.6394**	-63.1533***
	(13.095)	(13.118)	(13.226)	(13.396)	(14.193)	(21.733)	(21.762)	(21.935)	(22.272)	(23.621)
Backward integration * Tradeability		3.2731					1.2771			
		(4.650)					(7.778)			
Forward integration * Tradeability		-0.5896					12.5933**			
		(3.265)					(5.448)			
Complexity	-0.0219	-0.0322	-0.0583	-0.0645	-0.1173	0.1156	-0.0172	0.0107	0.0972	-0.0291
	(0.327)	(0.328)	(0.327)	(0.327)	(0.326)	(0.547)	(0.549)	(0.547)	(0.548)	(0.547)
Rule of law	-1.7167***	-1.7251***	-1.7219***	-2.3210***	-2.5922***	1.3004	1.2915	0.9183	0.3591	-0.3096
	(0.605)	(0.605)	(0.602)	(0.635)	(0.669)	(1.025)	(1.025)	(1.021)	(1.085)	(1.138)
Labour regulation	0.4611***	0.4610***	0.5040***	0.4715***	0.5509***	0.6407***	0.6526***	0.6447***	0.8164***	1.0848***
	(0.107)	(0.107)	(0.106)	(0.113)	(0.123)	(0.192)	(0.192)	(0.190)	(0.206)	(0.222)
Private Credit	0.0037	0.0036	0.0036	0.0034	-0.0002	0.0343***	0.0353***	0.0363***	0.0379***	0.0312***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)
Insolvency time	9.4838***	9.4928***	9.3635***	9.8633***	8.1921***	-5.6181	-5.6493	-6.2712	-5.2252	-8.2037*
	(2.719)	(2.720)	(2.749)	(2.782)	(2.957)	(4.498)	(4.496)	(4.543)	(4.613)	(4.910)
Import integration			-5.1073***		-4.2770**			-3.9482**		1.7791
			(1.182)		(1.829)			(1.975)		(3.058)
Export integration			-1.4332***		0.8			-3.1868***		-0.064
			(0.550)		(1.081)			(0.922)		(1.809)
Export integration * Tradeability			2.8772					5.1357		
			(2.030)					(3.393)		
Import integration * Tradeabiltiy			4.9438					8.5271		
			(3.654)					(6.156)		
Backward integration * Rule of law				3.0683***					1.5122	
				(0.783)					(1.315)	
Backward integration * Labour regulation				-0.1823					-0.6050**	
				(0.169)					(0.288)	
Backward integration * Private Credit				-0.0009					0.0055	
				(0.007)					(0.012)	
Backward integration * Insolvency time				0.5492					3.4591**	
				(0.911)					(1.532)	
Forward integration * Rule of law				0.9722					1.6689*	
				(0.595)					(1.003)	
Forward integration * Labour regulation				-0.3348**					-0.5374**	
				(0.133)					(0.224)	
Forward integration * Private Credit				0.0038					0.0186**	
				(0.005)					(0.008)	
Forward integration * Insolvency time				1.5477**					0.55	
				(0.725)					(1.205)	
Export integration * Rule of law					0.4992					0.0659
					(0.334)					(0.561)
Export integration * Labour regulation					-0.2533***					-0.2465**
					(0.059)					(0.099)
Export integration * Private Credit					-0.0008					0.0087*
					(0.003)					(0.005)
Export integration * Insolvency time					0.3221					-0.2424
					(0.422)					(0.704)
Import integration * Rule of law					1.6260***					1.2311
					(0.595)					(1.002)
Import integration * Labour regulation					-0.0962					-0.6943***
					(0.124)					(0.211)
Import integration * Private Credit					0.0058					0.0151*
					(0.005)					(0.008)
Import integration * Insolvency time					-1.0496					-0.2617
					(0.713)					(1.199)
ln(active enterprises)	1.7070***	1.6889***	1.6656***	1.6307***	1.5142***	2.6884***	2.5578***	2.4719***	2.5903***	2.1750***
	(0.339)	(0.341)	(0.339)	(0.341)	(0.339)	(0.568)	(0.571)	(0.567)	(0.571)	(0.569)
Constant	-15.8133*	-15.7221*	-14.2348	-17.1923*	-9.8828	13.2054	14.7643	17.4491	11.3279	21.2905
	(8.807)	(8.815)	(8.902)	(9.007)	(9.619)	(14.561)	(14.569)	(14.711)	(14.929)	(15.969)
Observations	6,473	6,473	6,473	6,473	6,473	6,356	6,356	6,356	6,356	6,356
R-squared	0.762	0.762	0.763	0.763	0.765	0.494	0.494	0.495	0.496	0.497
adj. R-squared	0.72	0.72	0.721	0.721	0.723	0.402	0.402	0.403	0.404	0.406

Source: Eurostat, World Bank, WIFO calculations.
Note: Significance levels: ***p<0.01, **p<0.05, *p<0.1

Table 3.41: Industry dynamics and Market Integration, 2007 – 2014: turnover rate and share of high growth firms

	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
			Turnover rate					Share of high growth firms		
VARIABLES										
Forward integration	-3.6705***	-7.4460***		-6.6991*		-19.1191**	-62.5887***		41.0104	
	(1.184)	(2.322)		(4.022)		(8.499)	(20.651)		(32.349)	
Backward integration	-5.1067***	-6.8102**		-13.6583***		3.8366	19.776		5.8701	
	(1.581)	(3.208)		(5.008)		(10.284)	(22.337)		(33.383)	
Tradeability	-58.9818**	-61.8198**	-65.3950**	-50.5340*	-68.5461**	78.2677	44.9969	-2.0318	145.7802	283.2581*
	(26.335)	(26.373)	(26.539)	(26.960)	(28.476)	(152.835)	(153.373)	(153.451)	(158.285)	(155.905)
Backward integration * Tradeability		5.0596					-58.868			
		(9.405)					(67.378)			
Forward integration * Tradeability		12.1039*					123.5430**			
		(6.570)					(52.256)			
Complexity	0.0964	-0.0493	-0.0463	0.0271	-0.1538	1.2597	0.7558	1.4283	2.265	1.9746
	(0.660)	(0.663)	(0.659)	(0.660)	(0.657)	(4.043)	(4.044)	(4.014)	(4.014)	(3.874)
Rule of law	-0.7304	-0.7457	-1.1257	-2.4644*	-3.3470**	16.3811**	16.1212**	14.1043*	21.8415***	-3.3045
	(1.237)	(1.237)	(1.229)	(1.309)	(1.368)	(7.796)	(7.793)	(7.699)	(8.399)	(8.432)
Labour regulation	1.2681***	1.2796***	1.3201***	1.5095***	1.8650***	-2.9755*	-2.8649*	-2.5633*	-5.1792***	0.3376
	(0.232)	(0.232)	(0.229)	(0.249)	(0.268)	(1.541)	(1.545)	(1.516)	(1.655)	(1.635)
Private Credit	0.0376***	0.0385***	0.0395***	0.0419***	0.0306***	-0.1961**	-0.1747*	-0.1748*	-0.1878*	-0.2621***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.094)	(0.095)	(0.094)	(0.101)	(0.097)
Insolvency time	3.633	3.6211	3.05	4.063	-0.3944	-1.231	-1.3855	-8.7736	19.1659	11.685
	(5.456)	(5.454)	(5.503)	(5.588)	(5.921)	(22.478)	(22.476)	(22.520)	(23.262)	(22.974)
Import integration			-9.4023***		-3.159			-30.1063*		8.2919
			(2.382)		(3.676)			(17.521)		(24.453)
Export integration			-4.5257***		0.8323			-40.3335***		24.7743
			(1.109)		(2.173)			(8.674)		(15.156)
Export integration * Tradeability			8.0047**					79.2997***		
			(4.083)					(27.365)		
Import integration * Tradeabiltiy			14.1873*					75.6712		
			(7.428)					(55.575)		
Backward integration * Rule of law				4.9295***					-22.6015**	
				(1.584)					(9.668)	
Backward integration * Labour regulation				-0.9120***					5.5305**	
				(0.348)					(2.166)	
Backward integration * Private Credit				0.0082					-0.0847	
				(0.014)					(0.096)	
Backward integration * Insolvency time				4.6024**					-8.0603	
				(1.847)					(11.707)	
Forward integration * Rule of law				2.4188**					32.9986***	
				(1.207)					(9.657)	
Forward integration * Labour regulation				-0.8682***					-11.0990***	
				(0.269)					(2.050)	
Forward integration * Private Credit				0.0236**					0.1047*	
				(0.009)					(0.060)	
Forward integration * Insolvency time				2.1077					-12.3977	
				(1.453)					(13.846)	
Export integration * Rule of law					0.5411					22.7659***
					(0.673)					(4.234)
Export integration * Labour regulation					-0.5110***					-6.6495***
					(0.119)					(0.847)
Export integration * Private Credit					0.0085					0.0753**
					(0.005)					(0.032)
Export integration * Insolvency time					0.1252					-8.9836
					(0.847)					(6.628)
Import integration * Rule of law					2.9644**					26.9213***
					(1.204)					(7.168)
Import integration * Labour regulation					-0.8543***					-7.5792***
					(0.254)					(1.586)
Import integration * Private Credit					0.0235**					0.0076
					(0.010)					(0.064)
Import integration * Insolvency time					-0.9644					9.322
					(1.441)					(9.839)
ln(active enterprises)	4.3522***	4.2000***	4.0940***	4.1597***	3.6222***	9.4072	8.7349	8.3505	6.9696	5.5804
	(0.684)	(0.688)	(0.682)	(0.688)	(0.683)	(7.097)	(7.093)	(7.057)	(7.091)	(6.806)
Constant	-1.5615	0.0829	3.6253	-3.7294	12.8413	-78.8621	-64.343	-27.6764	-122.1142	-150.684
	(17.672)	(17.682)	(17.824)	(18.103)	(19.273)	(88.443)	(88.634)	(89.006)	(92.027)	(92.221)
Observations	6,331	6,331	6,331	6,331	6,331	2,478	2,478	2,478	2,478	2,478
R-squared	0.718	0.718	0.719	0.719	0.722	0.362	0.364	0.372	0.383	0.426
adj. R-squared	0.666	0.666	0.668	0.668	0.671	0.00548	0.00789	0.0205	0.0336	0.101

Source: Eurostat, World Bank, WIFO calculations.
Note: Significance levels: ***p<0.01, **p<0.05, *p<0.1

Regarding tradability, the results show a negative effect of tradability on the exit rate and on the turnover rate, while entry and for the share of high growth firms one cannot establish clear statistical significant relations across the different specifications and models. Considering the interaction terms, there is a positive interaction terms for forward integration for the exit rate, the turnover rate and the share of high growth firms.

Forward integration has a negative effect on exit and consequently as it has no statistically significant effect on the entry rate on the turnover of firms. The forward integration into value chains seems to stabilise the firm dynamics by reducing exit. However, its impact is also negative for the share of high growth firms (models (16) and (17) but not (19)). Backward integration in contrast has a negative impact on entry. Backward integration into value chains seems thus to create entry barriers, while not creating exit barriers. The impact on turnover is thus negative and the share of high growth firms seems not to be affected in a systematic way by the backward integration. The interaction term of forward integration with tradability is positive – as mentioned earlier. Forward integration creates industry dynamics (increases the exit rate) but also creates opportunities for high growth firms, but not for start-ups.

For export and import integration one can observe negative coefficients for the entry rate, the exit rate, the turnover rate and the share of high growth firms. Thus, a larger direct integration into the Single Market reduces industry dynamics across all indicators. The likely mechanism behind this phenomenon is that a higher import and export integration is associated with larger fixed (entry) costs. Therefore, one would expect that opportunities for entrants are lower because (fixed) entry costs are higher in markets with high import or export integration than in markets that show lower import and export integration. However, the interaction with tradability suggests for the turnover rate and the share of high growth firms that tradability reduces the negative impact of export integration on industry dynamics via the generation of opportunities for firms and especially high growth firms in tradable sectors that display high export integration. Thus, the direct effects of Single Market integration seem to be more relevant for industry dynamics, especially for high growth firms in tradable sectors. Together with the results of the sections 3.2 and 3.3 and the previous analysis of medium-run productivity (section 3.4.5) suggests that most productivity growth comes from established enterprises, not necessarily from industry dynamics associated with the change in producer identities or high growth firms.

The coefficients on the institutional variables show in general a negative relationship of the entry rate with the rule of law that mirrors the results from the country capability analysis in section 3.4.3. Freer labour markets are associated with higher entry rates and the credit to the private sector seems to have a (weakly) statistically significant association to the entry rate. Regarding the exit rate there is no statistically significant association to the rule of law. The labour market regulations increase the number of exit, as does the indicator of credit to the private sector. For the turnover rate, there is a positive association to labour market regulations and to the availability of credit. For the share of high growth firms the association with the rule of law is positive, interestingly there is a negative association with freer labour markets. While freer labour markets do increase the industry, dynamics related to entry and exit, they are not favourable for the share of high growth firms. Similarly, surprising is the result for the credit to the private sector. While industry turbulence is increased by more credit to the private sector the association with the share of high growth firms is (weakly) negative statistical significant. Interestingly, insolvency time is not statistically significant, probably reflecting the fact, that some of the efficiency of insolvency proceedings are already incorporated in the more general variable rule of law.

Specifications (4) and (5) for the entry rate (and (9), (10), (14), (15), (19) and (20) for the other indicators analyse the interaction between Single Market integration indicators and institutions in more detail. The results for the entry rate show backward integration in countries with well-developed judicial system is favourable to entry. This is mirrored by the result for import integration. In contrast labour market regulation has a negative sign for both export and import integration. For the exit rate, a negative effect of forward integration and the labour market regulation and positive effect of forward integration with credit to the private sector is observed. Interestingly, there is a positive interaction coefficient of the indicators insolvency time with backward integration for the entry rate. This implies that longer bankruptcy proceedings are associated with higher entry rates when backward integration is high. The results for import and export regulation for the exit rate show that freer labour markets together with a high export or import integration reduce the impact on exit, while more private credit to the private sector in combination with high export or import integration increases the exit rate.

The results for the entry and exit rate are mirrored by the turnover rate. Freer labour market regulations associated with high forward, backward, import or export integration reduce the turnover of firms, while the availability of credit to private sector increases the turnover of firms when the Single market integration is high.

The results for share of high growth firms show a differentiated picture. The quality of the legal system matters for the share of high growth firms especially with high levels of Single Market integration. The coefficient is positive for forward integration, import integration and export integration. On the other hand, however, a better legal system has a negative effect on the share of high growth firms in the case of backward integration. Regarding labour regulation this section recovers the results from the productivity analysis in the previous section. There is a negative interaction term of labour regulations/flexibility. A more flexible labour market is associated with a lower share of high growth firms with high export, import and forward integration. Only with backward integration a higher labour flexibility leads to a larger share of high growth firms. This result seems to contradict standard assumptions, where more flexible labour markets should increase efficient reallocation of resources. The share of high growth is a measure of reallocation dynamics. However, the labour market literature also emphasizes that high labour market flexibility may adversely affect incentives of employees to invest in firm-specific human capital. If high firm growth requires also firm-specific human capital, higher labour market flexibility could affect firm growth in potential high growth firms negatively. The third institutional indicator, credit to the private sector, has a negative statistical significant baseline effect. The interaction terms are statistically significant and positive for the forward integration and export integration, but no statistically significant interaction term is found for the backward integration and import integration. This suggests that the quality of the financial system is especially relevant for high growth firms in countries/sectors that offer export opportunities (high forward or export integration). Together with the results for the turnover rate this confirms that the quality of the financial system matters of industry dynamics, especially for more ambitious high growth firms. Interestingly there is no statistically significant interaction term involving insolvency regulation, hinting at the fact that the interaction between the efficiency of insolvency regulation and the share of high growth firms may be associated primarily with the overall quality of the legal system (rule of law) and not with some very specific details of the insolvency law that affect the duration of resolving a business.

3.4.7.Summary

This section investigated the role of industry dynamics in structural change and Single Market integration using four different indicators of industry dynamics. The analysis led to some important findings. The analysis confirms that industry dynamics indicators are not independent of the business cycle. Entry rates and the share of high growth firms are procyclical, exit rates anticyclical and for the turnover rate no statistically significant association was found.

More important are structural differences across countries. Already the descriptive evidence shows considerable heterogeneity regarding industry dynamics indicators across EU Member States. Industry turbulence - entry, exit and the turnover of firms - seems to be decrease with the relative economic position, while the share of high growth firms seems to decrease with the distance to frontier countries. This is confirmed by a country-level analysis of the associations of country capabilities and industry dynamics indicators. Industry turbulence shows a negative association with indicators that are associated with better institutions and higher knowledge intensity, while for the share of high growth firms a positive albeit not significant relationship is found. However, the industry level analyses show that institutions matter for both industry turbulence and high growth firms. For labour productivity improvements one can observe an influence of industry dynamics only for productivity improvements associated with structural change that is generally mediated by institutional factors – government effectiveness, Rule of Law and labour market flexibility. This finding suggest that an appropriate institutional setting (high government effectiveness, Rule of Law and an intermediate level of labour market flexibility) are needed so that industry dynamics can have an impact on productivity improvements associated with structural change. However, the impact on overall productivity is low, as no statistical significant association was found for industry dynamics indicators and overall labour productivity improvements.

The central role of institutions for industrial dynamics was also confirmed in the last analysis that investigated the relationship between Single Market Integration and Industry dynamics indicators. Industry dynamics indicators are affected by Single Market integration. Forward and backward integration into Single Market value chains have in general a negative effect on turnover rates, as has tradability. However, tradability affects positively opportunities for high growth firms when forward integration is high, that is, when value chains offer growth opportunities for firms. This is confirmed by the direct effects of trade integration measured by export integration. Moreover, forward integration leads to a decrease in the entry rate and backward integration reduces exit rates. Regarding institutional quality there are positive effects of the rule of law the positive mediating effects of rule of the law on industry turbulence (especially backward integration and import integration), while labour market flexibility seems to have a mixed effect on industry turbulence and high growth firms. An intermediate level of labour market flexibility seems to be associated with both higher turnover rates and a higher share of high growth firms.

3.5. Producer price developments and the Single Market

Prices are assumed to mirror aspects of competitiveness. The study of prices is difficult. Albeit economics as a research discipline assigns central roles to prices and their development, there is no unified (and unifying) price theory. A wide range of different price measures are applied (consumer or producer prices, relative prices, price levels etc.) to an equally wide range of topics, such as the analysis of competition on consumer or factor markets, exchange rate adjustments or eventually macro-economic inflation dynamics (Weyl, 2015).

There is a long history of research on the interplay of prices and competitiveness. Perhaps the starting point is the Harrod-Balassa-Samuelson model, which departs from the observation that levels are higher in wealthier countries. It strongly resembles the TNT framework (Sachs and Larraine, 1993) insofar that it splits the economy into the same two sectors. In an open economy model, it argues that prices in the tradable sector are determined internationally as a function of country and sector specific productivity levels and transport costs. Prices of nontradables are determined domestically by other factors such as the overall macroeconomic development or wage policies (Kravis and Lipsey, 1983). However, the Harrod-Balassa-Samuelson model focuses on adjustments through prices, especially exchange rate mechanisms (Samuelson, 1994; Tica and Družić, 2006; Mihaljek and Klau, 2004; Asea, Corden, and others, 1994).

Hence the Harrod-Balassa-Samuelson notably differs from the structural tradable-nontradable model, which expects adjustment dynamics in the sectoral composition, and to a lesser extent via prices. Either adjustment mechanism plays a prominent role in neoclassical imbalance analysis, and both are commonly used by international institutions in their assessment of rebalancing processes (Tressel et al., 2014). Another established line of price research comes from a structural background, and hinges on the thoughts of Baumol, who argued that technologically stagnant sectors experience above average cost and price increases. This would lead to a rising share of national output, and slow down aggregate productivity growth (Baumol, 1967; Heilbrun, 2003; Baumol, Blackman, and Wolff, 1985; Ghavidel and Narenji Sheshkalany, 2017). While there is a plethora of studies in the tradition of Baumol's 'cost disease', evidence remains mixed, and it is hard to extract stylised findings (Nordhaus, 2006).

The following draws on these strands of literature, and provides empirical evidence on the developments of deflators across sectors. These are an indicator of producer price inflation. The chapter first splits the economy into a tradable and a nontradable sector, which serves as a basis to compute weighted price indices. Their development not only varies across countries, but also across sectors (within the tradable framework). Next, the changes in producer prices are confronted with policy aspects and Single Market indicators in a series of panel regressions.

Price adjustments play an important role in rebalancing mechanisms. Given the unbalanced growth within economies that later suffered from structural imbalances, one would expect asymmetric price developments across sectors. Drawing on the TNT model and Baumol's cost disease a straightforward expectation would be that tradables' prices increase at a slower rate than nontradables' in periods where imbalances evolve. One possible explanation is that there are differences in the degree of competition. While tradables are traded internationally by definition, and therefore exposed to international competition that can be assumed to lower prices, nontradables are sold only domestically, which implies a strong tendency to lower degrees of competition. Certainly, the impact of growth of a bigger role of nontradables in the sector composition is ambiguous, since it is the outcome of both relative prices and overall, often declining output. Baumol typically assumed demand to be price-inelastic, i.e. growth of nontradables would lead to rising shares of nominal output in stagnant industries (Nordhaus, 2006; Ghavidel and Narenji Sheshkalany, 2017).

These considerations serve as the conceptual underpinning for the study of price developments from a structuralist perspective. The following will explore two questions. First, it asks if price developments in tradable sectors were different than in nontradables across EU Member States. Second, does European integration explain producer price developments?

3.5.1.Descriptive statistics from a TNT perspective

The following analysis focuses on producer price indices, i.e. deflators at the sector level. The tradable-nontradable framework is used to construct sector specific price indices (Dixon et al., 2004). The presently used prices are based on Eurostat deflators (B1G_PD10_EUR; "Price index (implicit deflator), 2010=100, euro"). These pose a supply-side measure of production costs at the sector level. The index is a weighted sum of the price dynamics at the industry level.

The price indices for tradables and nontradables are calculated in a stepwise manner. First, deterministic industry weights are defined. This is, the share of tradables and nontradables are calculated for the entire period analysed, which covers the years 2000 to 2014. To this purpose, the total deflated value added produced by each sector is computed, and then put into context by the overall value added. Second, these time-invariant industry weights are used to compute the aggregate shares of tradables and nontradables. Due to missings in some countries' samples, the sectors U and T are not considered. Third, the deflators are recalculated so that they use the year 2000 as the common base. These indices then allow comparing the price dynamics of both tradables and nontradables.

This type of analysis is in the tradition of the Harrod-Balassa-Samuelson model, which provides a conceptual foundation for the observation that price levels differ across countries, with richer economies also having more price levels. While prices in the tradable sector are determined internationally as a function of productivity and transport costs (assuming an open economy), prices of nontradables are determined domestically by other (e.g., macroeconomic) developments (Kravis and Lipsey, 1983). This idea triggered a large amount of research, typically focusing on exchange rates which are argued to exaggerate real incomes in wealthier economies with a more productive tradable sector, but an equally productive nontradable sector (Samuelson, 1994; Tica and Družić, 2006; Mihaljek and Klau, 2004; Asea, Corden, and others, 1994).

A slightly different interpretation offers the Baumol model, which perceives inflation of nontradable prices not as an implicit currency appreciation as in the Balassa-Samuelson model, but rather as a shift towards a 'stagnant sector' which is then results in a 'cost disease. Tradable goods inflation declining and nontradables inflation rising is the key mechanism through which adjustments in the tradable-nontradable model occur. In other words, the relative price developments explain the relative shift in production shares (Hunt, 2009; Baumol, 1967).

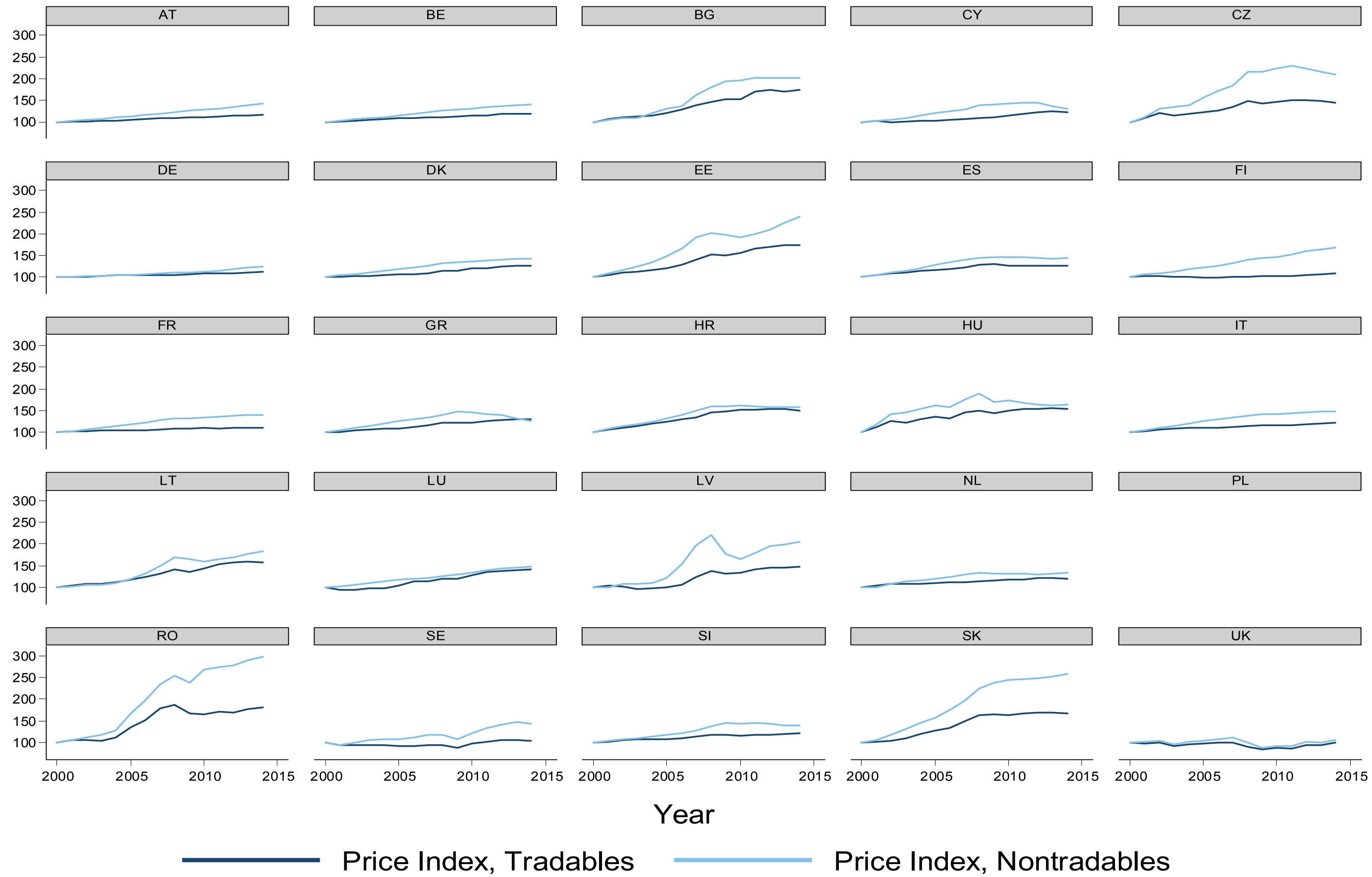
The results show heterogeneous price developments across countries (see Figure 3.25).[26] Price increases tend to be higher in CEE countries than in Core European or countries in Southern Europe. The price ratio of tradables to nontradables can be interpreted against a real exchange rate framework (Sachs and Larraine, 1993). A country appreciates its currency in real terms if the prices of nontradables increase at a faster pace than the prices of tradables. The price developments of tradables and nontradables are remarkably similar in the bulk of countries of the sample. These graphs suggest that a Baumol-type cost disease is hardly observable from a rather broad macroeconomic perspective. However, there are notable exceptions. Especially in Finland, Romania, Latvia, Slovakia and the Czech Republic the producer prices of nontradables seem to increase faster than in tradables.

Drawing on these indicative results, the sector specific price index (B1G_PD10_EUR, an implicit deflator provided by Eurostat) is explained in an exploratory analysis. To arrive at sector specific inflation rates, the price differences from one period to another are calculated in natural logs. The results not only differ across countries, but also across sectors.

[26] These developments are robust to the exclusion of 'Real estate activities' (L); see Figure 3.41 in the Annex.

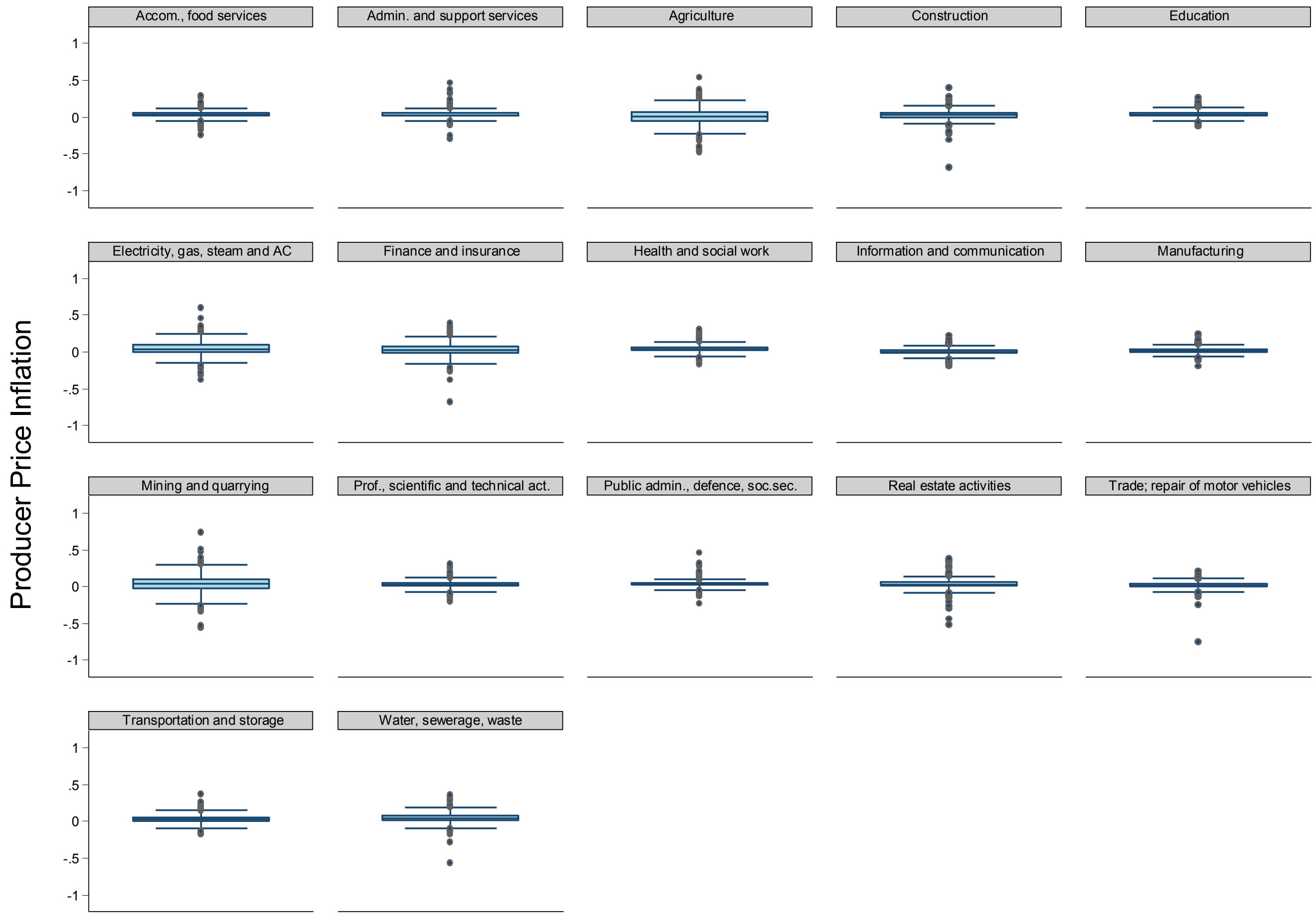
Figure 3.26 uses boxplots to illustrate these performance differences. Some sectors exhibit particularly large variance in their pooled price deflators over countries. These are ‚Agriculture, forestry and fishing', 'Financial and insurance activities' and 'Electricity, gas, steam and air conditioning supply'. Nontradable sectors such as 'Human health and social work activities', 'Education', 'Real estate activities' or 'Public administration and defence; compulsory social security' exhibit rather small levels of variance (see also Table 3.42). This suggests different factors determining price developments across sectors. For instance, the deflator developments of tradables may be more affected by prices of raw materials.

Figure 3.25: Price developments of tradables and nontradables across countries



Source: Eurostat, WIFO calculations.
Note: There are data issues with the deflators in Ireland. The price indices for Poland were only available since 2003 and are therefore not directly comparable. Data for Malta are missing.

Figure 3.26: Boxplots of producer price changes in natural logs across sectors



Source: Eurostat, WIFO calculations.

3.5.2.Price dynamics and the Single Market in an exploratory regression analysis

The following explores the factors driving the sector specific price developments. Price changes are explained as a function of factors capturing both global and country specific developments. Also, cyclical components are controlled for to identify structural aspects (Aisen and Veiga, 2008, 2006; Friesenbichler, 2016).

The dependent variable is the country and sector specific inflation rate of producer costs. This indicator is defined as the change in the price deflators in natural logs; the year 2000 is used as the common base. To address possible concerns about non-stationarity, the indicator is estimated in first-differences. A Levin-Lin-Chu panel unit-root test rejects the null hypothesis of a unit root in favour of the alternative hypothesis of stationary data. Also, a Fisher-type panel unit-root tests fitting an augmented Dickey-Fuller regression for each panel reject non-stationarity (Choi, 2001).

The first explanatory variable is a continuous tradability index capturing tradability as an industrial property. Following the tradables-nontradables framework, it is expected that producer prices of tradable goods and services are the results of a more competitive market selection, and should therefore exhibit lower inflation rates of producer prices. Hence, a negative sign is expected. Yet, it is also conceivable that industries that are more open to trade are more exposed to external price shocks which potentially increase producer prices. Then again, they might also be better able to absorb such shocks.

To capture the effect of the Single Market, the backward and forward integration indicators are used. Both indicators are defined as 'surplus indicator', i.e. they capture the difference between linkages with EU Member States and non-EU Member States. In addition, both backward and linkages from EU and non-EU countries are considered separately as a robustness check. The backward integration indicator measures the share of the inputs in a sector's induced value added sourced from other EU Member States relative to non-EU countries. Higher levels of international sourcing should lower price increases. Hence a negative sign is expected. The forward indicator – defined as the share of final demand of a sector's induced value added consumed abroad – is to be interpreted differently. It is conceivable that a Member State hardly sells its goods and services to other Member States, but rather partakes in extra-EU trade. It is therefore an indicator that also reflects demand structures. The forward integration indicator may on the one hand reflect different positions in the value chain. On the other hand, it might also be a sign of lacking competitiveness. This ambiguity does not allow making a straightforward hypothesis about the directionality of the effect. The sign of the coefficient is unclear. All trade indicators are based on WIOD data.

Two additional variables capture important institutional aspects that affect price dynamics. First, the EU membership status is considered. In the period analysed, there were several enlargement waves. EU accession requires countries to implement the Acquis Communitaire, and different stages of membership have different effects on the institutional environment. There is evidence that EU membership improves the institutional quality, and generates a more competitive and fairer playing field for firms (Böheim and Friesenbichler, 2015; Hölscher and Stephan, 2009; Dimitrova, 2010). As a result, EU-membership, as opposed to being a candidate country, should lower price developments. A set of dummy variables are defined taking on the value of one if a country can be assigned to a certain membership status (Member State, accession candidate, no accession candidate) and zero otherwise. Second, the common monetary policy of the European Central Bank is captured by a dummy variable taking on the value of one if a country uses the Euro, and zero otherwise. These indicators have been constructed using publicly available information on the enlargement and the monetary union provided by the EU.

An important determinant of price developments is the macroeconomic environment. The GDP trend based output gap is used as a relative measure of demand and supply conditions of the domestic economy. If the output gap is negative, the actual output is less than its potential output, which is a symptom of a weak macro-economy showing deflationary tendencies. If it's positive, the macro-economy performs better than its long run trend, which is associated with economic boom periods. This leads to an expected positive sign of the coefficient for the output gap. The output-gap also mirrors the real interest rate gap, which is the difference between the observed real interest rate - that is, the nominal short-term interest rate minus expected inflation - and the natural rate of interest. Hence the output-gap provides a measure for monetary policy, and is therefore preferable to other cyclical measures such as GDP growth (Cúrdia, 2015; Cúrdia et al., 2015). Since higher inflation rates are associated with poor macro-economic performance, a positive relationship between the output-gap and sector specific price increases is expected (Fischer, Sahay, and Végh, 2002). The indicator has been retrieved from the AMECO database.

Two additional control variables capture price developments on international markets. First, a raw material price index obtained from the Hamburg Institute of International Economics (HWWI) is used (HWWI, 2015, Gesamt index Euro, B). This index is held in Euros, and considers price developments of a wide range of raw materials, including crude oil.[27] A second index controls for the real effective exchange rate. This indicator is provided by Eurostat and poses an import and export weighted rate of effective exchange rates which considers a total of 42 countries.[28] One can expect this raw material index to be positively, and the foreign exchange rate index to be negatively associated with sector specific producer price inflation (Aisen and Veiga, 2006).

In addition, global developments are included by three-year time dummies, beginning with the period 2000 - 2002 until 2012 - 2014.

Let DEFL denotes the producer price deflator in year t of each panel group j, which is defined at the country-sector level. INT denotes trade based integration indicators, STATUS defines the EU membership status. MACRO stands for macroeconomic control variables, such as the raw material price, output gap or part of the Eurozone. TIME stands for time dummies. The intercept and the fixed effects are captured by α; the β is the estimated coefficient for each variable, and υ is the fixed effects panel error term. Hence, the estimated equation can be expressed as follows:

(Eq. 3-4) $$\Delta DEFL_{j,t} = \alpha_j + \beta_1 INT_{j,t} + \beta_2 STATUS_{j,t} + \beta_3 MACRO_{j,t} + TIME_t + \upsilon_{j,t}$$

[27] For further details, see http://hwwi-rohindex.de/index.php?id=8875&L=1 (retrieved on 9 May 2017).

[28] For further details, see https://ec.europa.eu/info/business-economy-euro/indicators-statistics/economic-databases/price-and-cost-competitiveness_en (retrieved on 9 May 2017).

Table 3.42: Descriptive statistics of price developments and its explanatory variables

	Mean	**Median**	**S.d.**	**Min**	**Max**
Price change, nat.log	0.03	0.03	0.08	-0.75	0.74
Tradability	0.25	0.26	0.18	0.01	0.63
B.w. integration	0.06	0.08	0.21	-0.84	0.64
F.w. integration	0.00	0.00	0.25	-0.97	0.69
B.w. (EU)	0.09	0.08	0.06	0.01	0.45
B.w. (Non-EU)	0.08	0.07	0.06	0.00	0.56
F.w. (EU)	0.15	0.12	0.13	0.00	0.80
F.w. (Non-EU)	0.14	0.11	0.12	0.00	0.87
No candidate	0.01	0.00	0.12	0.00	1.00
Candidate	0.15	0.00	0.36	0.00	1.00
Member State	0.83	1.00	0.38	0.00	1.00
Euro	0.66	1.00	0.47	0.00	1.00
Output gap (trend GDP)	0.27	-0.05	4.15	-13.38	19.94
Raw Materials	1.00	0.99	0.38	0.48	1.56
FX	1.01	1.00	0.08	0.76	1.33

Source: WIOD, Eurostat, European Commission, Böheim and Friesenbichler (2015), HWWI, WIFO-calculations.

Table 3.42 provides the descriptive statistics for the variables. A series of regression techniques are used to explain the differences in price developments. The main regression technique implemented is a fixed effects model where the dependent variable is estimated in first differences. This also renders a lagged dependent variable estimator futile. A straightforward fixed effects regression of the lagged deflator in levels on its contemporaneous values finds an AR(1) coefficient of 0.88 (p-value: 0.000). Implementing this regression in first differences solves the autoregression issue; the coefficient drops to 0.03 and turns statistically insignificant (p-value: 0.261). However, a Wooldridge test rejects the null-hypothesis that there is no first-order autocorrelation in the error term (p-value: 0.001), which is why a fixed effects model with disturbance terms that are first-order autoregressive is estimated (Wooldridge, 2010). In addition, OLS regressions with clustered standard errors at the country-industry level are estimated, and estimation applies industry specific weights. The weights are defined as time invariant employment shares of each sector.

Table 3.43 presents the regression results. Two approaches have been chosen which differ in their set of control variables. First, price changes are merely perceived as a function of the Single Market and time specific trends. Second, price changes are perceived as an outcome of not only the Single Market, but also a wider set of institutional variables and policy variables. To test for the robustness of the results, only the public sector is estimated separately. In the specifications (8) and (9) only the industries 'Public administration and defence; compulsory social security' (O), 'Education' (P) and 'Human health and social work activities' (Q) are considered.

Table 3.43: Regression results of sector-specific price developments

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	OLS (cl. S.e.)	FE, AR1	OLS (cl. S.e.)	FE, AR1	FE, AR1, weights	FE, AR1	FE, AR1	OLS (cl. S.e.)	FE, AR1
Tradability	-0.02***		-0.02***					-0.31	
	(0.008)		(0.007)					(0.191)	
B.w. integration	-0.02**	-0.06***	-0.02***	-0.04**	-0.04***		-0.04**	-0.02	-0.02
	(0.006)	(0.018)	(0.006)	(0.018)	(0.016)		(0.017)	(0.019)	(0.030)
FW integration	0.02***	-0.01	0.01***	-0.02	-0.02*	-0.02		0.02*	-0.04**
	(0.005)	(0.013)	(0.006)	(0.012)	(0.011)	(0.012)		(0.011)	(0.016)
B.w. (EU)						-0.21***			
						(0.079)			
B.w. (Non-EU)						0.04			
						(0.068)			
F.w. (EU)							0.02		
							(0.037)		
FW (Non-EU)							0.07**		
							(0.033)		
Candidate			-0.01	-0.02*	-0.01	-0.02**	-0.02*	0.02	-0.01
			(0.009)	(0.012)	(0.010)	(0.012)	(0.012)	(0.012)	(0.019)
Member State			-0.03***	-0.03**	-0.02*	-0.03**	-0.03**	-0.02	-0.03
			(0.009)	(0.014)	(0.011)	(0.013)	(0.013)	(0.012)	(0.021)
Euro			-0.01*	0.00	0.01	0.01	0.00	-0.01	0.02
			(0.003)	(0.007)	(0.006)	(0.007)	(0.007)	(0.006)	(0.011)
Output gap			0.00***	0.00***	0.00***	0.00***	0.00***	0.01***	0.01***
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
FX			0.05***	-0.03	-0.02	-0.05**	-0.04**	0.07***	-0.01
			(0.014)	(0.022)	(0.018)	(0.021)	(0.022)	(0.023)	(0.034)
Raw materials			0.04***	0.04***	0.03***	0.04***	0.04***	0.01	-0.00
			(0.007)	(0.005)	(0.004)	(0.005)	(0.005)	(0.010)	(0.008)
Constant	0.02***	0.01***	-0.05***	0.02	0.01	0.06**	0.03	-0.01	0.06*
	(0.003)	(0.002)	(0.019)	(0.026)	(0.021)	(0.029)	(0.027)	(0.029)	(0.038)
Observations	6,141	5,702	5,882	5,460	5,460	5,460	5,460	1,049	974
R-squared	0.041	0.0427	0.087	0.0809	0.101	0.0852	0.0855	0.293	0.286

Source: WIFO calculations.
Note: Three-year period dummies are included in each specification. Clustered standard errors at the country-sector level in parentheses for the OLS regressions, AR(1) s.d. for the fixed effects specifications; ***$p<0.01$, **$p<0.05$, *$p<0.1$; Within R^2 in all fixed effects specifications. Specifications (8) and (9) only contain the public sector comprising Public administration and defence; compulsory social security (O), Education (P) and Human health and social work activities (Q).

In line with the TNT model and Baumol's cost disease, the coefficients for tradability indicate a negative effect on price developments. Hence, the more tradable a sector's goods and services are the lower the increases in producer prices. This finding adds to the results from the illustrations of price developments in a two-sector model, which – by and large – did not substantial differences between tradables and nontradable. Even though the coefficients indicate the presence of Baumol type cost disease, this effect is rather small. The coefficient is 0.02, which corresponds to a quarter of the standard deviation of the price increases in natural logs. This effect can only be examined in the OLS regressions, because this indicator is time invariant and sector specific, i.e. it only varies across sectors. The other regression techniques are panel estimators that control for country-industry specific effects which drop this indicator if considered.

The coefficients for backward integration in the internal market are negative. In line with expectations, a deeper integration in the Single Market reduces sector-specific increases of producer prices. The results for the forward integration indicator are mixed. While in the OLS regressions find a positive and statistically significant sign, the estimated coefficient turns negative and insignificant in the fixed effects estimation. The signs changes in the specification using industry size weights, however. Hence the indicator cannot be interpreted in a robust manner. Using the shares of imports from EU and non-EU countries separately warranted statistically significant results for backward integration with EU countries, which was again found to be producer price inflation reducing. Forward linkages to non-EU countries were found to accelerate price increases.

The EU enlargement influenced sector-specific price developments. The coefficients of the dichotomous variables indicate that especially Member States have lower inflation rates of producer prices than other countries. The signs for the Euro changes across specifications, and are only weakly significant.

The control variables perform as expected. The signs of the coefficients for the output gap and raw material index are positive, and the real foreign exchange rate index is negative, even though not statistically significant in all specifications. The unreported time dummies are statistically significant.

The robustness checks of specification (8) and (9) that only consider the public sector showed the expected results. The coefficients for the tradability index, the backward integration indicator, the raw material indicator and foreign exchange index are statistically insignificant; the results for forward integration were weakly significant, yet with ambiguous signs. These results are in line with the thought of the public sector as a 'nontradable' sector, whose price developments hardly depends on value chain embeddedness. The coefficient for EU accession remains negative, yet only weakly significant. This does not support the conjecture that EU accession has increased prices in the public sector. The only statistically significant control variable is the output gap, with the expected positive sign. The high R^2 is striking – almost 30% of the variance are explained by the statistical model.

3.5.3.Summary

Drawing on the tradable-nontradable framework, this chapter uses producer price deflators at the sector level to explore price developments. First, the tradability dimension is considered, and the economy is split into a tradable and nontradable sector, and then a weighted producer price index is calculated. The results indicate that producer prices of nontradables increase faster than the prices of tradables. This can be interpreted against the conceptual background of a Baumol-type cost disease, or an implicit currency appreciation of Balassa-Samuelson. However, its average extent is rather small, even though this effect is substantially larger in some countries than in others. The price development not only varies across countries, but also across sectors. The variance of price changes in the tradable sectors seems to be larger than in nontradables. There is evidence in many CEE countries that nontradables' prices increase at a faster rate than prices of tradables. A country appreciates its currency in real terms if the prices of nontradables increase at a faster pace than the prices of tradables.

Second, the changes in producer prices are confronted with aspects of European integration. These include policy dimensions and trade related Single Market indicators. A series of panel regressions was implemented to ensure robustness. Backward integration with other European economies was found to reduce the producer price inflation; the results for forward integration were mixed, and not sufficiently robust to be interpreted in an unambiguous fashion.

EU Membership Status was considered as an additional explanatory factor, since EU membership requires implementing the Community Acquis, the accumulated legislation, legal acts, and court decisions which constitute the body of European Union law. The estimation captured the effect of change in the status of accession countries. Especially becoming a Member State was found to lower price increases than other countries. In addition, the robustness checks did not support the conjecture that EU accession has increased prices in the public sector. Being part of the Euro zone showed ambiguous results. These findings are to be interpreted in a causal manner, since control variables control for cyclicality and time effects, and the findings performed as expected.

3.6. Summary and policy implications

This chapter took a Single Market perspective to discuss a wide range of topics that affect selected aspects of competitiveness. These comprise the relationship between sector performance and economic institutions, the role of industrial dynamics, shifts in demand patterns and producer price developments. The eclectic approach implies that the main dependent variables differ across the subchapters. Each subchapter concluded with a brief summary. Hence, the following proposes a joint interpretation of the findings. These are policy relevant – for the EU as a whole on the one hand, and for national policy makers on the other hand.

General demand trends

The growth diagnostics work (see Chapter 2) linked tradability to structural change. However, the TNT framework is – by and large – a supply side, structuralist model that tends to focus on external competitiveness. Thus, it only implicitly considers demand side aspects. While this model perceives a high share of nontradables as a sign of poor competitiveness, consumption studies offer an alternative explanation. It seems that (at least certain) nontradable goods and services are increasingly consumed as countries grow in their wealth. Hence, the question of the evolution of consumption patterns arises, as well as how these are linked to the Single Market. Two different phenomena became evident. On the one hand, there is a trend to the consumption of nontradables. On the other hand, there is a continuing integration and internationalisation process.

A change of demand is the outcome of changes in total consumption and changes of the types of goods and services consumed, which is why a shift-share analysis was implemented to decompose these effects. In the first half-decade, there were substantial changes in the commodity structure across all EU Member States. The consumption of nontradables grew rapidly at the expense of domestically produced tradables. This development was equally borne by intermediate demand and private consumption. In later years, nontradables lost some of their shares to imported tradables from both within and outside the common market. There are substantial country differences, however. The economies in the South witnessed a massive boom in the consumption of nontradables, which came at the expense of tradables from all three sources (domestic, intra-EU and extra-EU). In the aftermath of the crisis, these countries returned to a consumption pattern which corresponds with the demand pattern of other countries.

These dynamics in nontradables are mirrored by an increase in international economic activity. How do the demand shifts link to the single market with respect to import and export structures? Overall, the consumption of domestically produced goods has decreased, and both imports and exports have increased more than proportionally. In Europe, extra-EU imports grew more quickly than intra-EU imports. Also, extra-EU exports grew more quickly than their intra-EU exports, mirroring the growing importance of an extra-EU destination. This trend is particularly driven by 'Core countries, which could expand their net export surplus vis-a-vis the "Rest-of-the-World". The countries of CEE and the South region could diminish their trade deficits, and were rather integrating into the Single Market than seeking extra-EU trading partners.

Integration indicators

Against this background, the question of the effects of market integration arises. European integration is measured by two dimensions, by EU membership itself and by trade related integration indicators. A third indicator captures the general 'tradability of goods and services' produced and is used as a sectoral property affecting competitiveness.

The first indicator used examines the effect of EU membership. Joining the European Union requires implementing the Community Acquis, the accumulated legislation, legal acts, and court decisions which constitute the body of European Union law. It has been shown that the accession process brings about not only trade openness, but also institutional change. This alters the business climate, and seeks to generate a level playing field for entrepreneurs.

Second, participation in the Single Market is captured by two value chain trade measures. Both indicators are based on WIOD data, and consider an upstream (backward linkage) integration measure, and a downstream (forward linkage) measure. These indicators were linked to employment and labour productivity in levels and growth rates, as well as industrial dynamics.

Eventually, the general tradability of a sector was used as a control variable capturing a general sectoral property. This aspect can be interpreted as a precondition to (forward) market integration, whose correlation with trade-based integration measures is remarkably low. Tradability is positively associated with value added and negatively with employment. Tradability seems to reduce producer price inflation, which can be interpreted as an indication of a Baumol type cost disease. Also, the more tradable a sector is, the lower its firm turnover rates are, which may reflect sunk costs. Tradability also reduces the firm turnover in each sector, and improves opportunities for high growth firms.

EU Membership and economic the catching-up of New Member States

A status index was defined to capture the effect of accession processes, i.e. the impact of switching from being a candidate country to a Member State. This status variable was considered as an explanatory factor over and above effective trade related integration measures. The results robustly show that becoming a Member State increases sectoral value added and employment and lowers producer price inflation. Both indicate a more efficient allocation system.

EU membership facilitated an economic catching up process of the New Member States. This is for instance mirrored by producer price inflation rates. These were higher in nontradables than in tradables in many CEE countries, which can be interpreted as a currency appreciation in a Balassa-Samuelson framework. The catching up process that occurred after joining the EU is also reflected by industrial turbulence indicators. Firm entry, firm exit and the turnover of firms seem to decrease with the relative economic position. These indicators therefore tend to be higher in CEE countries. Only the share of high growth firms seems to decrease with the distance to frontier countries, indicating that firm growth is a different industrial process than firm turbulence. These patterns are robust reflections of structures, although the industrial dynamics themselves are cyclical. In addition, a dummy variable taking on the value of one, if a country uses the Euro, and zero otherwise, was included in the estimates of producer price inflation. These did not produce statistically significant results.

The effects of value chain trade integration on value added and employment

Forward and backward integration into Single Market value chains positively affect industry level employment. Additionally, a positive effect of forward integration on value added is observed. The effect of backward integration on value added is not significantly different from zero, although the coefficient is positive.

The effects generally tend to increase with the tradability of the industries, which clearly suggests that the effects of market integration get transmitted into the Member States economies through sectors with high tradability. If the value added share of sectors with high tradability drops because of major macro-economic shocks as suggested in earlier sections, then also the economic effects of Single Market integration on Member States' economies are weakened. In other words, the effects of the Single Market on employment and value added are pro-cyclical.

Economic institutions are important moderating factors

The role of institutions provided by each Member State was explored next. This analysis drew on institutional trade competitiveness literature, which identified three aspects of institutional quality to be key for competitiveness. These are the (i) overall quality of the governance system, (ii) the use of external finance and (iii) labour market flexibility. Linking these institutional aspects to employment showed that the magnitude of the effects of market integration is strongly driven by the quality of institutions, especially with respect to a sound and impartial legal system and labour market regulation.

The extent of the positive effect of market integration – especially on employment – is strongly driven by the quality of institutions, especially with respect to a sound and impartial legal system and labour market regulation. This stresses the importance of a high institutional quality at the Member State level, which moderate the effects of integration into the Single Market.

The effects of trade integration on employment- and productivity-growth contributions

These results lead to the question of growth dynamics. How do economic institutions and aspects of the Single Market interact to jointly affect employment and productivity growth? Hence, the dimensions of institutional quality (general governance, use of external finance and labour market flexibility) were interacted with the single market indicators to explain sectoral performance differences.

Three outcome indicators were used: employment (hours worked) growth, the within industry and between industry contribution to labour productivity growth. Each indicator was obtained from the shift-share analysis of the previous work on performance diagnostics (see Chapter 2). Hence, this analysis offered a more differentiated perspective with respect to productivity growth. The first indicator measures the contribution to productivity growth within a given sector structure. Second, the contribution of structural change (i.e., the contributions due to changes in sector structures and the interaction term of the shift-share analysis) are linked to institutional variables. The entire period (2000-2014) was used to make use of the entire business cycle and thus to obtain a rather structural result.

The results suggest that sound institutions and well-integrated markets facilitate productivity increases in established structures. This effect suggests that good institutions favour path dependence. In other words, stronger institutions and greater market integration facilitate productivity growth that occurs within given structures. Especially, backward integration with other EU Member States is a strong contributor to within-industry productivity growth. Given that most productivity growth stems from within-industry contributions, this is an important finding that corroborates the reform agenda about the rule of law, public services and infrastructure availability.

The contributions to productivity gains from a change in sector composition are negative in countries with a better legal system and industries that are better integrated. This should be interpreted against the background of the structural change pattern, where productivity gains from structural change mainly came from the less productive nontradable sector. The structural change contribution was higher in economies struggling with imbalances. Moreover, productivity contributions from structural change are also linked to industry dynamics, which is moderated by institutional factors, especially government effectiveness, rule of law and labour market flexibility. Hence, an appropriate institutional setting (high government effectiveness, rule of law and an intermediate level of labour market flexibility) are required for industry dynamics to increase productivity growth associated with structural change. However, the impact that firm dynamics makes on aggregate labour productivity growth was found to be low.

These results can be used for the simulation of a hypothetical policy reform, in which institutions (government effectiveness, Rule of Law) increase from the 25th percentile of the sample to the 75th percentile. Cognisant of all limitations involved in such a scenario (reform resistance, long run effects of reforms, measurement issues, etc.), the results suggest that the bulk of the productivity growth asymmetries can be explained by differences in the institutional quality.

Industrial dynamics and the Single Market

Economic integration into the Single Market affects industrial dynamics. Forward and backward integration into European value chains generally have a negative effect on firm turnover rates. However, the turnover rate is a composite indicator, which consists of both entry and exit rates. The results for the individual components are more nuanced. Forward integration leads to a decrease in the entry rate, pointing at sunk costs. Backward integration reduces exit rates, suggesting a stabilising function of intra-EU sourcing.

The analyses of industrial dynamics support the prominent role of institutions. There are positive interaction effects between backward integration and the rule of law on industry turbulence, while labour market flexibility seems to have a mixed effect on industry turbulence and high growth firms. An intermediate level of labour market flexibility seems to be associated with both higher turnover rates and a higher share of high growth firms.

3.7. References

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e+rates+over+the+course+of%22+%22leading+to+their+nominal+share+in+GDP+increasing.3+The+final+theory+is+related%22+&ots=8nK7yKvEDH&sig=uipaSG6TRavsVdPRFkOe3mn2Twg.

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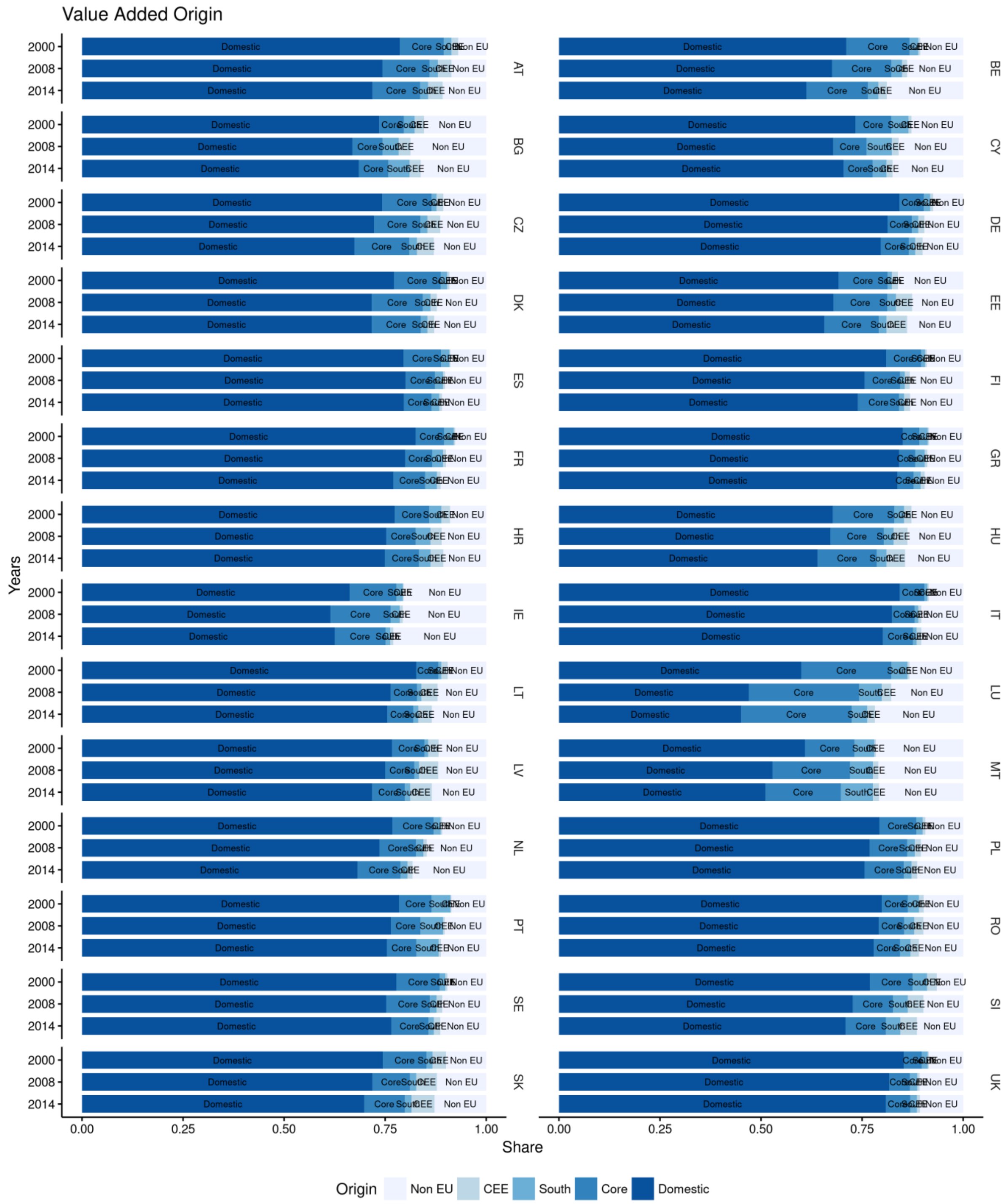
3.8. Appendix to Chapter 3

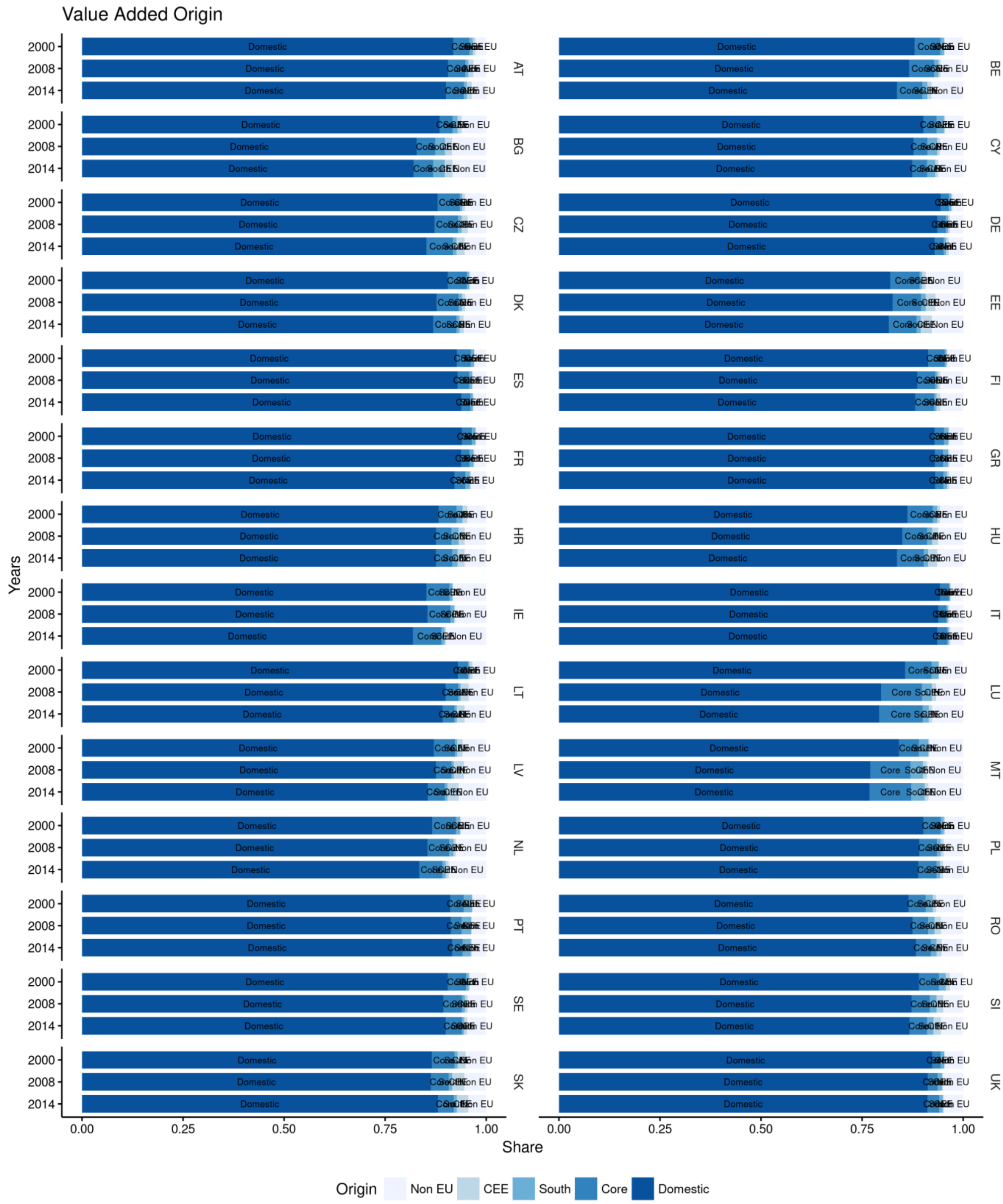
3.8.1. Appendix to Chapter 3.1

Figure 3.27: Value added by tradables across countries and years



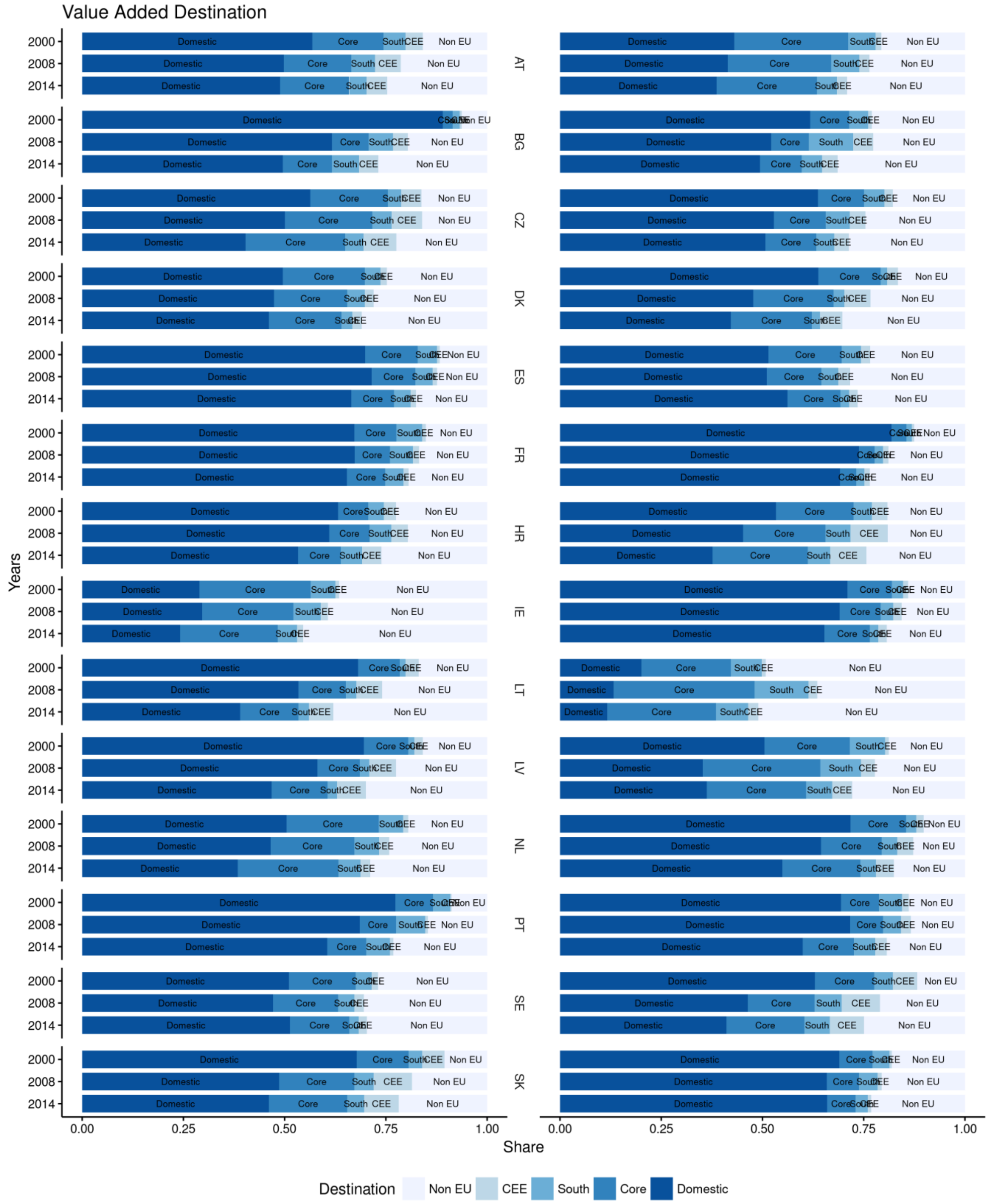
Source: WIOD Release 2016, WIFO calculations.
Note: The graph illustrates induced value added shares across EU member states (as of April 2017) of five origin groups for the years 2000, 2008 and 2014.

Figure 3.28: Value added by nontradables across countries and years



Source: WIOD Release 2016, WIFO calculations.
Note: The graph illustrates induced value added shares across EU member states (as of April 2017) of five origin groups for the years 2000, 2008 and 2014.

Figure 3.29: Value added destination of tradables across countries and years



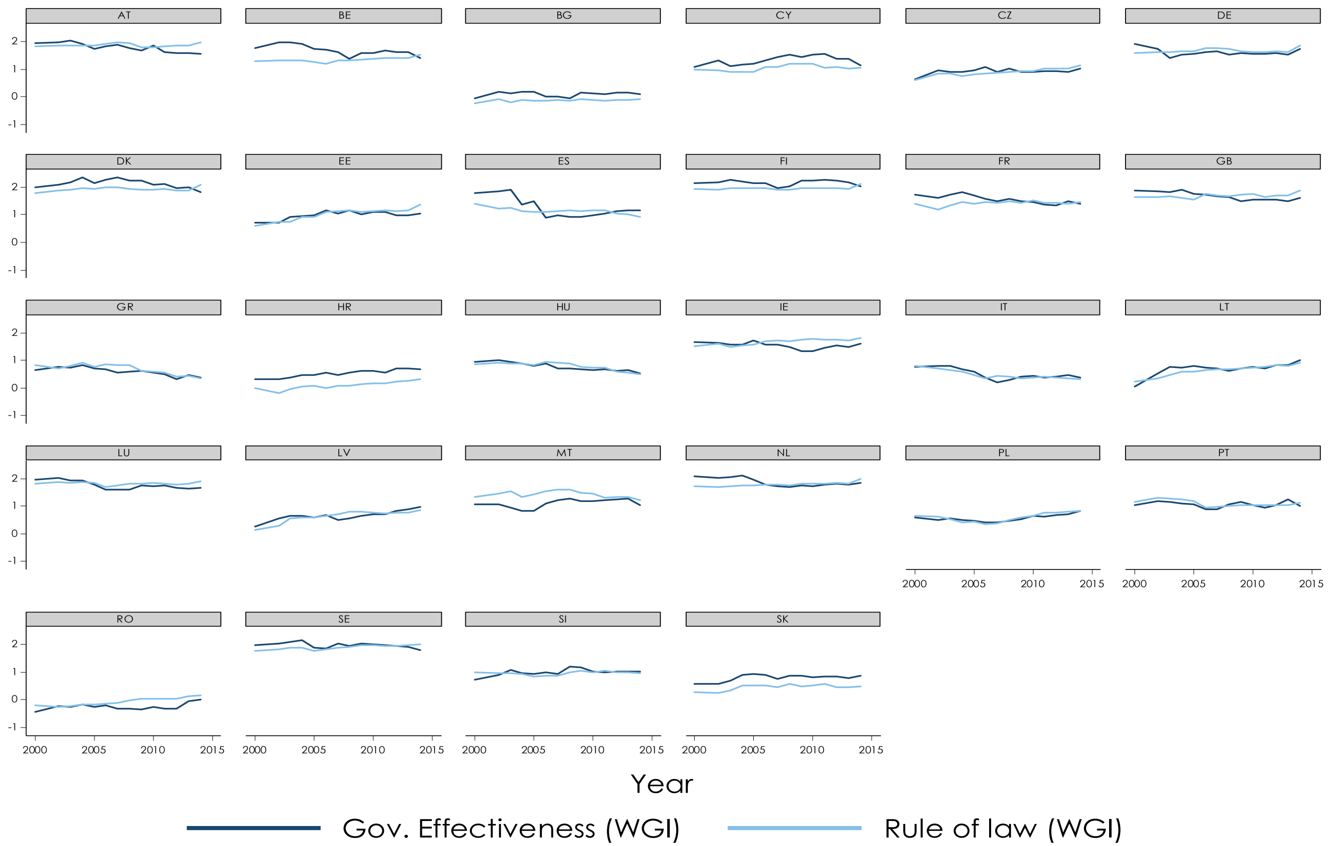
Source: WIOD Release 2016, WIFO calculations.
Note: The graph illustrates value added shares of EU member states (as of April 2017) generated by the final demand of five destination groups for the years 2000, 2008 and 2014.

Figure 3.30: Value added destination of nontradables of across country groups and years

Source: WIOD Release 2016, WIFO calculations.
Note: The graph illustrates value added shares of EU member states (as of April 2017) generated by the final demand of five destination groups for the years 2000, 2008 and 2014.

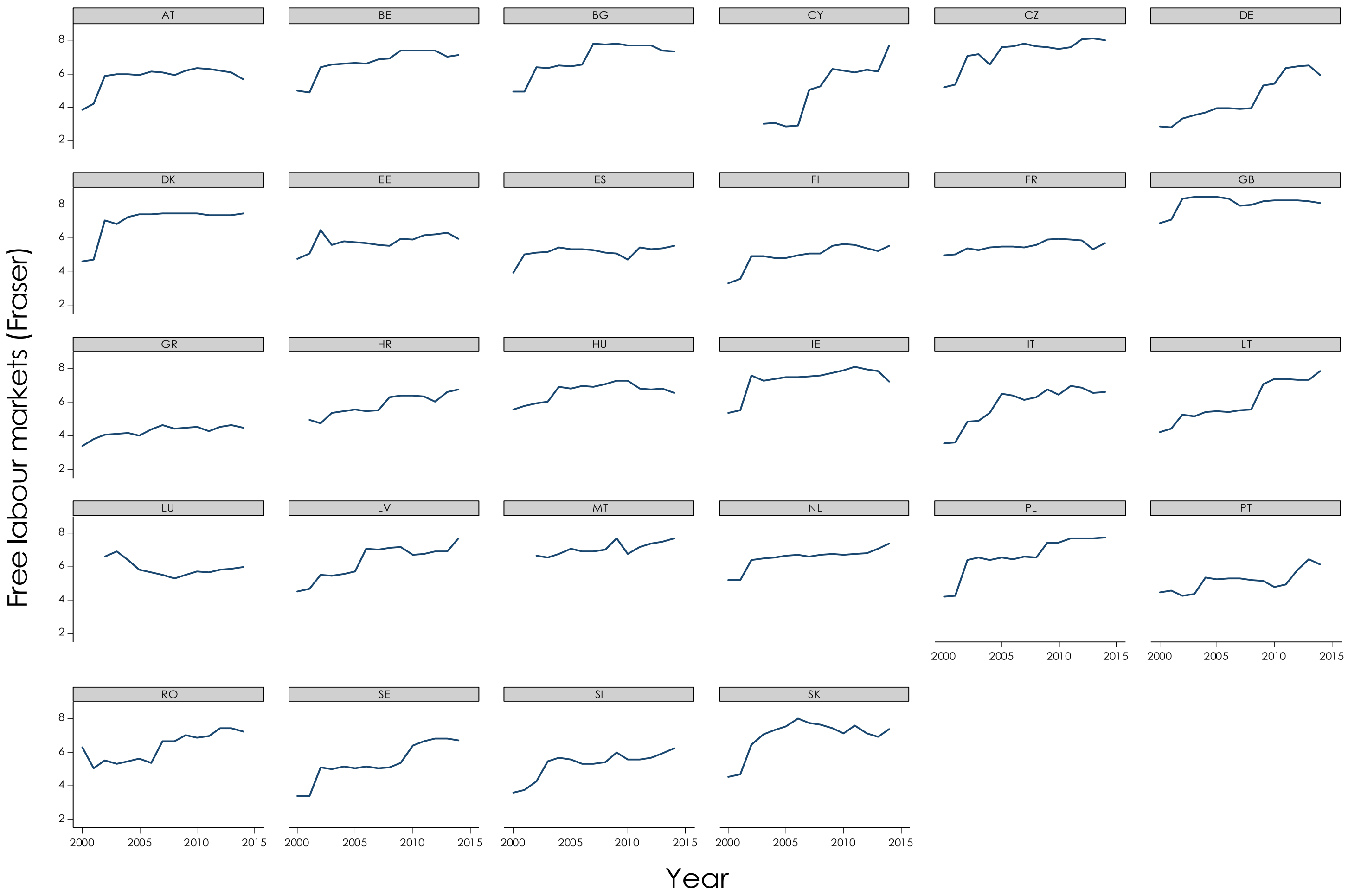
3.8.2.Appendix to Chapter 3.2

Figure 3.31: Government Effectiveness and Rule of Law across Member States



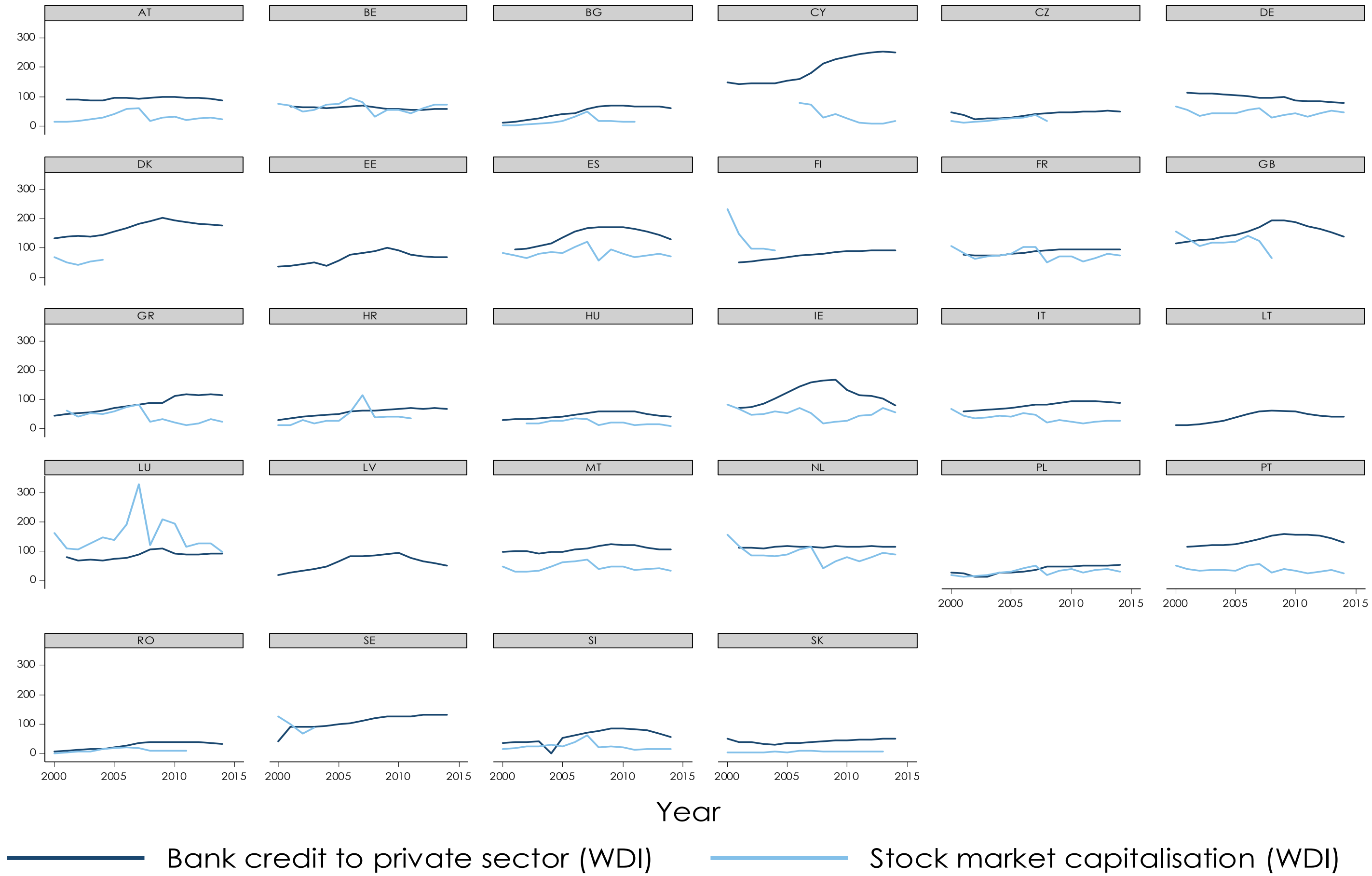
Source: Worldwide Governance Indicators, World Bank, WIFO calculations.

Figure 3.32: Free labour markets across Member States and time



Source: Fraser Institute, WIFO calculations.

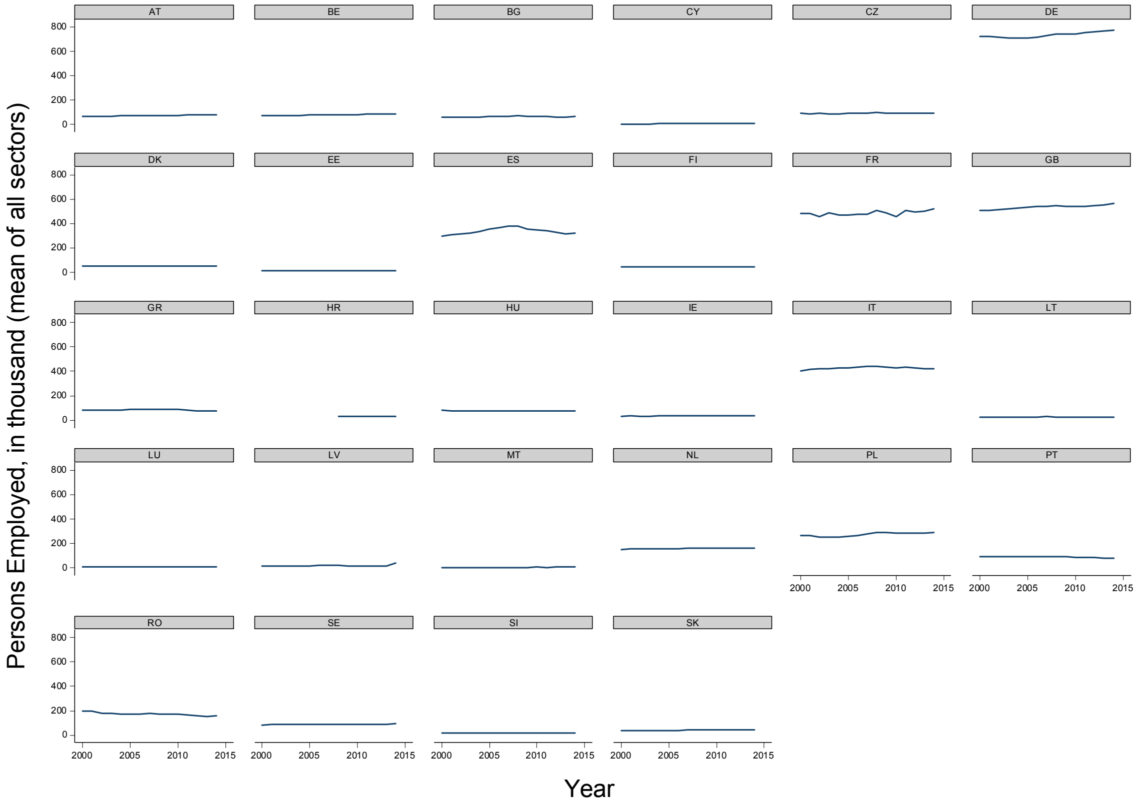
Figure 3.33: Bank credit to the private sector and stock market capitalisation across Member States and time



Source: Worldwide Governance Indicators, World Bank, WIFO calculations.

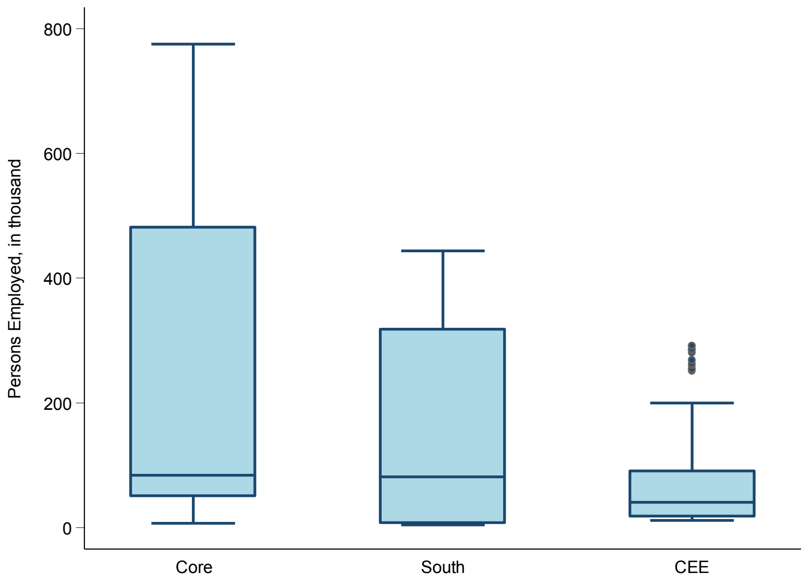
3.8.3.Appendix to Chapter 3.3

Figure 3.34: Persons employed across countries, in thousand



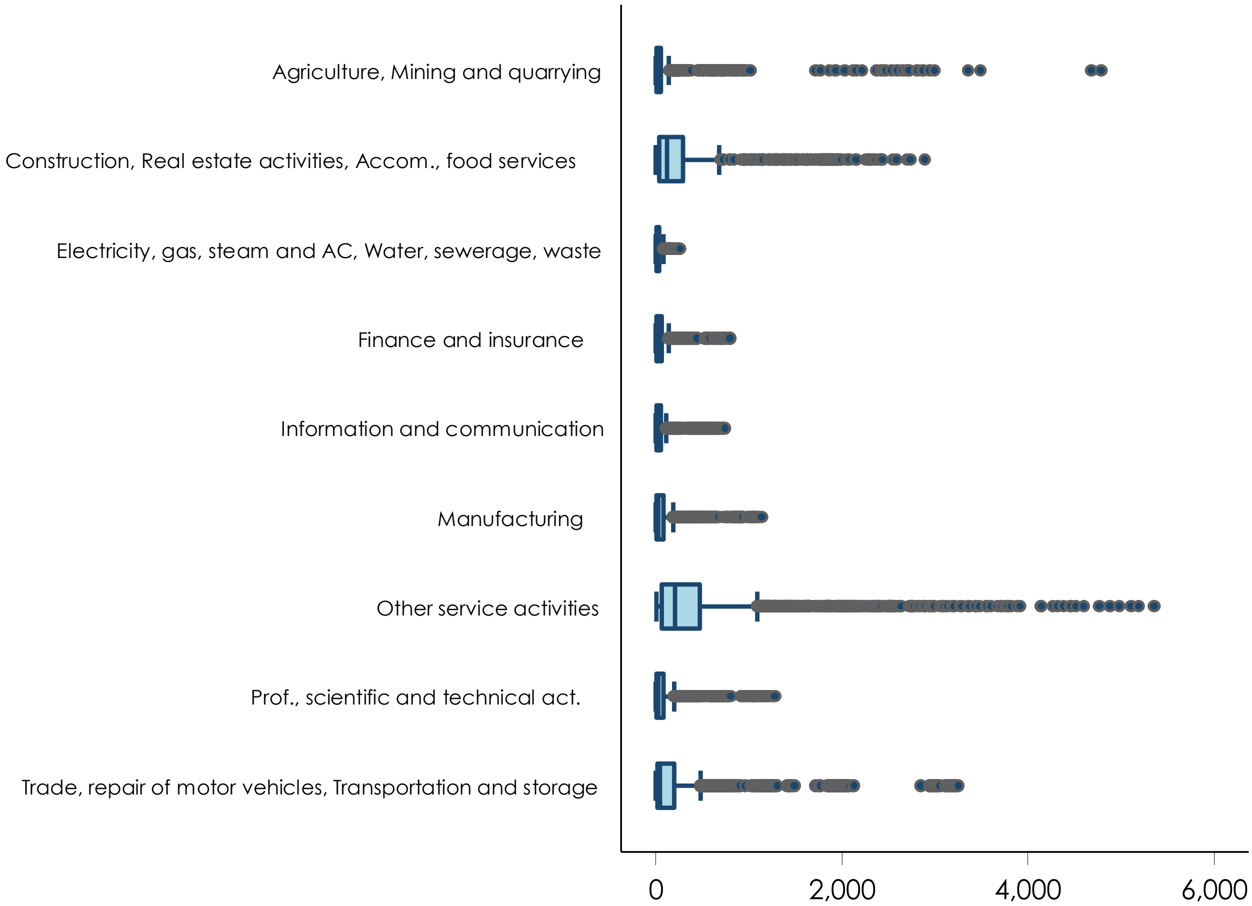
Source: Eurostat, WIFO calculations.
Note: Data for Malta are not available.

Figure 3.35: Box plot of persons employed by country groups, in thousand



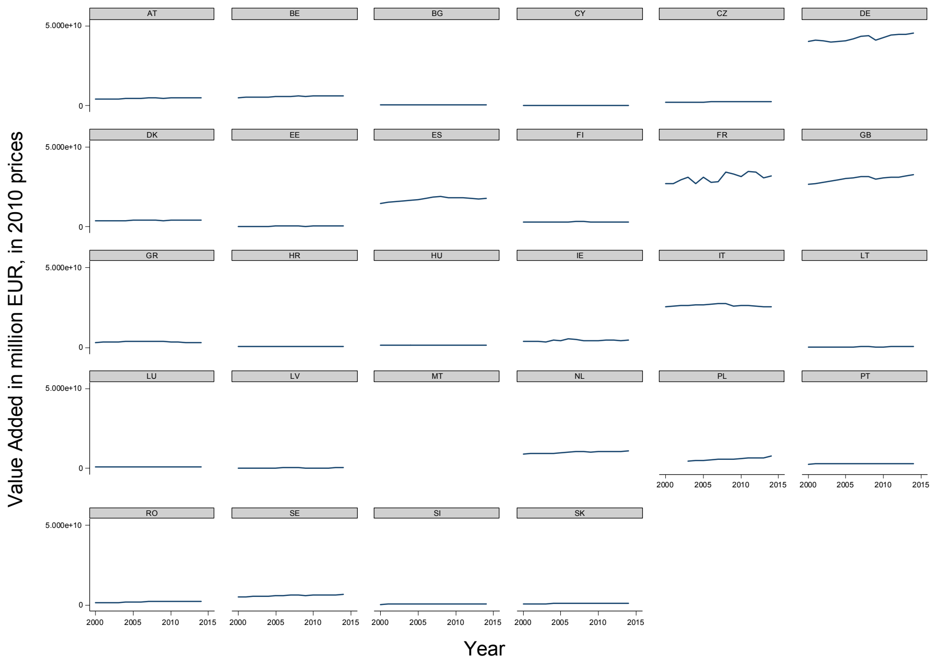
Source: Eurostat, WIFO calculations.

Figure 3.36: Box plot of persons employed across sector groups, in thousand



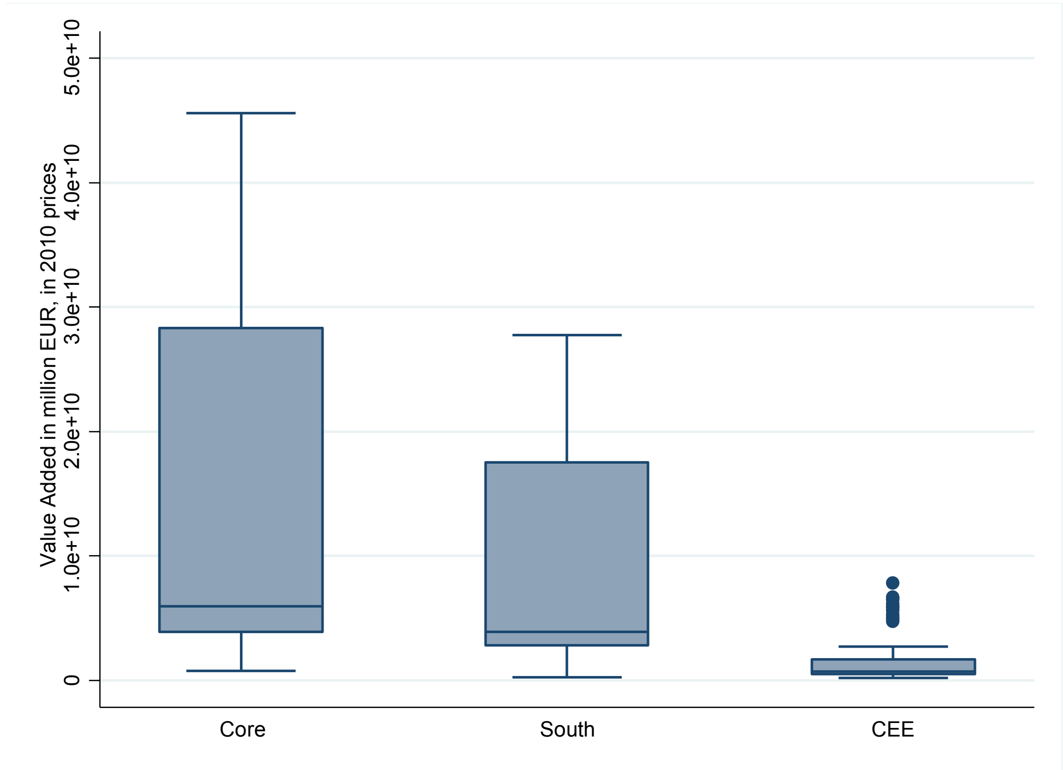
Source: Eurostat, WIFO calculations.

Figure 3.37: Valued added across countries



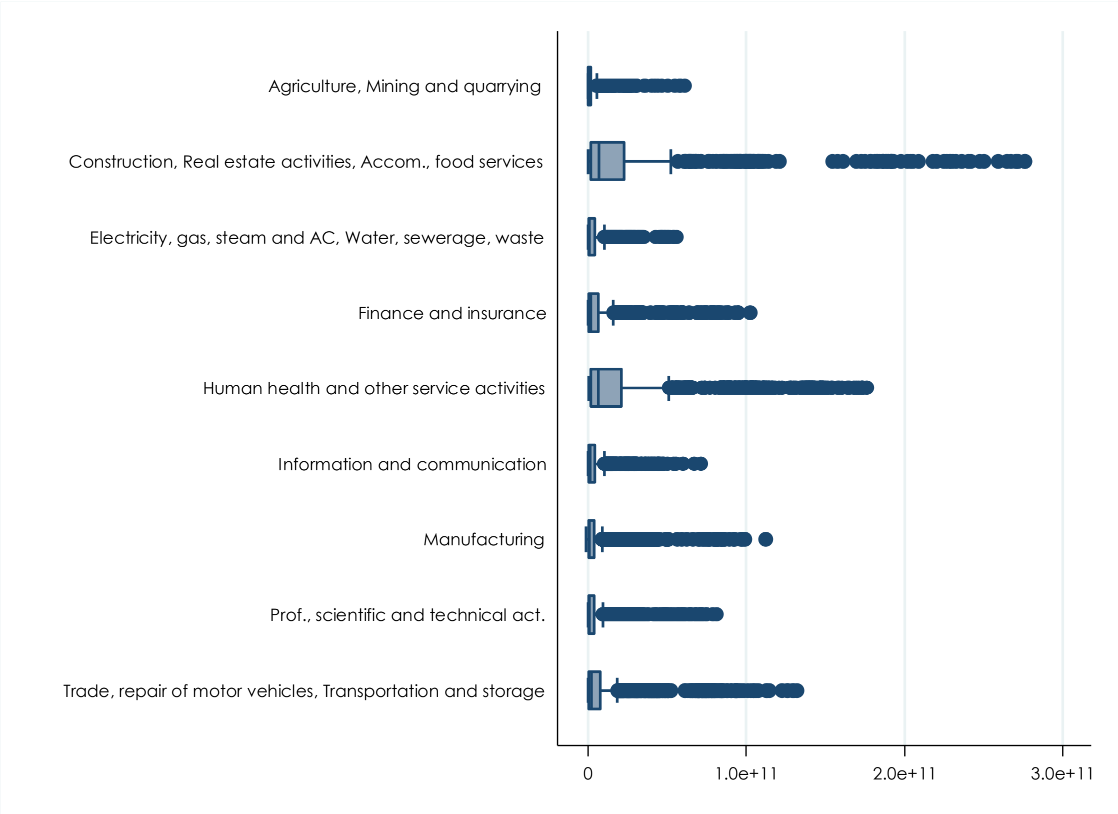
Source: Eurostat, WIFO calculations
Note: Data for Malta are not available.

Figure 3.38: Box plot of value added by country groups



Source: Eurostat, WIFO calculations.

Figure 3.39: Box plot of value added for sector groups



Source: Eurostat, WIFO calculations.

Table 3.44: Estimation results for the baseline model on sector employment and value added

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Dependent Variable	ln(employment)					ln(VA)					
VARIABLES											
ln(forward integration)	0.585***		0.135***		0.309	0.369***		0.195***		0.231	0.102
	(0.000)		(0.004)		(0.207)	(0.000)		(0.000)		(0.171)	(0.139)
ln(backward integration)	1.159***		0.745***		1.952***	0.011		-0.074		0.100	-0.484***
	(0.000)		(0.000)		(0.000)	(0.899)		(0.141)		(0.497)	(0.000)
ln(tradeability)	-0.654***	-0.716***	-0.694***	-0.374***	-0.694***	-0.622***	-0.630***	-0.637***	-0.589***	-0.639***	-0.637***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(backward integration)*ln(tradability)	0.417***					0.151***					
	(0.000)					(0.002)					
ln(forward integration)*ln(tradability)	0.242***					0.102***					
	(0.000)					(0.000)					
ln(ROL)	-0.053	0.002	0.002	0.266	-0.030	1.106***	0.833***	0.893***	1.275***	1.099***	1.195***
	(0.840)	(0.993)	(0.993)	(0.389)	(0.910)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
ln(Labour Market Flexibility)	0.069	0.049	0.080	0.137	0.080	-0.085	-0.085	-0.060	-0.056	-0.084	-0.086
	(0.416)	(0.572)	(0.342)	(0.188)	(0.348)	(0.299)	(0.312)	(0.467)	(0.584)	(0.307)	(0.295)
ln(Private Credit)	0.013	0.021	0.019	0.014	0.016	0.046**	0.033	0.047**	0.035	0.045**	0.047**
	(0.586)	(0.392)	(0.449)	(0.588)	(0.526)	(0.035)	(0.137)	(0.036)	(0.141)	(0.041)	(0.034)
ln(Complexity)	0.231***	0.469***	0.232***	-0.159**	0.118**	0.250***	0.181***	0.242***	0.242***	0.245***	0.256***
	(0.000)	(0.000)	(0.000)	(0.015)	(0.036)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
No EU member		0.154***	0.004				-0.170***	-0.114***			
		(0.002)	(0.923)				(0.000)	(0.001)			
No EU member * ln(tradability)		0.126***					-0.024				
		(0.000)					(0.170)				
ln(forward integration)*No EU member			0.215**					-0.072			
			(0.014)					(0.223)			
ln(backward integration)*No EU member			-0.592***					-0.408***			
			(0.000)					(0.000)			
ln(Export integration)				0.095***					-0.046**		
				(0.000)					(0.017)		
ln(Import integration)				0.155***					0.043		
				(0.000)					(0.115)		
ln(Export integration)*ln(tradability)				0.094***					-0.003		
				(0.000)					(0.782)		
ln(Import integration)*ln(tradability)				0.081***					0.047***		
				(0.000)					(0.001)		
ln(backward integration)*ln(complexity)					-1.786***					-0.376**	
					(0.000)					(0.030)	
ln(forward integration)*ln(complexity)					-0.112					-0.063	
					(0.656)					(0.726)	
ln(forward integration)^2											-0.079
											(0.238)
ln(backward integration)^2											-0.337***
											(0.000)
Constant	2.028***	1.730***	1.822***	2.477***	2.138***	18.714***	19.205***	18.934***	18.546***	18.731***	18.641***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Country Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	19,064	19,071	19,064	11,644	19,064	18,484	18,490	18,484	11,437	18,484	18,484

Outlier robust regression based on M-estimators (Huber 1973) using iteratively reweighted least squares (IRWLS)

Source: WIFO calculations.
Note: Outlier robust based on M-estimators (Huber, 1973) using iteratively reweighted least squares (IRWLS), Cluster robust pval in parentheses: ***p<0.01, **p<0.05, *p<0.1.

Productivity growth

To complement the results based on employment and valued added, growth regressions for productivity are also introduced in the appendix (see Table 3.45 and Table 3.46). In Table 3.45 the columns numbered (1) through (5) present regression results from different specifications where country and time dummies have been used to control for unobserved heterogeneity, while columns (6) to (10) show regression results incorporating country-industry and time specific effects. To account for initial productivity levels, the first five regressions include the logarithms of sectoral labour productivity levels of the year 2000. Initial levels are redundant in the last six regressions since they include country-industry specific fixed effects.

Starting with the first five specifications of Table 3.45, one can observe that the coefficient of the initial productivity level has the expected negative sign. The lower the initial levels, the higher productivity growth. Further, the level of tradability is positively related with productivity growth. Changing the sectoral degree of tradability by 10 percent leads to an increase in productivity growth by 0.06 to 0.07 percent.

The positive effect of backward integration on productivity growth increases with the level of sectoral tradability. This result is statistically significant also for the specification including country-industry fixed effects (see column (6) in Table 3.45).

Forward integration into the Single Market has a restraining effect on productivity growth when sectoral tradability is positive. However, the effect is rather small and only significantly different from zero on a 10% significance level (see column (6) in Table 3.45). The quantile regression results in Table 3.46 reveal that for lower levels of productivity growth the effect of forward integration is even significantly positive and diminishes only with higher levels of productivity growth, such that the overall effect in Table 3.45 is zero or even slightly negative.

EU membership status goes along with a negative impact productivity growth (see column (3) in Table 3.45). However, after the introduction of country-industry specific effects the results suggest that this effect is driven by the sector-specific level of tradability (see column (8)). The quantile regression results in Table 3.46 show that the positive effect of *not* being an EU member only holds for higher levels of productivity growth.

The evidence with respect to the impact of integration of industries in European value chains on productivity growth is somewhat ambiguous and depends to some extent on the level of aggregation, the composition of the sample and the market integration indicators chosen. Foster-McGregor et al (2016) show for a different level of aggregation, a different sample composition and different market integration indicators that integration into EU-VCs had positive impacts on growth and productivity.

Turining now to the institutional indicators, the results show that legal stability goes along with slower productivity growth. This is supported by the results for the Rule of Law indicator, which captures the quality of the legal system and contract enforcement. This indicator is highest in frontier economies, and is negatively and significantly correlated with productivity growth across all specifications. Given their high levels of productivity, these countries typically experience also slower productivity growth, which drives these results. Increasing the Rule of Law indicator by one percent results into a decrease of productivity growth between 0.11 and 0.15 percent (see Table 3.45). This finding is stable across different levels of productivity growth (see Table 3.46). Looking at other indicators capturing domestic institutional framework conditions only, the indicator for labour market flexibility is statistically significant at a 10% level and positive. The more flexible a labour market the higher productivity growth.

On possible explanation for positive effects of flexible labour markets on productivity growth could be that firms need to upgrade their workforce quality through labour turnover in order to implement new technologies and internalize their positive effects on productivity (Gust - Marquez, 2004).

Table 3.45: Estimation results for the baseline model on sector labour productivity growth

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent Variable					ln (LP growth)$_{t+1}$					
VARIABLES										
ln (LP)$_{2000}$	-0.014***	-0.013***	-0.014***	-0.015***	-0.015***					
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)					
ln(forward integration)$_t$	0.006			-0.020	0.001	-0.052			-0.052	-0.017
	(0.375)			(0.142)	(0.749)	(0.100)			(0.252)	(0.343)
ln(backward integration)$_t$	0.009			-0.022*	-0.007	0.113*			0.057	0.030
	(0.340)			(0.057)	(0.244)	(0.088)			(0.449)	(0.527)
ln(tradeability)$_t$	0.007***	0.006**	0.006***	0.007***	0.006***					
	(0.000)	(0.013)	(0.000)	(0.000)	(0.000)					
ln(backward integration)$_t$ * ln(tradability)$_t$	0.012**					0.056***				
	(0.020)					(0.006)				
ln(forward integration)t * ln(tradability)t	0.002					-0.018*				
	(0.396)					(0.050)				
ln(ROL)$_t$	-0.132***	-0.154***	-0.122***	-0.136***	-0.135***	-0.110**	-0.146***	-0.111**	-0.112**	-0.112**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.016)	(0.008)	(0.011)	(0.013)	(0.013)
ln(Labour Market Flexibility)$_t$	0.010	0.012	0.011	0.010	0.010	0.025*	0.019	0.025*	0.025*	0.026*
	(0.214)	(0.258)	(0.184)	(0.231)	(0.219)	(0.064)	(0.266)	(0.059)	(0.061)	(0.059)
ln(Private Credit)$_t$	-0.001	0.001	-0.001	-0.001	-0.001	-0.003	-0.001	-0.003	-0.003	-0.003
	(0.648)	(0.680)	(0.708)	(0.566)	(0.587)	(0.385)	(0.705)	(0.382)	(0.373)	(0.389)
ln(Complexity)$_t$	0.011**	0.015***	0.009**	0.009**	0.011***	-0.011	0.007	-0.009	-0.019	-0.011
	(0.011)	(0.003)	(0.026)	(0.039)	(0.010)	(0.725)	(0.901)	(0.777)	(0.577)	(0.742)
No EU member$_t$			0.019***					0.014		
			(0.003)					(0.172)		
No EU member$_t$ * ln(tradability)$_t$			0.007***					0.009**		
			(0.002)					(0.012)		
ln(forward integration)$_t$ * No EU member$_t$					0.007					-0.007
					(0.483)					(0.699)
ln(backward integration)$_t$ * No EU member$_t$					-0.002					0.002
					(0.903)					(0.946)
ln(Export integration)$_t$		-0.002					-0.010*			
		(0.393)					(0.073)			
ln(Import integration)$_t$		-0.002					-0.018			
		(0.556)					(0.150)			
ln(Export integration)$_t$ * ln(tradability)$_t$		-0.000					-0.004			
		(0.639)					(0.125)			
ln(Import integration)$_t$ * ln(tradability)$_t$		-0.000					-0.008			
		(0.829)					(0.140)			
ln(backward integration)$_t$ * ln(complexity)$_t$				0.021					-0.035	
				(0.115)					(0.514)	
ln(forward integration)$_t$ * ln(complexity)$_t$				0.026*					0.037	
				(0.082)					(0.406)	
Country Dummies	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No
Sector*Country Dummies	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14,601	9,091	14,603	14,601	14,601	15,731	9,727	15,733	15,731	15,731
R-squared						0.021	0.025	0.020	0.021	0.021
Regression Type	+	+	+	+	+	-	-	-	-	-

Source: WIFO calculations.
Note: Regression Type +: outlier robust based on M-estimators (Huber, 1973) using iteratively reweighted least squares (IRWLS), –: FE-estimation. Cluster robust pval in parentheses: ***p<0.01, **p<0.05, *p<0.1.

Table 3.46: Quantile regression results for the baseline model on sector labour productivity growth

	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Dependent Variable							ln(LP growth)$_{t+1}$								
							percentile								
VARIABLES	25	50	75	25	50	75	25	50	75	25	50	75	25	50	75
ln (LP)$_{2000}$	-0.017***	-0.011***	-0.009***	-0.019***	-0.011***	-0.007***	-0.018***	-0.012***	-0.009***	-0.018***	-0.009***	-0.008***	-0.018***	-0.012***	-0.010***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(forward integration)$_t$	0.026**	0.011*	-0.012				0.008*	-0.000	-0.006				-0.020	-0.021	0.005
	(0.034)	(0.084)	(0.212)				(0.096)	(0.954)	(0.279)				(0.238)	(0.323)	(0.835)
ln(backward integration)$_t$	0.037***	0.016*	-0.019				0.012	-0.001	-0.032***				0.017	-0.025**	-0.067***
	(0.010)	(0.084)	(0.150)				(0.103)	(0.830)	(0.000)				(0.414)	(0.024)	(0.001)
ln(tradeability)$_t$	-0.002***	0.007***	0.015***	-0.003***	0.006***	0.015***	-0.003***	0.006***	0.016***	-0.004**	0.008***	0.018***	-0.003***	0.006***	0.016***
	(0.004)	(0.000)	(0.000)	(0.003)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.046)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(backward integration)$_t$ * ln(tradability)t	0.018***	0.013***	0.008*												
	(0.002)	(0.003)	(0.067)												
ln(forward integration)$_t$ * ln(tradability)$_t$	0.009**	0.004**	-0.004												
	(0.027)	(0.023)	(0.106)												
ln(ROL)$_t$	-0.134***	-0.140***	-0.141***	-0.111***	-0.115***	-0.125***	-0.137***	-0.143***	-0.148***	-0.160***	-0.140***	-0.194***	-0.142***	-0.143***	-0.136***
	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)	(0.002)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.007)	(0.000)	(0.000)	(0.001)
ln(Labour Market Flexibility)$_t$	-0.002	0.005	-0.005	0.001	0.005	0.002	-0.003	0.006	-0.003	-0.002	0.009	-0.009	-0.005	0.004	-0.001
	(0.790)	(0.480)	(0.680)	(0.936)	(0.480)	(0.891)	(0.677)	(0.358)	(0.823)	(0.848)	(0.264)	(0.501)	(0.623)	(0.585)	(0.956)
ln(Private Credit)$_t$	-0.003	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.001	-0.000	-0.001	-0.003**	-0.002	-0.002
	(0.114)	(0.100)	(0.349)	(0.200)	(0.248)	(0.304)	(0.138)	(0.348)	(0.291)	(0.688)	(0.992)	(0.790)	(0.050)	(0.254)	(0.462)
ln(Complexity)$_t$	0.015***	0.009**	0.003	0.018***	0.011**	-0.005	0.015***	0.010*	0.002	0.018***	0.014***	0.001	0.013***	0.009**	0.006
	(0.000)	(0.031)	(0.464)	(0.000)	(0.011)	(0.243)	(0.000)	(0.061)	(0.737)	(0.008)	(0.003)	(0.820)	(0.003)	(0.048)	(0.214)
No EU member$_t$				0.013	0.020***	0.029***									
				(0.170)	(0.005)	(0.000)									
No EU member$_t$ * ln(tradability)$_t$				0.002	0.006***	0.012***									
				(0.562)	(0.004)	(0.000)									
ln(forward integration)$_t$ * No EU member$_t$							0.004	0.013	0.016						
							(0.688)	(0.210)	(0.105)						
ln(backward integration)$_t$ * No EU member$_t$							-0.015	-0.004	0.016						
							(0.433)	(0.745)	(0.400)						
ln(Export integration)$_t$										-0.004**	0.002	0.003			
										(0.040)	(0.437)	(0.257)			
ln(Import integration)$_t$										-0.001	-0.002	-0.003			
										(0.883)	(0.575)	(0.327)			
ln(Export integration)$_t$ * ln(tradability)$_t$										-0.002	0.001*	0.002			
										(0.169)	(0.057)	(0.156)			
ln(Import integration)$_t$ * ln(tradability)$_t$										-0.001	-0.001	-0.000			
										(0.730)	(0.630)	(0.933)			
ln(backward integration)$_t$ * ln(complexity)$_t$													-0.008	0.031**	0.048**
													(0.746)	(0.028)	(0.027)
ln(forward integration)$_t$ * ln(complexity)$_t$													0.032*	0.024	-0.008
													(0.087)	(0.293)	(0.732)
Constant$_t$	0.361***	0.342***	0.395***	0.339***	0.305***	0.342***	0.374***	0.349***	0.407***	0.399***	0.306***	0.460***	0.392***	0.355***	0.386***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	14,601	14,601	14,601	14,603	14,603	14,603	14,601	14,601	14,601	9,091	9,091	9,091	14,601	14,601	14,601

Source: WIFO calculations.
Note: Cluster robust pval in parentheses: ***p<0.01, **p<0.05, *p<0.1.

3.8.4. Appendix to Chapter 3.5

Table 3.47: Principal components capturing important characteristics of country capabilities

	Factor loadings				Correlation		
	PC1	PC2	PC3	Unexplained	PC1	PC2	PC3
Government effectiveness	0.36	0.13	-0.01	0.08	0.95	-0.49	0.19
Regulatory quality	0.35	0.15	0.09	0.12	0.92	-0.40	0.30
Rule of Law	0.37	0.14	0.01	0.05	0.97	-0.48	0.22
R&D intensity (% of GDP)	0.30	0.32	-0.10	0.11	0.91	-0.19	-0.06
Researcher intensity (per mio. people)	0.29	0.27	-0.13	0.21	0.86	-0.25	-0.08
Labour force with secondary education	-0.21	0.38	0.12	0.27	-0.28	0.85	-0.22
Labour force with tertiary education	0.26	-0.21	0.22	0.32	0.51	-0.63	0.59
FDI flows in % of GDP	0.03	-0.16	0.61	0.20	-0.01	-0.03	0.88
Manufacturing share (% of GDP)	-0.15	0.44	0.29	0.17	-0.08	0.86	0.01
Employment in industry (% of total employment)	-0.28	0.29	0.12	0.20	-0.50	0.87	-0.23
Trade in services (% of GDP)	0.14	-0.18	0.58	0.13	0.23	-0.25	0.93
Domestic credit to private sector by banks (% of GDP)	0.26	-0.33	-0.03	0.24	0.42	-0.85	0.34
Stock market capitalization (% of GDP)	0.28	-0.03	-0.23	0.36	0.66	-0.61	-0.06
Complexity of Exports	0.24	0.35	0.21	0.19	0.80	0.04	0.27

Source: Eurostat, World Bank, BACI database, WIFO calculations. Correlation coefficients above 0.8 are highlighted in grey.

Table 3.48: Estimation results for industry dynamics and backward integration

Backward integration	(1) total	(2) within	(3) str. change	(4) total	(5) within	(6) str. change	(7) total	(8) within	(9) str. change	(10) total	(11) within	(12) str. change
Entry rate	0.0020	0.0015	0.0005									
	(0.002)	(0.002)	(0.001)									
Exit rate				0.0022	0.0018	0.0005						
				(0.002)	(0.003)	(0.002)						
Turnover rate							0.0012	0.0009	0.0003			
							(0.001)	(0.001)	(0.001)			
Share of high growth firms										0.0035	0.0045	-0.0010
										(0.003)	(0.003)	(0.002)
Interaction	-0.0034	-0.0033	-0.0002	-0.0044	-0.0032	-0.0011	-0.0022	-0.0018	-0.0004	-0.0066	-0.0087	0.0021
	(0.003)	(0.003)	(0.002)	(0.004)	(0.005)	(0.003)	(0.002)	(0.002)	(0.001)	(0.006)	(0.006)	(0.004)
ln(active enterprises)	0.0064	-0.0031	0.0095*	0.0065	-0.0033	0.0098**	0.0065	-0.0032	0.0097*	0.0041	-0.0054	0.0095*
	(0.006)	(0.006)	(0.004)	(0.006)	(0.006)	(0.004)	(0.006)	(0.006)	(0.004)	(0.007)	(0.008)	(0.005)
Constant	-0.0405	0.0191	-0.0596*	-0.0406	0.0190	-0.0595*	-0.0407	0.0189	-0.0597*	-0.0260	0.0309	-0.0569+
	(0.038)	(0.042)	(0.025)	(0.038)	(0.042)	(0.025)	(0.038)	(0.042)	(0.025)	(0.047)	(0.052)	(0.031)
Observations	362	362	362	362	362	362	362	362	362	296	296	296
R-squared	0.229	0.403	0.537	0.227	0.402	0.536	0.228	0.402	0.536	0.225	0.403	0.542

Source: Eurostat, WIFO calculations.

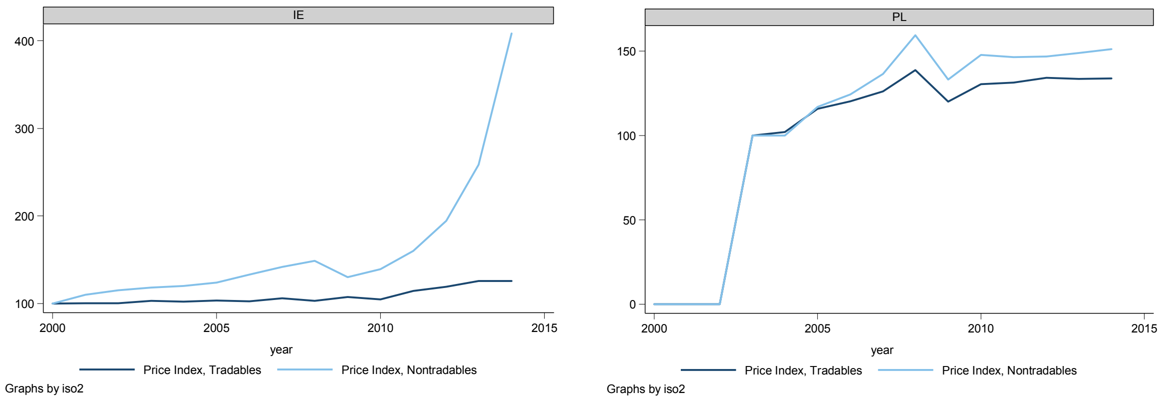
Table 3.49: Estimation results for industry dynamics and forward integration

Forward integration	(1) total	(2) within	(3) str. change	(4) total	(5) within	(6) str. change	(7) total	(8) within	(9) str. change	(10) total	(11) within	(12) str. change
Entry rate	0.0015	0.0011	0.0004									
	(0.002)	(0.002)	(0.001)									
Exit rate				0.0000	0.0010	-0.0010						
				(0.002)	(0.002)	(0.001)						
Turnover rate							0.0004	0.0006	-0.0001			
							(0.001)	(0.001)	(0.001)			
Share of high growth firms										0.0015	0.0020	-0.0005
										(0.003)	(0.003)	(0.002)
Interaction	-0.0023	-0.0023	0.0000	-0.0004	-0.0021	0.0017	-0.0008	-0.0012	0.0004	-0.0033	-0.0044	0.0012
	(0.004)	(0.004)	(0.003)	(0.004)	(0.005)	(0.003)	(0.002)	(0.002)	(0.001)	(0.006)	(0.007)	(0.004)
ln(active enterprises)	0.0064	-0.0031	0.0095*	0.0064	-0.0033	0.0097*	0.0065	-0.0031	0.0096*	0.0046	-0.0048	0.0094*
	(0.006)	(0.006)	(0.004)	(0.006)	(0.006)	(0.004)	(0.006)	(0.006)	(0.004)	(0.007)	(0.008)	(0.005)
Constant	-0.0403	0.0193	-0.0595*	-0.0392	0.0202	-0.0594*	-0.0397	0.0196	-0.0594*	-0.0259	0.0309	-0.0569+
	(0.038)	(0.042)	(0.025)	(0.038)	(0.042)	(0.025)	(0.038)	(0.042)	(0.025)	(0.047)	(0.052)	(0.031)
Observations	362	362	362	362	362	362	362	362	362	296	296	296
R-squared	0.226	0.401	0.537	0.225	0.401	0.536	0.225	0.401	0.536	0.222	0.399	0.542

Source: Eurostat, WIFO calculations.

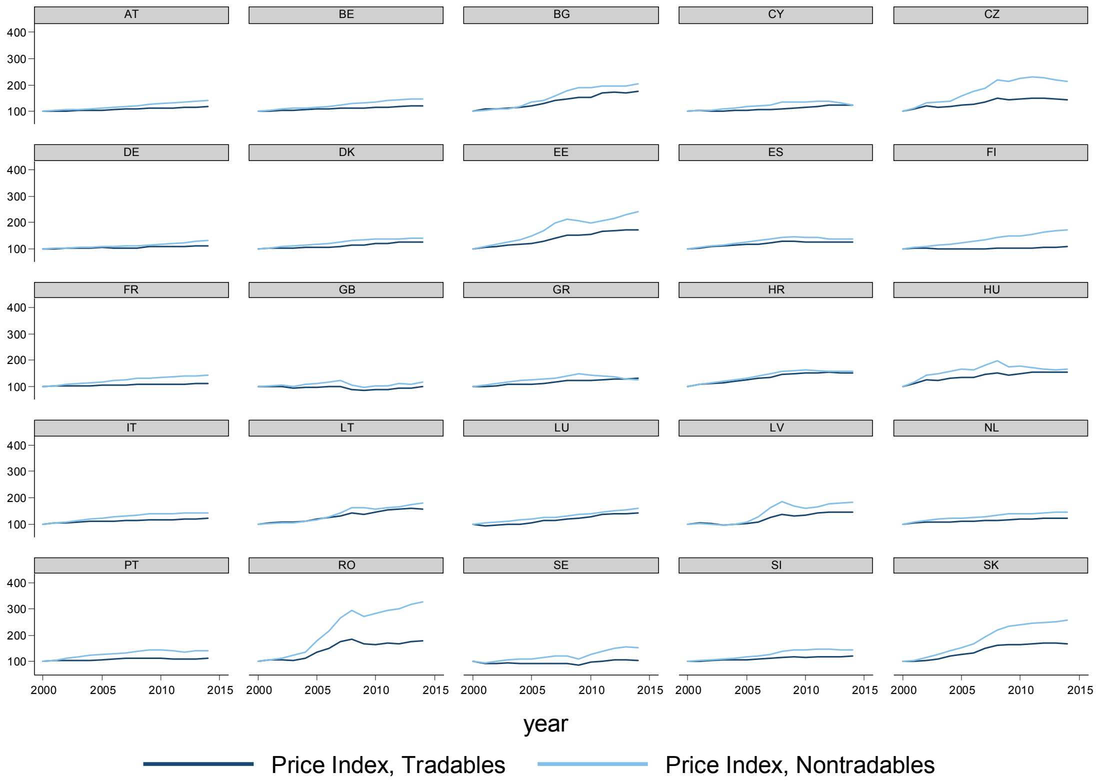
3.8.5. Appendix to Chapter 3.6

Figure 3.40: Tradables and nontradables prices in Ireland and Poland



Source: Eurostat, WIFO calculations.
Note: There seems to be a data issue with the prices for nontradables in Ireland. The price indices for Poland were only available since 2003 and are therefore not directly comparable.

Figure 3.41: Price developments of tradables and nontradables across countries without real estate activities



Source: Eurostat, WIFO calculations.
Note: This graph reproduces the producer price developments across countries of Figure 3.25, but does not include the real estate sector (L). The picture remains largely unchanged.

4. Global and Regional Value Chains

This chapter focuses on value chain trade of EU Member States and the EU as a whole. One of the key elements to be addressed is the more recent, i.e. post-crisis, development in the international organisation of production. This sheds light on the question whether value chain trade (VC trade) has peaked (Veenendaal et al., 2015) in the aftermaths of the 'Great Trade Collapse' or even before. The analysis is based on the latest update of the World Input-Output Database (Timmer et al., 2016). The trends of the past 15 years are investigated at the global level but also separately for the EU and individual Member States (or groups thereof).

The analysis of value chain trade, understood as trade that involves internationally organised production processes, requires a proper definition and, given the plethora of measures for value chain trade proposed in the literature, also requires making a choice. The analysis in this chapter relies strongly on a forward production integration measure which is referred to as re-exported domestic value added (*DVAre*) for reasons explained in the next section. A specific challenge in the context of value chain trade is the definition of the regional scope of the value chain involved for which a plausible method is suggested to identify regional and global value chains (despite the awareness of the technical limitations in this respect). Essentially, international value chains are split into trade involving only regional production partners and which consequently constitute regional value chains (RVCs) on the one hand and global value chains (GVCs) on the other hand which involve also extra-regional partner countries. Hence, in contrast to the bulk of the literature the term GVC in the context of this chapter denotes only a subset of international value chains. RVCs and GVCs together constitute international value chains. The importance of distinguishing between RVCs and GVCs becomes evident against the background of observation such as the one in Baldwin and Lopez-Gonzalez (2013) who argue that GVC trade is a misnomer for '21st century trade' (Baldwin, 2011) given that the international organisation of production is predominantly regional in scope. Consequently, the developments of RVC trade compared to GVC trade of the EU over time are traced with a focus on the post-crisis period.

While the EU and its individual Member States, respectively, are centre stage in this analysis, some comparisons with other regions are made, in particular with respect to RVC trade in other trading blocs such as NAFTA and the main trading nations in the South East Asian region, notably Japan, China and Korea.

Turning to the implications of value chain trade, a subsection of this chapter explores the relationship between countries' involvement in value chains and the implied value chain trade, on the one hand, and international competitiveness and structural change, on the other hand. Regarding competitiveness, two different concepts are considered: the first one, which in line with the firm-level literature associates competitiveness with productivity, whereas in the second concept competitiveness is interpreted as success in international markets, which allows making use of world market shares as an appropriate measure.[1] The analysis of structural change emphasises the impact of value chain trade on the value added share of manufacturing. The implicit assumption in this analysis is that manufacturing,

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[1] The analysis does not make use of the admittedly broader and more comprehensive concepts of competitiveness such as the one suggested in Aiginger et al. (2013) where competitiveness is defined as the *'ability of a country (region, location) to deliver the beyond-GDP goals for its citizens today and tomorrow'* (p. 13). The reason is that such a broad holistic concept, which is closer to the notion of welfare than the common understanding of competitiveness, lacks precision and, above all, it is difficult to make it operational.

due to its particular characteristics, is of central importance for the economy such that an increase in the manufacturing share is considered as 'positive structural change'. The econometric models used in both the competitiveness and the structural change analysis are applied to the entire sample of countries available in the World Input-Output Database (WIOD, 2016 release). Additionally, individual effects for the EU or sub-groups of Member States, notably the Central European (CE) Manufacturing Core, are identified.

The final subsection addresses the issue of the decline in the trade-to-GDP elasticity since the Great Recession (cf. Freund, 2009; Constantinescu et al., 2015). The updated WIOD comprises five post-crisis years (2010-2014) which allows tackling this question with both gross and value added based measures of trade in a gravity framework. This extends available analysis by analysing both reporter and partner specific elasticities as well as distinguishing between intra- and extra-EU trade flows as a proxy for differences between RVCs and GVCs.

4.1. Defining value chain trade

4.1.1. Relation to the existing literature

Following the growing importance of international value chains and the geographically-dispersed organisation of production as a real world phenomenon, empirical measures and indicators for this type of trade have mushroomed. The first generation statistics for measuring offshoring (Feenstra, 2016) relied on the share of imported intermediate inputs in costs (Feenstra and Hanson, 1999). These were soon supplemented with second generation statistics which are derived from inter-country input-output (IO) tables; most of the recent research on international value chains and offshoring employs such inter-country IO-based measures. The reason is that the information contained in inter-country IO tables is more suitable for analysing international production linkages (Feenstra, 2016). Thanks to various research endeavours, several inter-country IO datasets have become available in recent years. This chapter builds on one of the most recent initiatives in this area, which is the comprehensive update of the WIOD, Release 2016 (Timmer et al., 2016). The WIOD update includes an enlarged country sample (covering also Croatia, Norway and Switzerland)[2] and a larger number of industries (from previously 35 to 56) based on the NACE Rev. 2 industry classification and according to the SNA2008/ESA2010 methodology. Importantly, the WIOD Release 2016 provides international input-output tables for the years 2000-2014, thus encompassing the crisis years and a sufficient number of post-crisis years.

There are numerous second generation statistics measuring trade flows that are part of cross-country production sharing. One of the first of these measures was the foreign value added in exports (*FVAiE*) (see Koopman et al., 2014). This indicator belongs to the so-called 'backward' production integration measures because it singles out foreign value added embodied in a country's export vector. By definition, the foreign value added that forms part of a country's exports must have previously been exported too. Hence, starting from a country's gross exports, the *FVAiE* measure allows tracing backwards the origin of the foreign value added contained therein. The backward production integration measure is interesting because it reflects the extent to which countries have managed to link into international production networks.

An issue surrounding measures of backward production integration, however, is that they can lead to misleading interpretations. Usually, a rising *FVAiE is* considered as being a positive

[2] For the full list of countries see Appendix.

development. However, a high *FVAiE* implies that the domestic value added content of exports is relatively lower. Since countries have an interest in capturing a large domestic value added share, especially in innovative, high-productivity industries, a lower *FVAiE* would actually be preferable. For this reason the interpretation of the development of *FVAiE* is ambiguous.[3]

Due to the ambiguity problem of backward production indicators, this chapter relies on a forward production integration measure: the re-exported domestic value added, or *DVAre* for short. Measures of forward production integration comprise exclusively domestic value added. This makes the interpretation easier as a high *DVAre* can generally be considered to be positive as it indicates that countries capture a growing share of value chain-related trade. The *DVAre* indicator comprises all value added of a country that is exported and crosses borders at least twice. Wang et al. (2016) also use this criterion to define 'deep international production sharing', which is synonymous with value chain trade (VC trade). The *DVAre* measure is similar to the vertical specialisation (VS1) measure initially suggested by Hummels et al. (2001) and defined mathematically by Koopman et al. (2012) but it avoids the double counting included in the VS1 measure (see Koopman et al., 2012; Wang et al., 2013).

4.1.2. Re-exported domestic value added as a measure of international value chain trade: an illustration

The *DVAre*, defined as the domestic value added embodied in a country's intermediate exports that cross borders at least twice, includes three components. These components are the value added of reporting country *r* embodied in its exports of intermediates to a partner country – the immediate production partner (*ipp)* – which are then (i) finally shipped to the destination country (*dest)* – either directly or via another production partner – the ultimate production partner (*upp*) – in the form of final goods; (ii) finally shipped to the destination country *(dest)* in the form of intermediates); or (iii) shipped back to the country of origin *r* in the form of either intermediates or final goods[4].

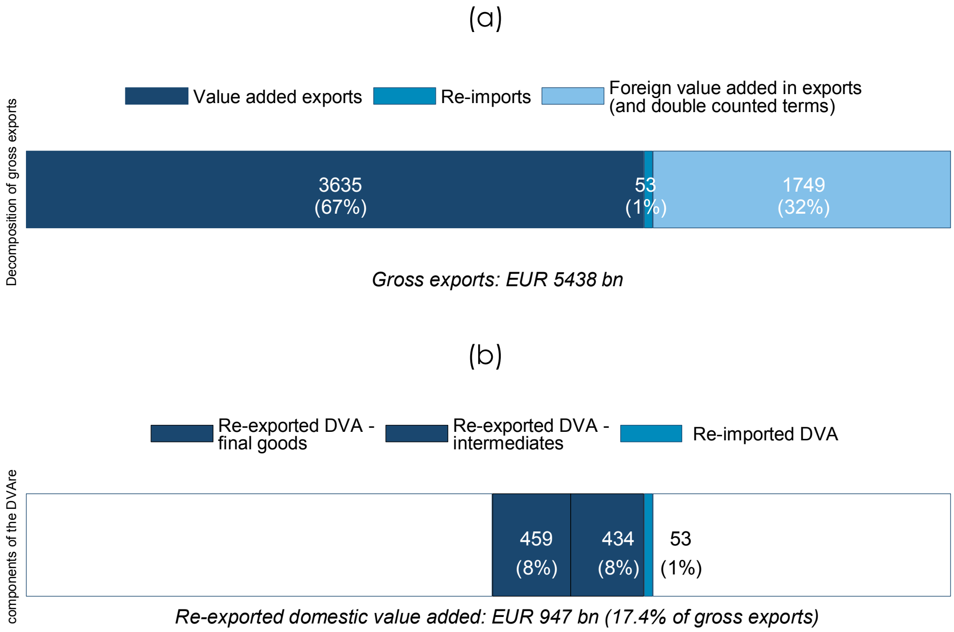
The *DVAre* part of gross export flows is illustrated in Figure 4.1 using EU-28 exports in 2014 as an example. In this illustrative example, the EUR 5.4 trillion of gross exports can be decomposed into the well-known value added exports (VAX), which comprise the value added originating in EU Member States that is absorbed by other countries (Johnson and Noguera, 2012), exported value added that returns home, i.e. re-imports, and foreign value added that is embodied in domestic exports (panel a). The criterion of two border-crossings for defining VC trade implies that not the entire 3.6 trillion of VAX enter the *DVAre* indicator. Rather only two parts thereof, namely EUR 459 billion worth of re-exported domestic value added that is shipped to the destination country as final goods and the EUR 434 billion worth of re-exported domestic value added that is shipped to the destination country as intermediates, enter the definition of the *DVAre* (panel b). In addition, *DVAre* includes also the re-imports, that is value added that has been exported by the country of origin and is re-exported back to that

[3] The ambiguity problem in interpreting the *FVAiE* (or any other backward measure) stems from the fact that it is unknown whether a growing *FVAiE* reflects (i) a situation where domestic content is replaced by foreign content (e.g. due to offshoring) or (ii) a situation where new additional exports are stimulated by activities of foreign firms, for example due to inward FDI, where the newly created export capacity also contains a high share of foreign value added.

[4] See Appendix for details.

country after some processing. All three components taken together make up the *DVAre* which in 2014 amounted to EUR 947 billion, accounting for about 17.4% of gross exports.

Figure 4.1: Decomposition of EU-28 gross exports, 2014



Source: WIOD Release 2016. wiiw calculations.
Note: Values refer to economy-wide value added exports of EU Member States to all countries in the world. Including intra-EU trade. Converted into euro using Eurostat's EUR/USD exchange rate (yearly averages).

4.1.3.Other methodological aspects: normalisation and the definition of industries

While the *DVAre* measure as the main indicator for VC trade emerges from the decomposition of gross exports, it is preferable to use the VAX (or alternatively value added) for normalisations. The reason is that the *DVAre* is a value added-based measure. Hence, it is methodologically consistent to relate it to another value added-based indicator. The normalisations are needed especially in cross-country comparisons but are equally employed in the econometric work.

With regard to the industry split-up, there are several possibilities to disaggregate value chain trade due to the large number of dimensions emerging in complex trade transactions. The most basic distinction is between defining the industry (or sector) as the *industry of origin* of the value added that is exported or, alternatively, as the *industry of export*, i.e. the industry which records the gross export flow. In the latter case, since there are multiple export transactions involved in VC trade flows, the question arises which of these flows defines the export sector. However, throughout the entire chapter, all analyses of sector respectively industry level follow the sector of origin approach. More specifically, the industry aggregates that are considered, apart from the entire economy comprising all industries, are the manufacturing sector[5], advanced manufacturing industries and an extended manufacturing sector which includes manufacturing plus business services[6].

[5] As defined in NACE Rev. 2 by NACE section C.

[6] For the definition of these sectors see Appendix.

4.1.4.Defining European value chains

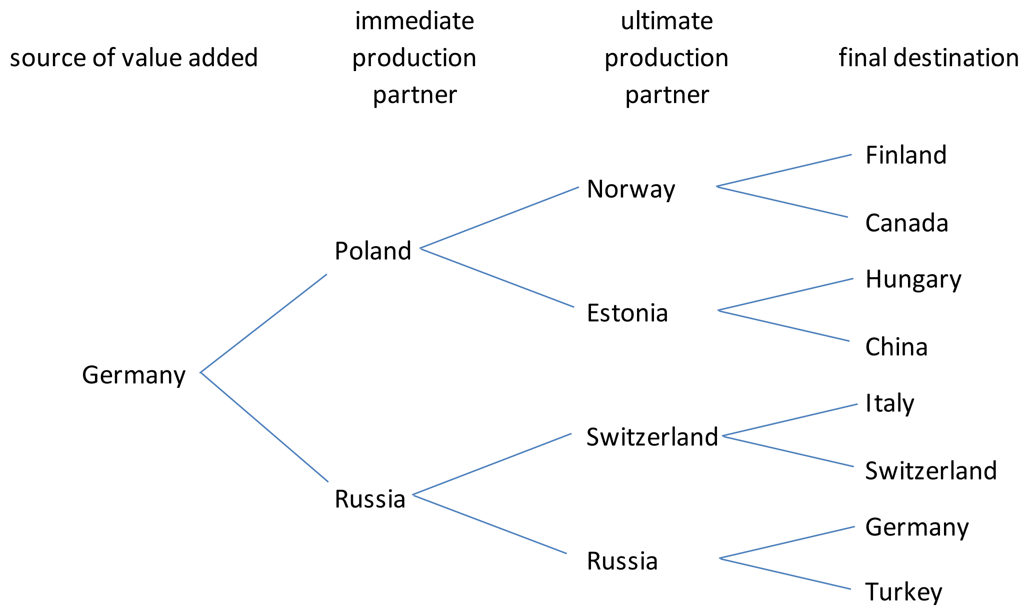
A second crucial dimension for the analysis of international VC trade is the definition of regional value chains (RVCs) as opposed to global value chains (GVCs). For the purpose of this analysis RVC trade refers to the situation where two or more EU Member States are jointly involved in producing for some other country or for themselves (i.e. the source country of value added and the production partner(s) are EU Member States)[7]. In contrast, GVC trade refers to inter-regional production sharing, i.e. the situation where at least one EU Member State and at least one third country is involved in internationally organised production. This approach is illustrated in Figure 4.2 taking Germany's involvement in value chain trade as an example.

In tracing the value added from some source country (or reporting country) to its final destination, the methodology allows the identification of four 'functions' that a country can take within an international value chain. It can be *(i)* the source of the value added that is traced (taking a forward perspective) - which in the example is always Germany; *(ii)* the immediate production partner; *(iii)* the country where the last production step takes place, i.e. the ultimate production partner; and *(iv)* the final destination country which is the country absorbing the value added. Obviously, a particular country can take several functions in a trade transaction. For example, in the case of a re-export of domestic value added in the form of intermediate goods, the destination country is also the ultimate production partner. In Figure 4.2 the sequence Germany – Russia – Switzerland – Switzerland would be such a transaction. For the definition of European value chains in the context of VC trade, it is necessary to identify which countries take which functions in the value chains. This approach allows tracing the value chains in more detail than, for example, in the approach by Baldwin and Lopez-Gonzalez (2013) who – while using input-output information – only focus on the bilateral relationships between source country and the neighbouring country in the supply chain. What this means is that in their approach, for example, value added originating from Germany that is re-exported by Poland (as in the upper part of Figure 4.2) would be part of the EU value chain. This is a legitimate approach but neglects the possibility that this German value added passes through additional production partners before arriving at the destination country. The sequence Germany – Poland – Norway – Finland could serve as an illustrative example for this. In this case, it is not fully adequate to consider the German value added that is re-exported by Poland as an element of a pure EU value chain. Instead, it is more accurate to define trade constellations as part of the European value chain trade[8] whenever the functions (i)-(iii), i.e. source country, immediate production partner and ultimate production partner, which all act as 'producers', are occupied by EU Member States. Among the illustrated production relations in Figure 4.2 only one satisfies this criterion which is the triplet Germany – Poland – Estonia. In this example, the joint production between Germany (as source country), Poland (as immediate production partner) and Estonia (as ultimate production partner) satisfies either Hungarian or Chinese final demand. In general, the *DVAre* indicator, in addition to allowing for a distinction between RVCs and GVCs, can also identify whether an international VC produces to satisfy intra-EU demand (with Hungary as the destination in this example) or for satisfying extra-EU demand (with China as the destination in this example). Note that in both cases, the last trade flow is an export of final goods out of Estonia involving by then German, Polish and Estonian value added.

[7] That is, the term 'European' refers here to the EU-28. A 'European' value chain is defined to comprise EU-28 countries only because it facilitates the comparison wither other trading blocs such as NAFTA.

[8] Remember that European value chains are those involving EU Member States only as production partners.

Figure 4.2: Illustrative example: Germany's involvement in RVCs and GVCs



Source: wiiw's own representation.

The figure shows several other trade relations involving re-exported German value added which by the above criterion all constitute GVCs because they involve EU Member States as well as third countries as producers.

With regards to the distinction between re-exports in the form of intermediates on the one hand and re-exports in the form of final goods on the other hand, only the sequence Germany – Russia – Switzerland – Switzerland represents a re-export of intermediates. All other cases involve the re-export of a final good in the last export transaction which is discernible from the fact that the ultimate production partner is different from the destination country. With a view to the number of border crossings, in the sequence Germany – Russia – Switzerland – Switzerland as well as in the sequences Germany – Russia – Russia – Germany and Germany – Russia – Russia – Turkey there are two border crossings while in the other cases there are three border crossings. Two more comments on the illustrated trade flows may be warranted. Firstly, the second to last trade relation shows Germany as the destination. This is a German re-import of value added via Russia (involving two border crossings). The last trade flow, involving Germany and Russia as producers – the latter having the function of both immediate and ultimate production partner – is a common constellation which is characterised by two border crossings[9].

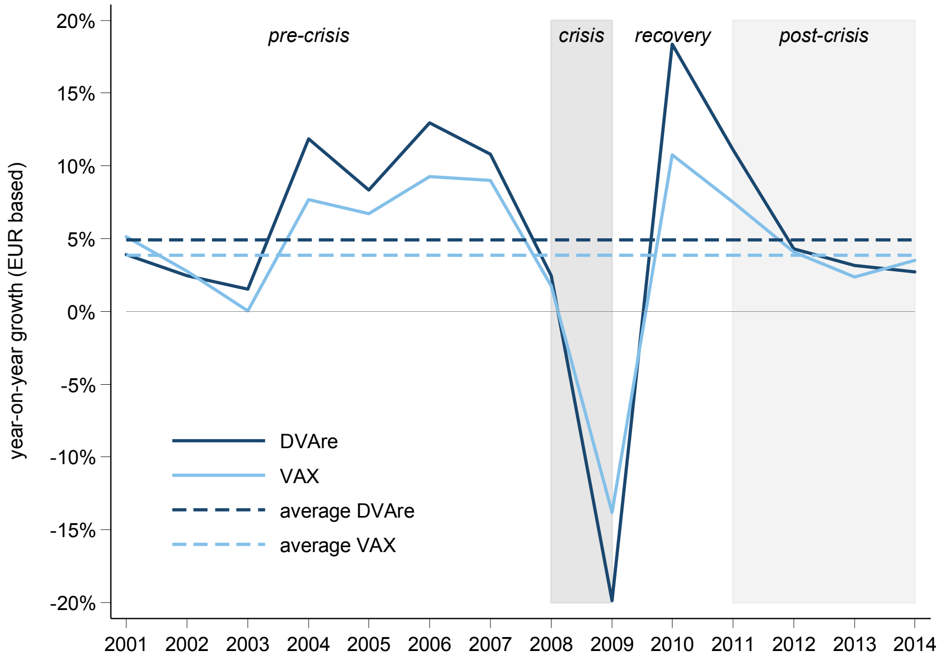
[9] Strictly speaking there are *at least* two border crossings in the former cases and *at least* three border crossings in the latter cases. This is because the methodology for identifying the countries fulfilling the various functions in these trade relations makes use of the so-called global Leontief Inverse, which reflects both direct and indirect production linkages. Therefore, in all the examples shown in Figure 4.2, there may be other countries involved between the immediate and the ultimate production partner.

4.2. Global and European trends in value chain trade: the post-crisis era

4.2.1. Recent trends in value chain trade: Has value chain trade peaked?

Despite widespread fears of incipient protectionism and the dismantling of international value chains (e.g. Baldwin and Evenett, 2009; Evenett, 2013), which in some instances are accompanied by political attempts to trigger such a development by initiating *'reshoring'* initiatives[10], little is known about the post-crisis trends in value chain trade. Here evidence on exports and VC-related exports is presented for the EU-28. For the purpose of this analysis the 15-year time span under consideration is divided into 4 sub-periods: a pre-crisis period (2000-2008), the crisis years (2008-2009), the recovery phase (2009-2011) and the post-crisis period (2011-2014).

Figure 4.3: VC trade and value added exports growth of the EU-28, total economy, 2000-2014



Source: WIOD Release 2016. wiiw calculations.
Note: Values refer to economy-wide exports of EU Member States to all countries in the world. Including intra-EU trade. Converted into euro using Eurostat's EUR/USD exchange rates (yearly averages).

Figure 4.3 tracks the development of VC trade growth rates – proxied by re-exported value added originating in the EU-28 (*DVAre*) introduced in the previous section – over the period 2000-2014. The figure refers to value added generated across all industries of the economy. As can be seen, the year-on-year growth rate of VC trade follows closely the movements of value added export (VAX) growth. An interesting aspect in this co-movement is that for almost all years, the growth rate of VC-related exports (*DVAre*) was slightly higher than that of the VAX. Likewise, during the great trade decline of 2009 the drop in VC trade[11] was more pronounced than that of the VAX. In recent years, however, the two lines have narrowed and in 2014, the growth rate of VAX was even slightly above that of VC trade. This convergence of growth rates for the different types of export flows occurred in the context of

[10] See, for example, the 'UK Reshore' initiative; https://www.gov.uk/government/news/new-government-support-to-encourage-manufacturing-production-back-to-the-uk

[11] Throughout the analysis the terms *DVAre* and VC trade are used interchangeably.

comparatively modest export growth that characterises the post-crises period (2011-2014) which amounted to 2.8% for VC trade and 3.3% for VAX in 2014 (all in nominal terms denoted in euro)[12]. These numbers are considerably lower than the corresponding longer-term (2000-2014) average growth rates which amounted to 4.9% and 3.9% respectively.

These trends are further analysed in Table 4.1, which shows the compound annualised growth rate for the four sub-periods, the pre-crisis years (2000-2008), the crisis (2008-2009), the recovery phase (2009-2011) and the post-crisis years (2011-2014), as well as the average rate over the entire time span (2000-2014).

In addition to the economy-wide flows of exported value added (panel a) – for VC trade (comprising both RVC trade and GVC trade), VAX and gross exports respectively – the table also shows the corresponding numbers for exported value added that is restricted to value added originating from the manufacturing sector (panel b), advanced manufacturing industries (panel c) and an expanded manufacturing sector which includes business services (panel d).

A first observation regarding Table 4.1 is that in the 'post-crisis' period[13], the current growth rate of exports (all types) is still below the corresponding longer-term average[14]. Focusing on panel (a), which shows the economy-wide developments, the longer-term growth rates of trade flows ranged from 3.9% for the VAX to 4.9% for the *DVAre*. Looking at the corresponding averages for the 'post-crisis' years suggests indeed that exports lost dynamism in the period after the Great Trade Collapse.

Most importantly, the table reveals an interesting pattern across the three types of exports: over the longer term, gross exports grew faster than value added exports which is evidence of a growing share of foreign value added in exports and therefore more complex trade transactions. In fact, this growing discrepancy between gross trade flows and trade flows on a value added basis (i.e. the VAX) is the main reason for the growing interest in analyses of trade on a value added basis. In the case of economy-wide exports, gross exports grew by 4.6% on average compared to 3.9% recorded for VAX. This confirms the proclaimed trend towards more complex trade transactions which is also in line with the fact that VC trade (*DVAre*) has been growing faster than VAX so that VC trade accounted for an increasing share of value added exports. This pattern is also found when considering the other aggregates (i.e. manufacturing, advanced manufacturing and manufacturing plus business services).

[12] The choice of the currency – US dollar, which is the currency of the WIOD, or euro, which is the most relevant currency at least for the euro area members – has a big impact on the resulting growth rates of the trade flows. The described pattern of the DVAre relative to the VAX, however, remains unchanged.

[13] The term 'post-crisis' should indicate that the Great Recession had more or less ended by 2011 though the eurozone crisis was still ongoing.

[14] In terms of US dollar, the growth rates of exports in the post-crisis period appears to be even more depressed, amounting to only approximately one third of the long-term average. This difference is due to the almost 5% devaluation of the euro vis-à-vis the US dollar between 2011 and 2014.

Table 4.1: Annualised compound growth rates of EU-28 exports by period, 2000-2014

(a) economy	*long-term*	pre-crisis	crisis	recovery	post-crisis
	2000-2014	2000-2008	2008-2009	2009-2011	2011-2014
VC trade	*4.91%*	6.69%	-19.87%	14.68%	3.38%
VAX	*3.87%*	5.23%	-13.81%	9.13%	3.32%
gross exports	*4.58%*	6.12%	-16.34%	13.19%	2.77%
(b) manufacturing					
	2000-2014	2000-2008	2008-2009	2009-2011	2011-2014
VC trade	*3.65%*	5.08%	-22.51%	15.50%	2.43%
VAX	*2.80%*	4.03%	-17.37%	10.24%	2.25%
gross exports	*3.76%*	5.76%	-20.82%	14.35%	1.16%
(c) advanced manufacturing					
	2000-2014	2000-2008	2008-2009	2009-2011	2011-2014
VC trade	*3.60%*	4.85%	-21.16%	15.09%	2.46%
VAX	*3.04%*	4.33%	-18.13%	11.49%	2.09%
gross exports	*3.36%*	5.14%	-20.07%	12.82%	1.47%
(d) manufacturing and business services					
	2000-2014	2000-2008	2008-2009	2009-2011	2011-2014
VC trade	*4.48%*	5.95%	-21.55%	15.03%	3.88%
VAX	*3.49%*	4.72%	-16.34%	9.90%	3.41%
gross exports	*4.22%*	5.97%	-19.21%	14.07%	2.19%

Source: WIOD Release 2016. wiiw calculations.
Note: Values refer to exports of EU Member States to all countries in the world. Including intra-EU trade. Converted into euro using Eurostat's EUR/USD exchange rates (yearly averages).

This pattern, however, has changed in the post-crisis period. During these years, the average growth rate of VAX exceeded that of gross exports which would signal that the domestic value added component in exports is gaining in importance. At the same time the growth of VC trade (3.4%) could keep pace with (or even slightly exceed) the VAX growth. The implication is that, while domestic value added content in exports may have risen slightly, this was not to the detriment of VC trade. Hence, the fact that the share of VAX in gross exports was increasing marginally between 2011 and 2014 does not per se imply that international value chains are threatened.[15] Of course, given that the overall dynamic of international trade seems to be comparatively low in the post-crisis period, it cannot be ruled out that the identified pattern across trade flows is influenced by demand factors. At the same time it is not obvious, why the three types of export flows in Table 4.1 should be affected differently by lower demand if the attitude of firms towards offshoring and international production sharing were to remain unchanged.

Importantly, the relative growth of the different types of trade flows for the global economy is not identical to the patterns observed for the EU-28. In particular, when considering VC trade of all reporters (EU Member States and third countries), it seems that VC trade is indeed on the retreat, growing at a slower pace than VAX (Table 4.3).[16] The latter also grow faster than gross exports. In this respect the global pattern and the pattern found for the EU-28 are identical.

[15] The difference between VAX in per cent of GDP and gross exports in per cent of GDP is used, for example, in the analysis by Veenendal et al. (2015).

[16] Except for the case of 'advanced manufacturing' industries where the two are growing at par.

Table 4.2: Annualised compound growth rates of global exports by period, 2000-2014

(a) economy	*long-term*	pre-crisis	crisis	recovery	post-crisis
	2000-2014	2000-2008	2008-2009	2009-2011	2011-2014
VC trade	5.73%	6.87%	-20.85%	22.88%	2.40%
VAX	4.80%	5.13%	-13.41%	16.60%	3.17%
gross exports	5.14%	5.69%	-16.12%	18.86%	3.01%
(b) manufacturing					
	2000-2014	2000-2008	2008-2009	2009-2011	2011-2014
VC trade	4.13%	4.23%	-19.33%	20.62%	2.55%
VAX	3.73%	3.45%	-13.09%	15.44%	3.21%
gross exports	4.63%	4.84%	-17.10%	19.36%	3.00%
(c) advanced manufacturing					
	2000-2014	2000-2008	2008-2009	2009-2011	2011-2014
VC trade	3.70%	3.11%	-16.99%	19.26%	3.29%
VAX	3.53%	3.03%	-13.21%	15.73%	3.28%
gross exports	3.95%	3.84%	-15.76%	17.53%	3.04%
(d) manufacturing and business services					
	2000-2014	2000-2008	2008-2009	2009-2011	2011-2014
VC trade	4.67%	4.92%	-18.27%	19.40%	3.47%
VAX	4.07%	3.92%	-12.44%	14.60%	3.76%
gross exports	4.84%	5.03%	-15.93%	18.63%	3.43%

Source: WIOD Release 2016. wiiw calculations.
Note: Values refer to global exports to all countries in the world. Including intra-EU trade. Converted into euro using Eurostat's EUR/USD exchange rates (yearly averages).

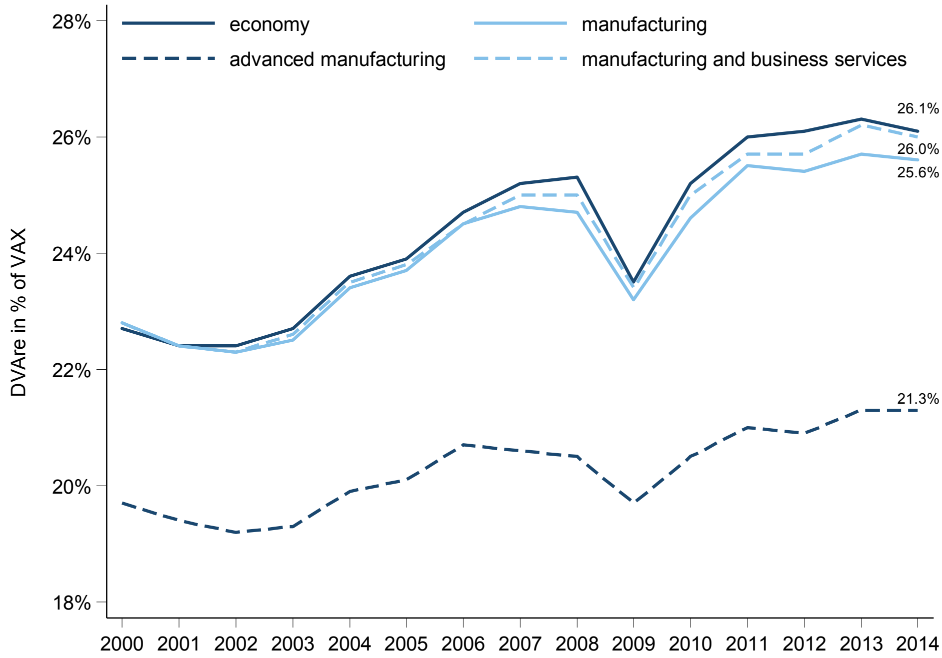
Table 4.1 and Table 4.2 only provide first insights into trade developments in the post-crisis era for the three-year period from 2011 to 2014. Nevertheless, the pattern for the EU-28 – if it were to persist – could be read as a reassuring sign. This is because it could signal a situation where EU-28 economies capture a growing share of value added embodied in exports (VAX are growing faster than gross exports), without dismantling VC trade which keeps pace with the growth of VAX. In contrast, at the global level the move towards growing domestic value added in exports coincides with a relative decline of VC trade (VC trade growth is lagging behind that of VAX). This is worth mentioning because the EU was definitely not the most dynamic economic area in the post-crisis phase and could still combine growing domestic value added with continued growth of VC trade. This may be related to the benefits of the Single Market which can also act as a reinsurance mechanism against potential protectionist tendencies. This is not to say that the EU-28 is immune to economic nationalism; nevertheless, the idea that the Single Market provides an institutional anchor to safeguard also internationally-organised production is fully consistent with the patterns of the post-crisis trade data in Table 4.1

Most of the assertions made are confirmed when switching from *levels* of VC trade and growth rates thereof to a relative measure. More precisely, the ratio between VC trade (*DVAre*) and value added exports shall serve as the intensity measure for an economy's involvement in VC trade. This is a statistic that indicates the extent to which domestic value added that is exported takes the form of VC trade.

The picture that emerges for this intensity measure in the case of the EU-28, still considering international VC trade (i.e. RVC trade and GVC trade combined) is one of a clear upward trend in the longer term that was interrupted in 2009 due to the Great Recession of 2008/2009

(Figure 4.4). After this crisis-related set-back, VC trade intensity recovered quickly, reaching the pre-crisis ratio already by 2011.

Figure 4.4: Intensity of VC trade in the EU-28, 2000-2014



Source: WIOD Release 2016. wiiw calculations.
Note: Values refer to exports of EU Member States to all countries in the world. Including intra-EU trade. Converted into euro using Eurostat's EUR/USD exchange rates (yearly averages).

A potentially worrisome aspect of the development is the levelling off in the VC trade to VAX ratio in the post-crisis period which would signal a peak in VC trade. Constantinescu et al. (2015) argue that the expansion of global value chains lost momentum already during the 2000s. Using the re-exported domestic value added (*DVAre*) as a proxy for VC trade leads to a different conclusion (at least for the EU-28) because the share of *DVAre* in VAX for the EU-28 was clearly increasing during that period. The peak in VC trade discernible in Figure 4.4 could not yet be identified by Veenendaal et al. (2015), who use a similar VC trade indicator as in this analysis, to explore whether the expansion of international production sharing has stopped.[17] The reason is that their analysis is limited to 2011. It is well possible that the levelling off of VC trade since 2011 is a short-term phenomenon, but for the time being it seems that the long-term trend towards increasingly deeper international production sharing (Wang et al., 2016) has come to a halt.

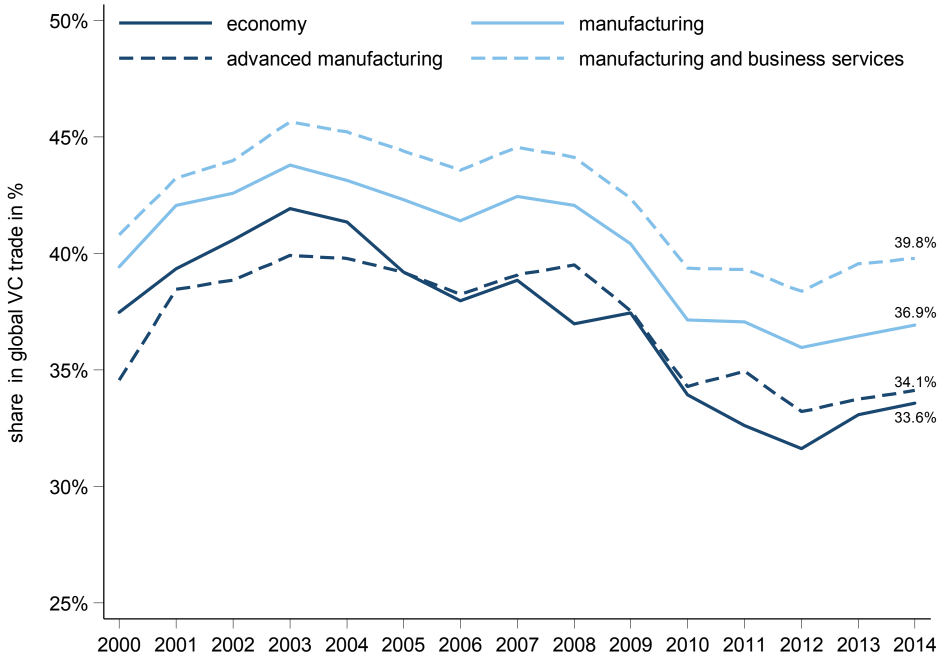
4.2.2. The competitive position of the EU in VC trade

The previous subsection has focused on the development of the EU-28's VC trade. In this subsection, these trends are compared to those in main competitor countries, including the United States, Japan, Korea, China, Brazil, Russia, India and Switzerland, by investigating the world market shares in exports.

[17] See Figure 9 in Veenendaal et al. (2015), p. 175.

As with international trade in general, the EU-28 is also a key player in VC trade. This is illustrated in Figure 4.5, which shows Member States' combined world market share in VC trade. In 2014 the EU's world market share[18] exceeded one third of global *DVAre* for value added originating from all industries in the economy; where these figures include intra-EU trade. If only value added originating from manufacturing and business services industries is considered, the share reaches even 40%. These figures are similar to the EU's world market share in gross exports, which stood at 35% in 2014.[19] Nonetheless, it should be noted that the world market share – both overall trade and VC trade – had been falling over the past 15 years – in the case of economy-wide VC trade – by roughly 4 percentage points.

Figure 4.5: World market share in VC trade of the EU-28, 2000-2014



Source: WIOD Release 2016. wiiw calculations.
Note: Based on global re-exported domestic value added including intra-EU trade.

However, this decline in world market shares reflects primarily the stronger integration of China and other emerging economies into the world economy. This is discernible from Figure 4.6, which shows the world market shares of the EU along with other major trading economies in 2000 and 2014 as well as the changes in these shares. When considering the economy-wide value added (panel a), the 4 percentage points decline in world market shares of VC trade is relatively modest compared to the losses experienced by the United States, which amounted to 7 percentage points. Also Japan's drop in world market share of VC trade exceeds that of the EU-28 despite the fact that the initial share in the year 2000 was much lower. Gains in world market shares were recorded by the BRIC countries (Brazil, Russia, India and China), with the lion's share of that gain, 6.5 percentage points, being captured by

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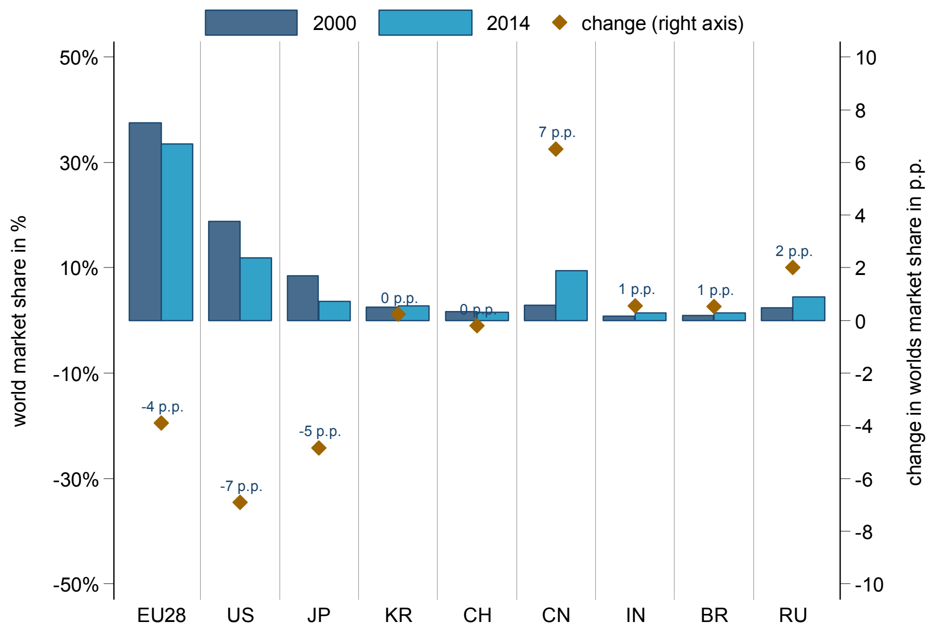
[18] The EU's share here refers to value added re-exported by EU Member States, i.e. where Member States take the role of the reporter.

[19] For value added originating from manufacturing industries the share amounted to 36.9%, which is close to the 38.5% reported by WTO (WTO, 2005, Table II.27) for the EU-28 world market share in manufacturing exports. The difference is partially due to the 'industry of origin' approach applied in this task which excludes services value added embodied in exports by manufacturing industries but includes manufacturing value added exported via services (and other) industries.

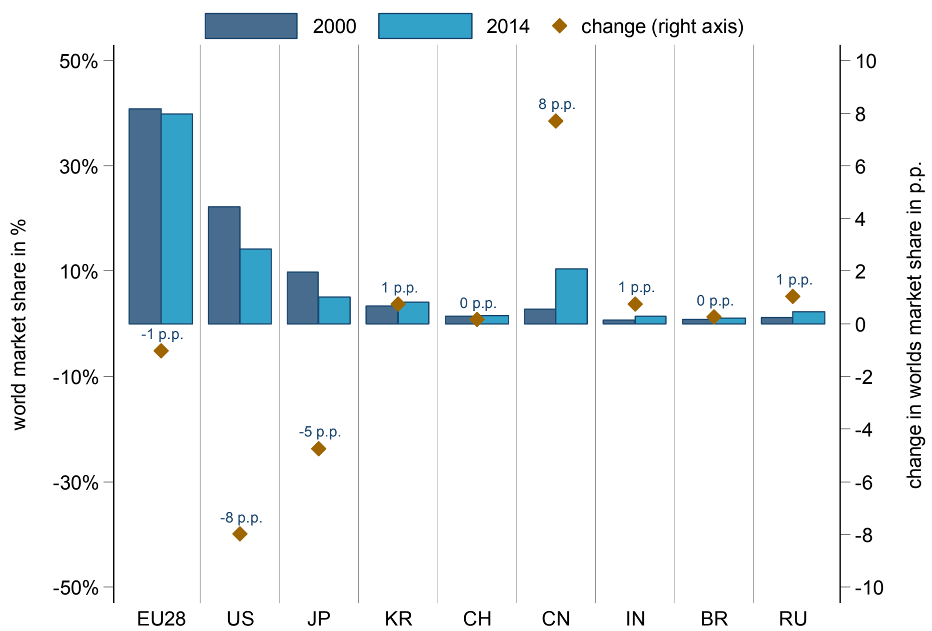
China. Qualitatively, the same picture emerges when only value added originating from manufacturing and services industries are considered (panel b). One aspect worth mentioning is that in this case the loss in the EU's world market share is more modest, while this is not true for the United States and Japan.

Figure 4.6: World market share in VC trade, country comparisons, 2000-2014

(a) total economy



(b) manufacturing and business services



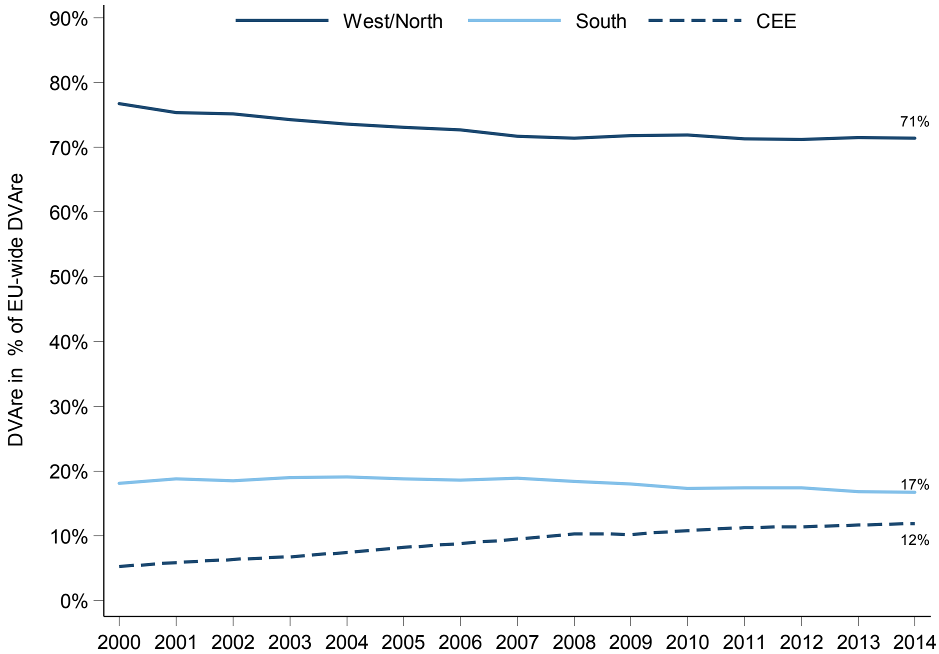
Source: WIOD Release 2016. wiiw calculations.
Note: Based on global re-exported domestic value added including intra-EU trade.

Comparing the dynamics in world market shares in VC trade with that of gross trade shows that the losses in the industrialised countries and the gains in emerging economies are larger in the former than in the latter. This constellation points to the fact that the globalisation process in large emerging markets is partly driven by the FDI activities of multinational enterprises (MNEs). In the case of vertical FDI, these activities are creating additional trade flows which tend to be complex, leading to an expansion of VC trade flows in the target countries of FDI.

4.2.3. Developments of the EU's VC trade by Member States

One reason why the EU-28 as a whole suffered a comparatively modest loss in world market shares in VC trade – relative to the United States and Japan – is the performance of the Central and Eastern European (CEE) Member States (Figure 4.7). Between 2000 and 2014 these countries could more than double their share in EU-wide VC exports from about 5% to more 11.6%. This is worth noting, as the VC trade indicator comprises uniquely domestic values. In the context of international value chains the CEE Member States are typically perceived as offshore destinations with the resulting trade flows from the offshoring activities being dominated by value added originating from the investor countries.[20] The trend for the CEE Member States shows, however, that these countries were also successful in participating with their domestic value added in such transactions.

Figure 4.7: Development of shares in EU-wide VC trade, total economy, 2000-2014



Source: WIOD Release 2016. wiiw calculations.
Note: Based on EU-wide re-exported domestic value added including intra-EU trade.

Figure 4.7 also reveals a stagnating share in EU-wide VC trade for the Southern cohesion countries. This picture is in contrast with the evidence for earlier periods for which a clear catching-up process of the Southern cohesion countries is detectable. At the latest by 2005, this catch-up process came to a halt. Since 2008 even a slight decline of this share is observable which is certainly linked to the severe economic difficulties that the members of the Southern EU periphery are facing. Given the rather flat development of the share of Southern EU Member States in EU-wide VC trade, increases in this share for the CEE Member

[20] This is still true, and the CEE Member States have particularly high ratios of foreign value added in exports (see, for example, Stehrer and Stöllinger, 2015).

States mainly constitute a reshuffling of market shares from the Western and Northern EU Member States, whose share declined by about 5 percentage points between 2000 and 2014.

The relative success of the EU-28 as an economic block in defending global market shares in VC trade masks a high degree of heterogeneity in performances across Member States. The country groupings in Figure 4.7 are too broad to reveal the existing differences. Therefore Table 4.3 shows the developments of the involvement in the EU-wide VC trade for more disaggregated country groups, including some regroupings of countries. First of all, the four Visegrád countries (Czech Republic, Hungary, Poland and Slovakia) are grouped together with Germany and Austria, which together build the Central European (CE) Manufacturing Core. This CE Manufacturing Core is attracting a growing share of the manufacturing activities undertaken in the EU (see Stehrer and Stöllinger, 2015; Stöllinger, 2016). These agglomeration tendencies left their marks in the share in VC trade of the core countries which rose by almost 5.4 percentage points from 2000 to reach 35% in 2014. This longer-term trend is positive for each member of the CE Manufacturing Core, with Poland contributing most strongly to the overall gain. Arguably, this Manufacturing Core is expanding eastwards to embrace also Romania and arguably Bulgaria. Both these countries could increase their share in EU-wide VC trade considerably.

These developments are in stark contrast to the trends in Italy, France and the United Kingdom. All three countries are characterised by relatively strong de-industrialisation tendencies which is why they are grouped into the 'Western De-industrialiser' although there are of course other Member States where similar trends are observable (e.g. the Scandinavian countries). This structural trend is bound to affect the export performance negatively, which is also true for VC trade as shown in Table 4.3. Taken together, the three Western De-industrialisers lost almost 7.5 percentage points of their EU-wide share in VC exports. In 2014 their share amounted to 31.5%, which is some 3 percentage points lower than that of the CE Manufacturing Core. Back in 2000 the situation was very different, with the combined share in VC trade of the 'Western de-industrialisers' surpassing that of the CE Manufacturing Core countries by a comfortable margin.

By and large these trends seem to have continued after the crisis of 2008/2009 though the dynamics have eased to some extent. An exception is the Southern EU, where for some of the countries, in particular Greece and Spain, the decline in the share of EU-wide VC trade has rather accelerated.

Table 4.3: Development of shares in EU-wide VC trade, total economy, 2000-2014

	2000	2005	2010	2011	2012	2013	2014	change 2011-2014 in p.p.	change 2000-2014 in p.p.
CE Manufacturing Core	29.47%	32.15%	34.45%	34.55%	34.44%	34.28%	34.88%	0.33 p.p.	5.41 p.p.
AT	*2.97%*	*3.09%*	*3.31%*	*3.28%*	*3.25%*	*3.19%*	*3.20%*	*-0.08 p.p.*	*0.23 p.p.*
DE	*22.54%*	*22.91%*	*23.28%*	*23.17%*	*22.96%*	*22.73%*	*23.18%*	*0.01 p.p.*	*0.64 p.p.*
CZ	*1.09%*	*1.74%*	*2.19%*	*2.26%*	*2.21%*	*2.19%*	*2.20%*	*-0.06 p.p.*	*1.11 p.p.*
HU	*0.71%*	*1.13%*	*1.20%*	*1.23%*	*1.25%*	*1.30%*	*1.29%*	*0.06 p.p.*	*0.58 p.p.*
PL	*1.87%*	*2.65%*	*3.59%*	*3.68%*	*3.80%*	*3.90%*	*4.04%*	*0.36 p.p.*	*2.17 p.p.*
SK	*0.29%*	*0.63%*	*0.89%*	*0.93%*	*0.98%*	*0.98%*	*0.97%*	*0.04 p.p.*	*0.68 p.p.*
Enlarged CEMC	0.50%	0.82%	1.40%	1.57%	1.53%	1.67%	1.74%	0.17 p.p.	1.24 p.p.
BG	*0.06%*	*0.17%*	*0.35%*	*0.43%*	*0.41%*	*0.42%*	*0.43%*	*0.00 p.p.*	*0.37 p.p.*
RO	*0.44%*	*0.65%*	*1.05%*	*1.14%*	*1.11%*	*1.25%*	*1.32%*	*0.18 p.p.*	*0.88 p.p.*
Western de-industrialisers	38.98%	35.53%	32.18%	32.15%	32.34%	31.00%	31.50%	-0.65 p.p.	-7.48 p.p.
FR	*12.81%*	*11.24%*	*11.26%*	*11.16%*	*10.97%*	*11.01%*	*10.72%*	*-0.44 p.p.*	*-2.09 p.p.*
GB	*16.39%*	*14.73%*	*12.67%*	*12.66%*	*12.82%*	*11.73%*	*12.63%*	*-0.03 p.p.*	*-3.76 p.p.*
IT	*9.78%*	*9.56%*	*8.26%*	*8.33%*	*8.55%*	*8.26%*	*8.15%*	*-0.18 p.p.*	*-1.63 p.p.*
Southern EU	6.61%	7.35%	7.32%	7.27%	7.09%	6.84%	6.78%	-0.49 p.p.	0.17 p.p.
CY	*0.09%*	*0.11%*	*0.19%*	*0.18%*	*0.20%*	*0.18%*	*0.17%*	*-0.01 p.p.*	*0.08 p.p.*
ES	*4.78%*	*5.07%*	*4.79%*	*4.82%*	*4.74%*	*4.51%*	*4.49%*	*-0.33 p.p.*	*-0.29 p.p.*
GR	*0.74%*	*0.95%*	*0.94%*	*0.86%*	*0.76%*	*0.74%*	*0.73%*	*-0.13 p.p.*	*-0.01 p.p.*
HR	*0.26%*	*0.33%*	*0.36%*	*0.36%*	*0.35%*	*0.34%*	*0.33%*	*-0.03 p.p.*	*0.07 p.p.*
MT	*0.06%*	*0.06%*	*0.07%*	*0.07%*	*0.08%*	*0.07%*	*0.07%*	*0.00 p.p.*	*0.01 p.p.*
PT	*0.69%*	*0.83%*	*0.96%*	*0.97%*	*0.97%*	*1.00%*	*0.99%*	*0.02 p.p.*	*0.30 p.p.*
EU Other	24.44%	24.13%	24.65%	24.45%	24.61%	26.22%	25.09%	0.64 p.p.	0.65 p.p.
BE	*5.16%*	*5.05%*	*4.97%*	*4.90%*	*4.90%*	*4.69%*	*4.54%*	*-0.36 p.p.*	*-0.62 p.p.*
LU	*0.64%*	*0.60%*	*0.80%*	*0.79%*	*0.75%*	*0.78%*	*0.81%*	*0.02 p.p.*	*0.17 p.p.*
NL	*8.06%*	*7.84%*	*7.91%*	*7.82%*	*8.01%*	*10.00%*	*9.36%*	*1.54 p.p.*	*1.30 p.p.*
DK	*2.02%*	*2.15%*	*2.01%*	*1.93%*	*1.96%*	*1.90%*	*1.82%*	*-0.11 p.p.*	*-0.20 p.p.*
FI	*1.92%*	*1.72%*	*1.60%*	*1.55%*	*1.54%*	*1.55%*	*1.46%*	*-0.09 p.p.*	*-0.46 p.p.*
SE	*4.16%*	*3.67%*	*4.09%*	*4.06%*	*4.01%*	*3.91%*	*3.68%*	*-0.38 p.p.*	*-0.48 p.p.*
EE	*0.08%*	*0.15%*	*0.20%*	*0.22%*	*0.23%*	*0.23%*	*0.23%*	*0.01 p.p.*	*0.15 p.p.*
LT	*0.12%*	*0.24%*	*0.33%*	*0.38%*	*0.42%*	*0.41%*	*0.40%*	*0.02 p.p.*	*0.28 p.p.*
LV	*0.09%*	*0.14%*	*0.20%*	*0.22%*	*0.23%*	*0.23%*	*0.22%*	*0.00 p.p.*	*0.13 p.p.*
IE	*1.95%*	*2.21%*	*2.13%*	*2.18%*	*2.15%*	*2.08%*	*2.11%*	*-0.07 p.p.*	*0.16 p.p.*
SI	*0.24%*	*0.36%*	*0.41%*	*0.42%*	*0.42%*	*0.42%*	*0.44%*	*0.02 p.p.*	*0.20 p.p.*

Source: WIOD Release 2016. wiiw calculations.
Note: Based on EU-wide re-exported domestic value added including intra-EU trade.

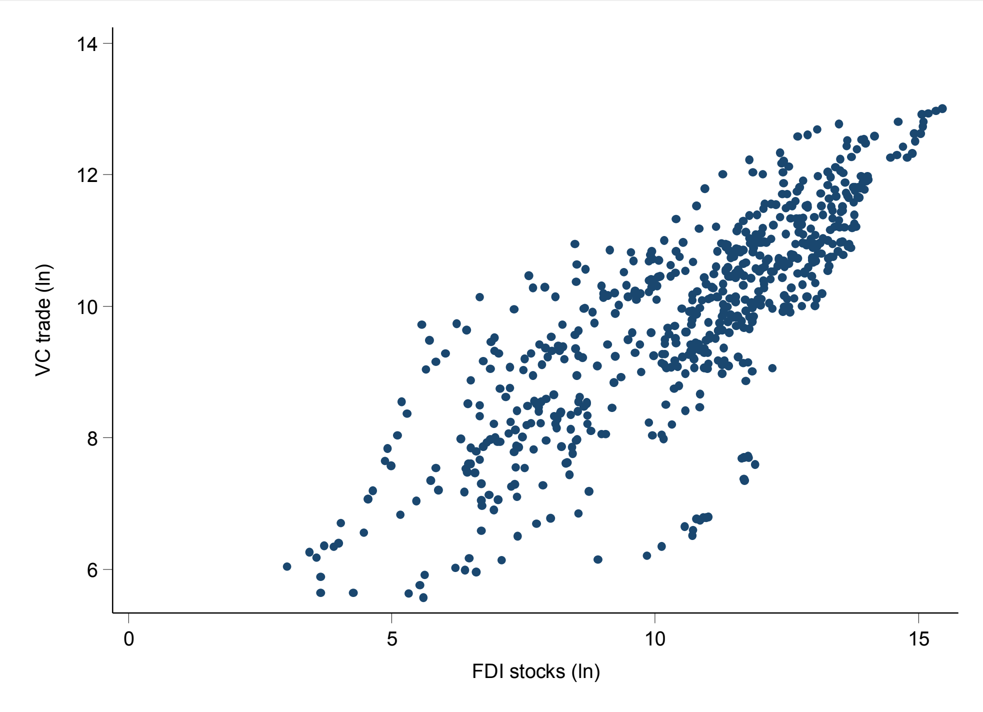
The reason for this rather pronounced agglomeration tendencies are manifold and include spillover effects and economies of scale coupled with geographic proximity and skill complementarities between the members of the CE Manufacturing Core. This is not to say that these factors are not present in the case of other EU Member States, but given the evidence in Table 4.3, Italy, France and the United Kingdom could exploit these opportunities to a much lesser degree. These shifts in the competitive positions in VC exports which are to the advantage of the (enlarged) CE Manufacturing Core and to the detriment of Italy, France and the United Kingdom as well as the Southern EU periphery constitute one of the greatest challenges that the EU will have to tackle in one way or the other.

Theoretically, the divergence in the shares of EU-wide VC trade may have been caused by different outward strategies of firms in, say, Germany and France, with the latter favouring to serve foreign markets predominantly by FDI instead of using the trade channel. Given the strong positive relationship between VC trade and FDI, however, this is very unlikely to explain the developments in Table 4.3 (see also Box 4.1.)

Box 4.1: Integration in international value chains and FDI

There is a long and established literature on the relationship between trade and FDI. One strand of the literature characterises exports and FDI as alternative modes of entries (Caves, 1985) and highlights the concentration-proximity trade-off in firms' choices of how to serve foreign markets (Brainard, 1997). The empirical results on whether trade and FDI are substitutes or complements is mixed, with a large number of (firm-level) papers arguing that actually both relationships can be found in the data.

Figure 4.8: *Relationship between FDI stocks and VC trade, global sample*



Source: WIOD Release 2016, wiiw-calculations.

Box 4.1 (continued): Integration in international value chains and FDI

In the context of VC trade, the presumption is that there is a complementary relationship as also described in Baldwin's characterisation of 21st century trade as incorporating a trade-investment-services nexus (Baldwin, 2011). Indeed, papers investigating the determinants of GVC participation typically find that FDI is strongly correlated with countries' involvement in value chains (e.g. Stehrer and Stöllinger, 2015). This finding is fully in line with the growing importance of intra-firm trade which is also well documented. In a recent contribution, Buelens and Tirpák (2017) undertook an in-depth investigation of the relationship between FDI and VC trade using very similar measures for VC trade as in this report. They find that both inward and outward FDI plays a key role in shaping economies' participation in international production network. In order to illustrate the strong relationship, Figure 4.8 displays the correlation between the measure for VC trade, the *DVAre*, and FDI outward stocks for the global sample.

Table 4.4 shows the tight relationship between VC trade and FDI by way of a bivariate regression. Already the pooled model (specification B1) has a very high explanatory power and the coefficient of the FDI outward stock variable is highly statistically significant.

Demonstrating the tight relationship between VC trade and FDI reinforces the result shown in Table 4.3 on the diverging market shares especially between Germany and the three other large EU economies, France, the UK and Italy, which were grouped together as the 'Western de-industrialisers'. The result is reinforced in so far as the diverging paths in export market shares is explained by different choices of firms regarding the entry mode to foreign markets which would require a substitutional relationship between VC trade and FDI activities.

Table 4.4*: Labour productivity and trade, total economy, EU-28*

Aggregate:	**Total economy**		
Sample:	**World (43 WIOD countries)**		
Dependent Variable:	**ln VC trade**		
	(B.1)	(B.2)	(B.3)
ln FDI outward stock	0.5070***	0.4925***	0.1805***
	(0.0135)	(0.0132)	(0.0574)
constant	4.4701***	4.3652***	7.2985***
	(0.1565)	(0.1850)	(0.5614)
time fixed effects	no	yes	yes
year fixed effects	no	no	yes
Observations	631	631	631
R-squared	0.6531	0.6643	0.9900
R-sq. dj.	0.653	0.656	0.989
F-test	1413	101.1	167.6

The positive relationship also remains when time fixed effects (specification B.2) and country fixed effects (specification B.3) are included. Hence, while the analyses in this subsection largely neglect FDI activities by multinationals firms, they are implicitly reflected in the VC trade indicator.

4.3. *Regional value chains and global value chains: Is 'Factory Europe' going global?*

4.3.1. A portrait of Factory Europe

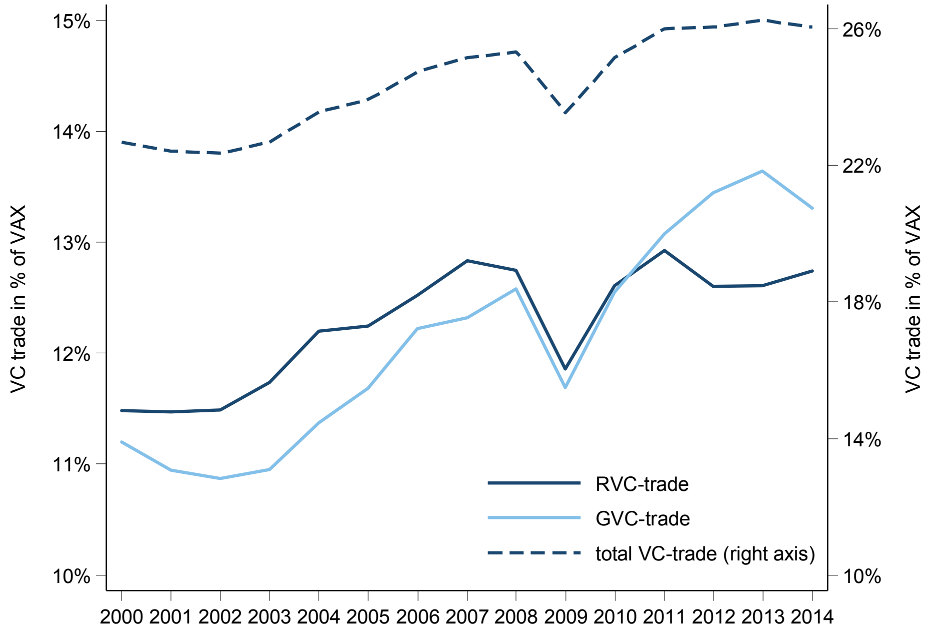
This section is dedicated to the analysis of the geographic dimension of internationally-organised production. The main distinction in this respect is between regional value chains (RVCs), which refer to cross-border production between countries of the same economic region, and global value chains (GVCs), which relate to joint production involving countries from different economic blocs. Following the concept introduced in Section 4.1, an RVC and the implied RVC trade flows are those where all 'producer' functions are occupied by countries from within the region. As a first step, the situation of the 'Factory Europe' is investigated which refers to the EU-internal production. Put differently, the EU-28 is defined as the region, making up the 'Factory Europe' for the purpose of this analysis.

According to Baldwin and Lopez-Gonzalez (2013) the use of the term 'global value chains' to denote internationally fragmented production in general is misleading because, according to their analysis, value chain trade is predominantly regional in scope. This result is derived using several indicators such as 'imports to produce', which is a backward production indication measure. The point stressed here is the fact that contributions in the literature that distinguish regional from global VC trade focus on bilateral relationships. The concept followed here traces the value chain from the reporting economy up until the final destinations and takes into account the 'regional affiliation' of all production partners involved.

Figure 4.9 starts with the split-up of the intensity of the EU's VC trade – shown in Figure 4.4 of the previous subsection – into the regional part (RVC trade associated with 'Factory Europe') and the global part (GVC trade).

Note that the scale, especially the left-hand scale, is rather small, so that the changes in the RVC intensity and the GVC intensity are actually rather modest. The RVC intensity, for example, rose by only 1.2 percentage points from 11.5% in 2000 to 12.7% in 2014. The increase of the GVC intensity component was somewhat stronger. Still, the intensities, and in particular their relative importance, seem to be moving slowly. Nevertheless, the trends of the two components are interesting. Focusing on the more recent years, one finds, for example, that RVCs and GVCs have been affected in a similar way and to a similar extent by the trade collapse of 2009. Also, the immediate recovery was quite synchronised. However, in 2012 a divergence occurred, with the intensity of GVC trade continuing to grow while that of RVC trade was declining slightly. Again, given the limited number of post-crisis years for which such data are available, this is only a snapshot. But if the trend were to continue, it would imply that VC trade involving value added originating in EU Member States becomes more global, even if the changes are not dramatic.

Figure 4.9: RVC trade intensity and GVC trade intensity, EU-28, 2000-2014



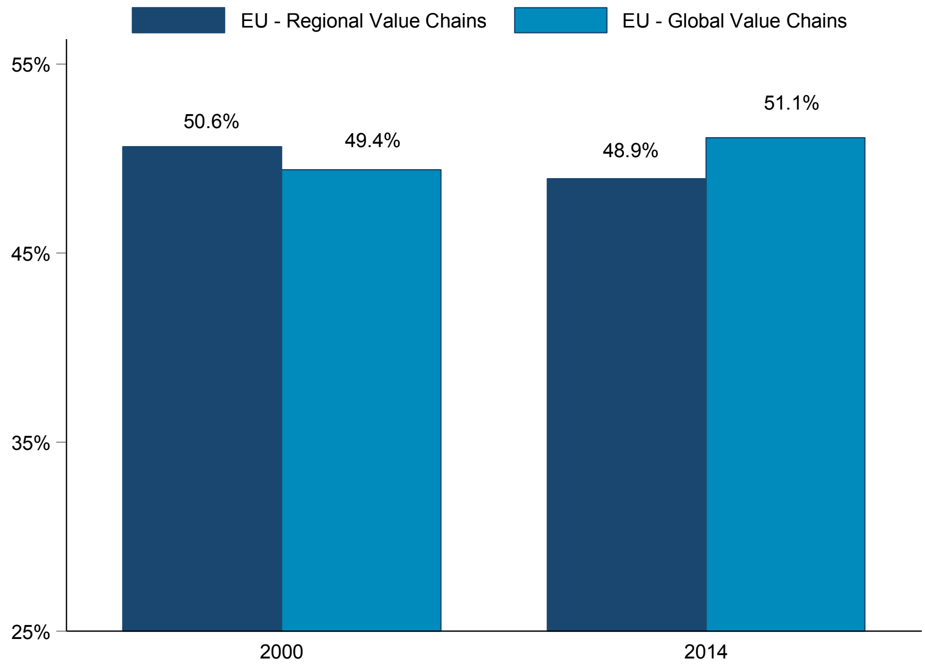
Source: WIOD Release 2016. wiiw calculations.
Note: RVC trade intensity = EU-28 DVAre involving EU producers only / total EU-28 VAX. GVC trade intensity = EU-28 DVAre involving EU and non-EU producers/ total EU-28 VAX. Hence RVC trade intensity + GVC trade intensity = VC trade intensity of the EU-28.

Figure 4.10 makes this more explicit by showing the relative shares of RVC trade and GVC trade involving EU-28 value added in 2000 and 2014. Again, the dynamics are limited but the trend seems to move towards GVC trade whose share increased from 49.4% to 51.1%.

In addition to this trend it also has to be emphasised that the commonly accepted fact that production fragmentation is predominantly regional needs to be qualified to some extent because almost half of VC trade by EU Member States also involves third countries as producers.

While Figure 4.10 shows that GVC trade has become slightly larger than RVC trade for the total economy when comparing the years 2000 and 2014, Figure 4.11 illustrates the developments of the two VC trade segments over time (2000-2014) for more detailed sectors, i.e. for manufacturing, advanced manufacturing and manufacturing including business services. The key insight is that the trends over time are very similar with only minor differences. In all cases, GVC trade slightly increased during the respective time period too, signalling that there is a tendency of 'Factory Europe' to embrace production cooperation that is global in scope. However, shifts were small in terms of percentage points, ranging from around 2 percentage points for the total economy and advanced manufacturing, to 2.5 percentage points in manufacturing and 3 percentage points in manufacturing and business services. Overall, in 2014, RVC trade still accounted for a slightly larger share than GVC trade in all the three sectors, in contrast to the total economy, where it fell to 48.9%. RVC trade still holds a share of 52.5% in manufacturing, 51.6% in advanced manufacturing and 50.7% in manufacturing and business services.

Figure 4.10: Relative shares of RVC trade and GVC trade, EU-28, 2000 versus 2014



Source: WIOD Release 2016. wiiw calculations.
Note: RVC trade = EU-28 DVAre involving EU producers only. GVC trade = EU-28 DVAre involving EU and non-EU producers.

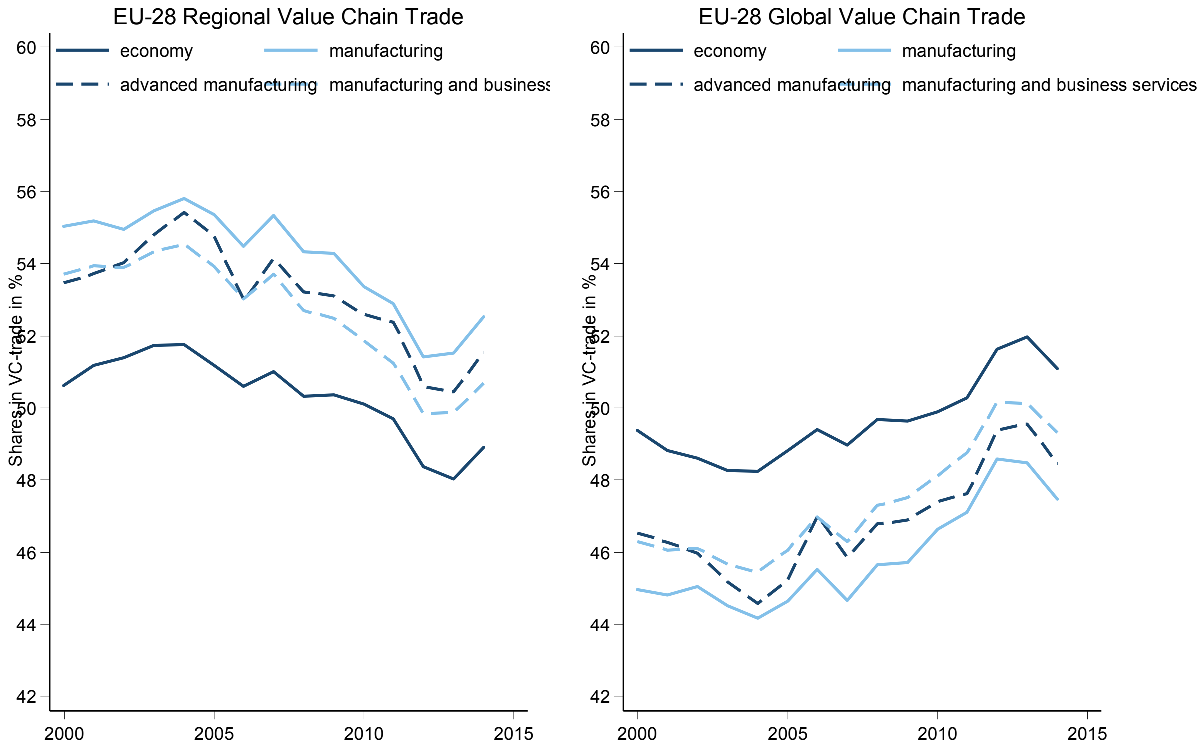
While these general shifts have occurred when comparing only the years 2000 and 2014, it is worth looking at the period in between. In fact, the share of regional value chain trade first rose between 2000 and 2004 and peaked in this latter year (see Figure 4.10, left-hand graph). Since then, however, the share fell decisively for eight years (except a small peak in 2007). RVC trade reached a trough in 2012/2013 but slightly recovered in 2014. Figure 4.10 on the right-hand side provides the mirror picture for global value chain trade shares. Looking at the total economy, global value chain trade in fact became slightly larger as a share in total value chain trade since 2011. For manufacturing and advanced manufacturing, regional value chain trade maintained a larger share than GVC trade throughout the period. For manufacturing and business services, the two shares approached each other and the GVC trade share slightly surpassed the RVC trade share in 2012 and 2013. This supports the observation of Baldwin and Lopez-Gonzalez (2013), who find that supply chain trade is more globalised for services than for goods.

Having established the relative development of RVC and GVC trade, the data allow for a further disaggregation of VC trade according to final demand. Both EU RVCs and EU GVCs might either produce for intra-EU demand or for extra-EU demand. It may be expected that RVCs produce more for the Single Market and GVCs more for the global market. The extent to which the geographic scope of production sharing is determined by where the output is sold to, i.e. the dependence on demand, is surprising though. Overall, EU-28 regional value chains indeed mainly produce for servicing intra-EU demand, accounting for about 70% of RVC trade when the total economy is considered. Thus 'Factory Europe' is primarily manufacturing for the Single Market, while the share attributable to global market demand is about one third.[21] In advanced manufacturing, regional value chains are slightly more

[21] However, one has to note that for a part of VC trade, i.e. the re-exported intermediates part, by definition, the RVC cannot produce for the global market as the final production step takes place in the destination country.

oriented towards extra-EU demand than the other sectors, shifting to about 40% produced for extra-EU demand and about 60% for intra-EU demand in 2014 but this does not change the main conclusion. Conversely, EU global value chains mainly produce for the global market, absorbing about 80% of GVC trade, while only 20% satisfy EU demand when the total economy is considered.

Figure 4.11: Evolution of RVC trade and GVC trade shares (total VC trade = 100), EU-28

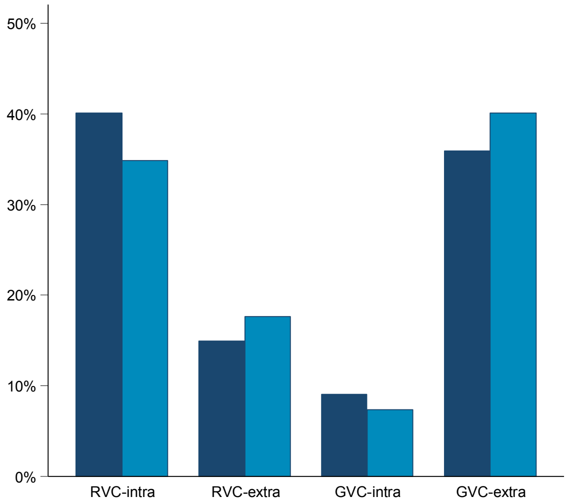


Source: WIOD Release 2016. wiiw calculations.
Note: RVC trade = EU-28 DVAre involving EU producers only. GVC trade = EU-28 DVAre involving EU and non-EU producers.

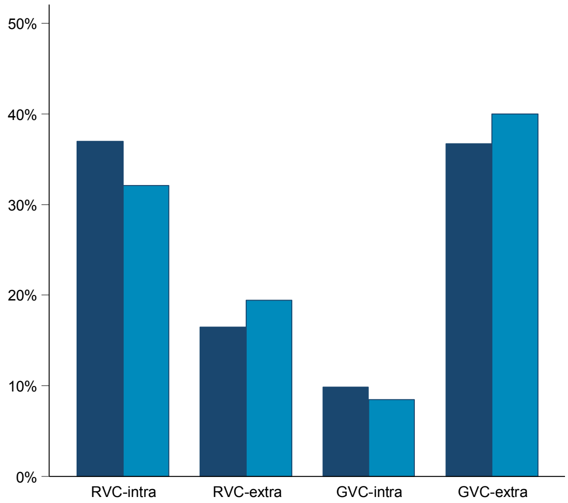
In Figure 4.12 visualises this 'demand dependence' of the organisation of VC trade by exhibiting the above mentioned four shares in per cent of total VC trade for the years 2000 and 2014. The general pattern is that the components serving extra-EU demand increased between 2000 and 2014, while those serving intra-EU demands decreased. The same picture emerges irrespective of whether the total economy or any of the three manufacturing aggregates is considered. Thus, larger demand from global markets explains part of the growing share of GVC trade relative to RVC trade for the EU-28. In Figure 4.12 this can be seen by comparing the RVCs producing for intra-EU and extra-EU demand with each other and likewise for the GVCs.

Figure 4.12: RVC and GVC trade by final demand (intra vs extra), EU-28, 2000 and 2014

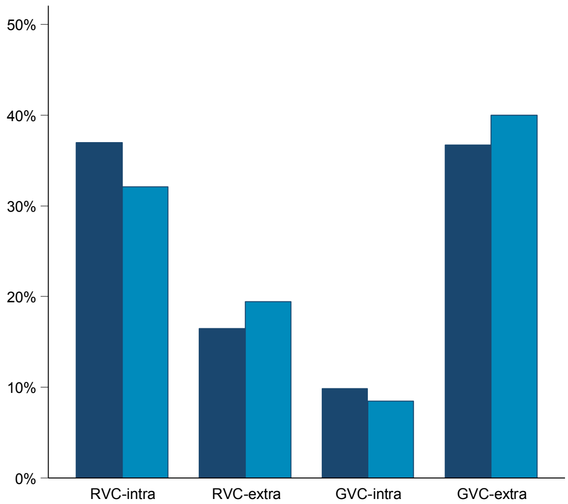
Total economy



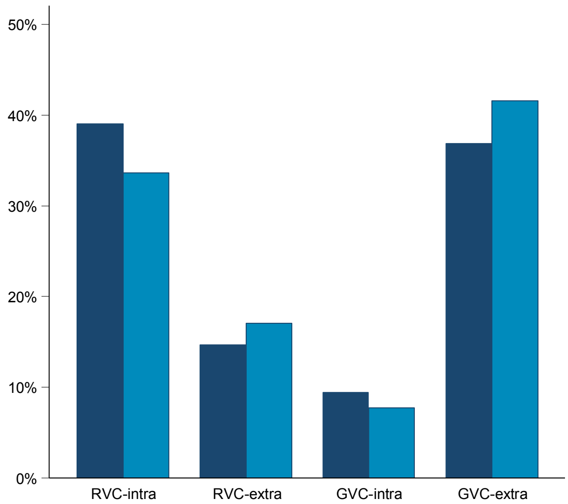
Manufacturing

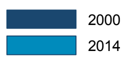


Advanced manufacturing



Manufacturing and business services

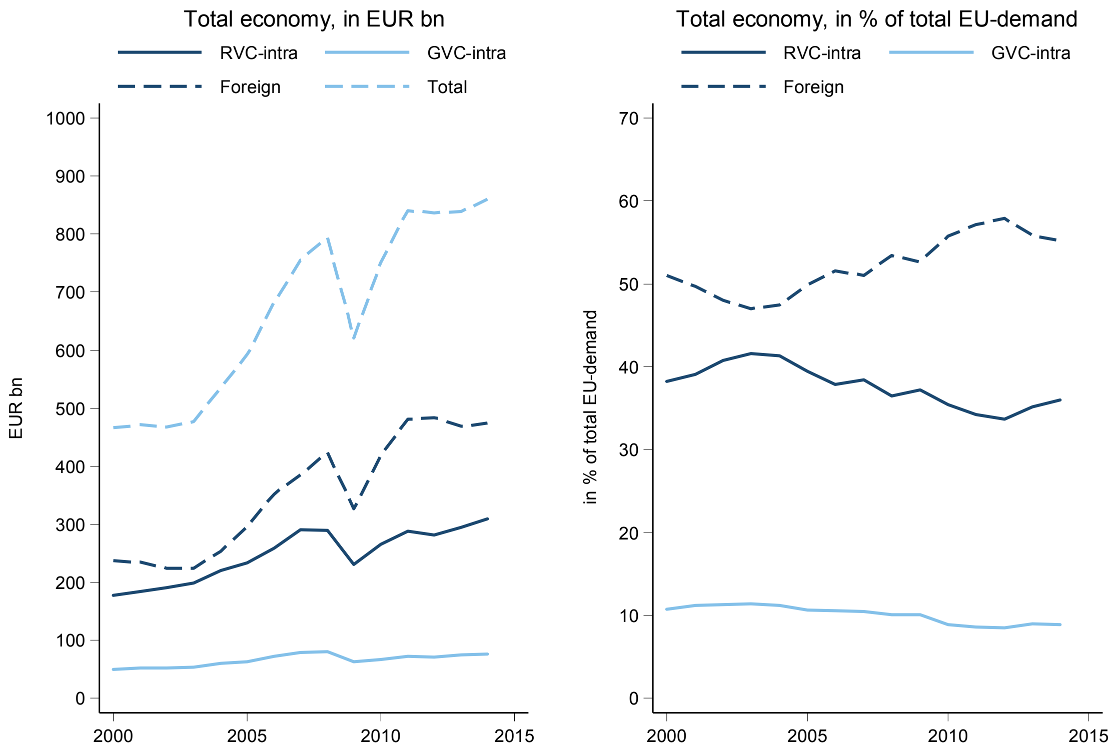




Source: WIOD Release 2016. wiiw calculations.
Note: RVC trade = EU-28 DVAre involving EU producers only. GVC trade = EU-28 DVAre involving EU and non-EU producers.

Figure 4.13 further explores the composition of VCs in serving EU demand. Hence, in comparison to the above analysis, here the extra-EU demand is disregarded, focusing only on intra-EU demand but VC trade from non-EU Members is also taken into consideration. Therefore three types of vCs are distinguished which are EU RVC trade for intra-EU demand (i.e. 'Factory Europe'), EU-GVC trade for intra-EU demand and foreign VC trade serving EU demand. Note that the latter includes value added originating from third countries but producing for the EU market (potentially including EU production partners). These shares were approximaley 38%, 11% and 51% respectively in 2000 and reached 36%, 9% and 55% respectivley in 2014. Thus, Factory Europe has slightly lost shares for satifsfying EU demand, while foreing VC trade has gained in shares and is now servicing 55% of EU demand. While this general trend reflects again the catching-up of emerging economies as documented in the previous sub-section, it is also interesting to note that in the post-crisis period, the trend was reversed and the share of 'Factory Europe' in satisfying EU demand was slightly growing again.

Figure 4.13: EU demand serviced by value chain trade by sources, 2000-2014



Source: WIOD Release 2016. wiiw calculations.

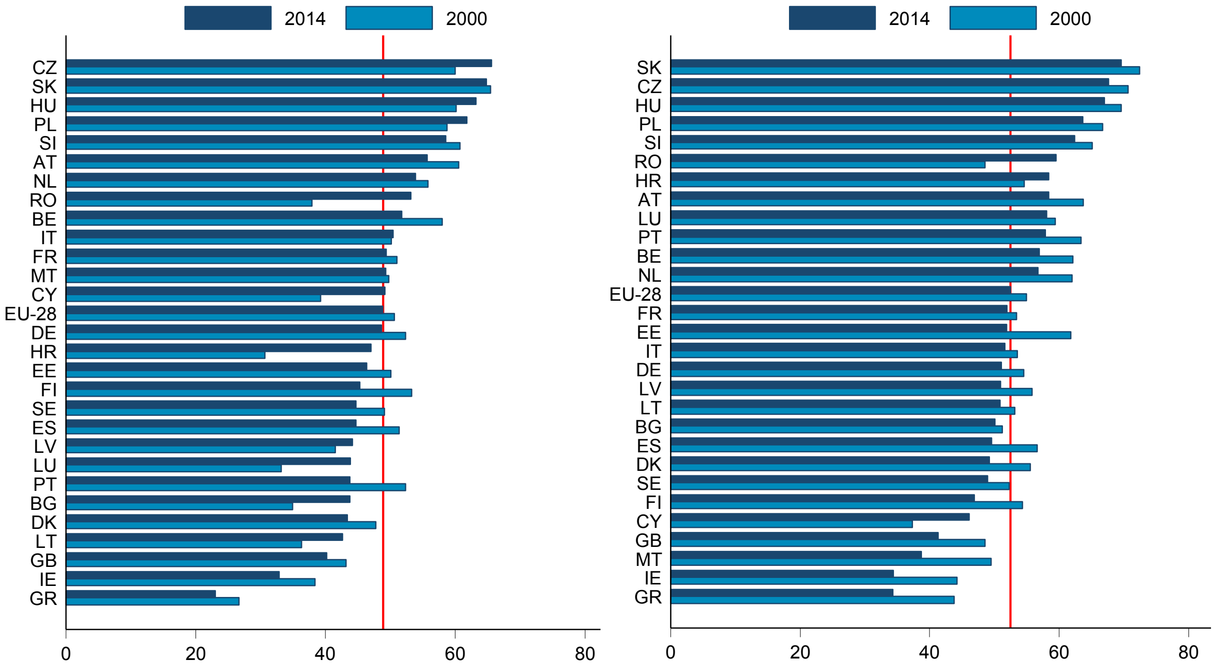
In a next step, value chain trade at the level of EU Member States is explored, focusing again on the split up into GVC and RVC trade.

Regional value chain trade is most pronounced in the CE Manufacturing Core countries, including the Czech Republic, Slovakia, Hungary, Poland and Austria but also Slovenia (see Figure 4.13 for total economy and manufacturing, and the Appendix for the other aggregates). In the total economy, the RVC trade share reached with about 66% of total VC trade in 2014 its highest level in the Czech Republic. As for the other sectors, the highest RVC trade share was reached by Slovakia. In these sectors, also Romania and Croatia are found at the top of the list. As such, mainly smaller countries and especially the new Member States are recording higher shares of RVC trade in total VC trade, benefiting from their inclusion in the German-led CE manufacturing supply chains (IMF, 2013). Germany is close to the EU-28 average (weighted and unweighted). Between 2000 and 2014, RVC trade shares in the total economy mostly increased for these countries. However, for the other three sectoral aggregates RVC shares declined for nearly all countries, suggesting an increase in GVC trade shares then. Only for Romania and Croatia did RVC shares rise strongly.

Global value chain trade, conversely (Figure 4.13, bottom), is most pronounced in the case of Greece, Ireland and Great Britain, which typically have stronger trade links with countries outside the EU. Stehrer et al. (2016), for example, have shown that some countries are more outward-oriented (i.e. have larger shares in extra-EU trade) than others. For goods trade these countries typically include the United Kingdom, Greece, Cyprus and Malta, for services trade Cyprus, Finland, Ireland, Sweden and the United Kingdom. As such, also these countries are among those with the largest GVC trade shares and resemble this pattern.

Figure 4.14: RVC trade share in % of total VC trade by Member States

Total economy *Manufacturing*



Source: WIOD Release 2016. wiiw calculations.

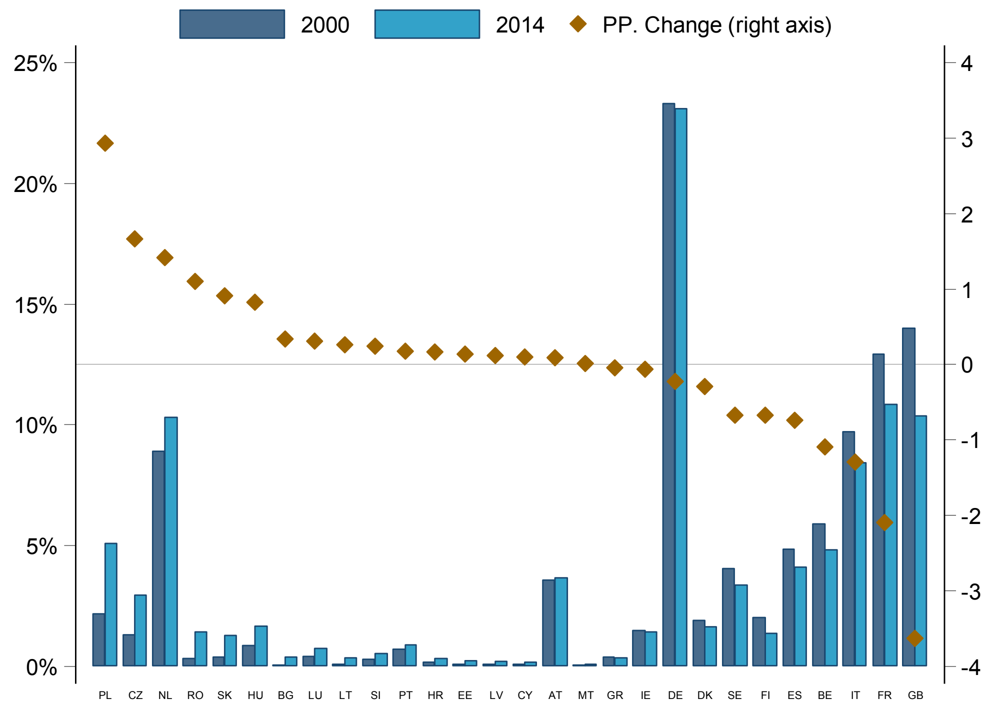
The involvement of Member States in the EU VC trade largely depends on their size. As has been shown already (Chapter 4.2.2.), the largest part of VC trade is conducted by the largest members, Germany, the United Kingdom, France and Italy, but also the Netherlands. Smaller players are Belgium, Spain and Poland. Typically again, this reflects their weight in goods and services trade (see Stehrer at al., 2016). Looking now at RVC and GVC trade separately shows again these countries as the main players in regional and global value chain trade. In terms of regional value chain trade, Germany accounts for 23% of total EU RVC trade, France for 11%, the United Kingdom and the Netherlands for 10% each and Italy for 8%. In terms of global value chain trade, Germany again accounts for 23% of total EU GVC trade, the United Kingdom for 15%, France for 11% and the Netherlands and Italy for 8% each.

Figure 4.15 depicts EU Member States' shares in regional value chain trade (upper graph) and global value chain trade (lower graph), with countries being ranked according to their change in shares between 2000 and 2014.

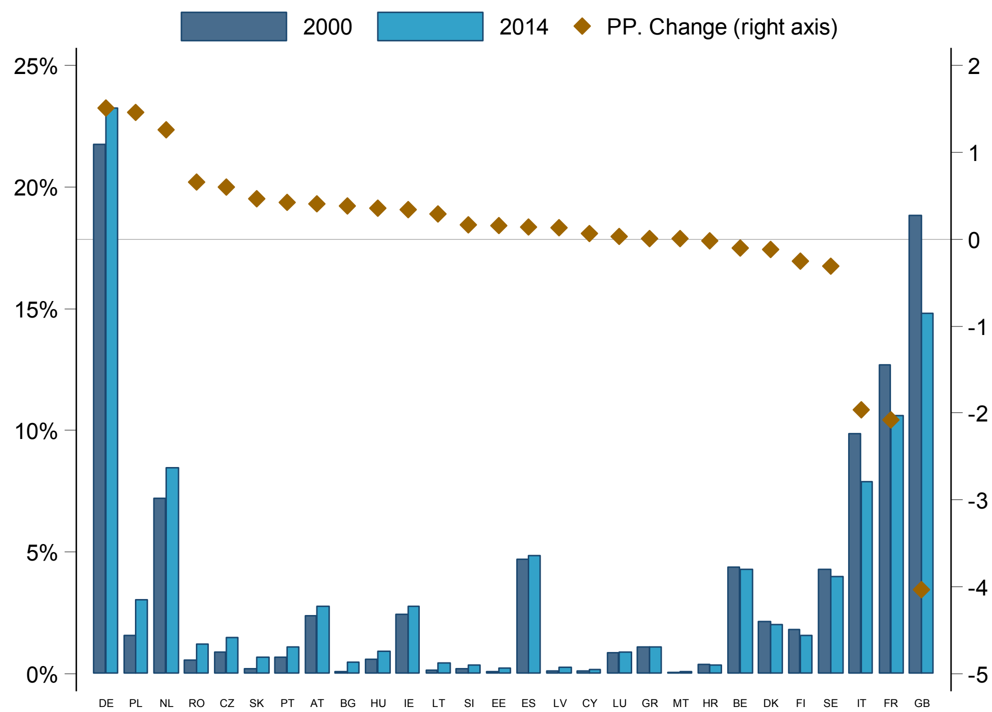
Overall, the Central and Eastern European (CEE) Member States are the main gainers both in terms of RVC trade and in GVC trade for the total economy. The Netherlands registered the third largest increase; Austria and Portugal also gained shares. Conversely, countries where shares declined the most were the United Kingdom, France and Italy. Germany shows a differentiated picture: In terms of RVC, Germany's share declined slightly, whereas in GVC trade Germany gained the most. However, Germany's main role becomes evident also in RVCs when looking at sub-aggregates, i.e. manufacturing and advanced manufacturing (see Figures in the Appendix).

Figure 4.15: Regional and global value chain trade, total economy

(a) Regional value chain trade (EU-28 = 100), shares and p.p. change



(b) Global value chain trade (EU-28 = 100), shares and p.p. change



Source: WIOD Release 2016. wiiw calculations.

Here, in fact, Germany was the country gaining most RVC shares; in manufacturing including business services it was in third place. This is due to the development of the German-Central European supply chain in manufacturing, 'producing goods for exports to the rest of the world' (see IMF, 2013), which evolved during the 2000s. Bilateral trade links between Germany and the Czech Republic, Hungary, Poland and Slovakia expanded rapidly. The CE

Manufacturing Core also encompasses Austria (see Stehrer and Stöllinger, 2015; Stöllinger, 2016), and also expands to the East (Romania and Bulgaria), explaining the growing shares for these countries as well.

When describing Factory Europe (defined as RVC trade between Member States), this should also include a picture of relations among Member States. As mentioned above, Germany has a main role, as bilateral links developed especially with the CE Manufacturing Core countries. Baldwin and Lopez-Gonzalez (2013) refer also to a hub-and-spoke pattern of EU trade, with Germany being the 'hub'. This means that trade relations between the hub and the spokes are strong but trade relations between the spokes are sparse (based on bilateral trade flows).

Looking in more detail at where value added exports are going within Factory Europe, four positions in the value chain can be distinguished: (i) the source country, (ii) the immediate production partner, (iii) the ultimate production partner, and (iv) the final destination country. 'Bilateral matrices' will show what functions countries take in the value chain. Table 4.5 depicts the forward linkages row-wise between source country and immediate production partner (leaving aside the second production partner). For example, about 47% of Austria's value added exports involve Germany as the immediate production partner, 8% involve Italy, 7% Hungary and 6% the Czech Republic as an immediate production partner. Indeed, the dominant role of Germany as an immediate production partner becomes evident, not only for the CEE countries but also for most of the EU Member States (except Cyprus and Malta). In the case of Austria (47%), the Netherlands (39%), the other CE Manufacturing Core countries (including the Czech Republic, Poland, Hungary, Romania, Slovakia), but also Slovenia, Italy and Belgium (25-39%), value added exports involve Germany as the most important immediate production partner. For the EU Member States, it is still 10-25%.

Table 4.6 depicts linkages between the source country, any EU Member State as the immediate production partner and the individual ultimate production partner. For example, close to 40% of Austria's value added exports involve Germany as the ultimate production partner, 9% in the case of Italy, 8% in France and 5% in Great Britain. Again, Germany is the main ultimate production partner, but now also France, Great Britain and Italy are main ultimate production partners. Table 4.5 and Table 4.6 confirm the importance of Germany as a main immediate and ultimate production partner in Factory Europe, but also highlight the importance of France, the United Kingdom and Italy as ultimate production partners. This is also attributable to the fact that these countries are also more important as destinations, i.e. are closer to final demand.

Table 4.5: RVC trade: Bilateral matrix (source country-immediate production partner), total economy, 2014, in % of RVC trade

	Immediate production partner																											
Source	AT	BE	BG	CY	CZ	DE	DK	ES	EE	FI	FR	GB	GR	HR	HU	IE	IT	LT	LU	LV	MT	NL	PL	PT	RO	SK	SI	SE
AT	0.0	2.4	0.4	0.1	5.8	47.5	0.7	1.9	0.1	0.6	4.3	1.9	0.2	1.4	7.3	0.7	8.4	0.1	0.6	0.1	0.4	2.7	3.5	0.3	1.2	3.2	2.5	1.8
BE	1.9	0.0	0.2	0.1	2.1	25.1	1.8	2.9	0.1	0.8	15.1	5.3	0.3	0.1	1.4	2.1	5.6	0.3	6.0	0.1	0.2	21.4	2.3	0.6	0.3	0.6	0.2	3.0
BG	5.9	14.9	0.0	0.3	3.8	17.6	1.3	3.7	0.2	1.6	5.4	2.6	2.9	0.4	4.0	1.4	11.8	0.2	0.6	0.1	0.4	5.2	2.7	0.9	6.2	2.3	2.2	1.4
CY	1.3	3.6	0.5	0.0	1.7	3.8	12.5	0.2	2.6	0.1	0.7	2.2	2.5	0.1	3.0	1.0	3.2	0.2	2.3	0.3	47.5	3.9	3.2	0.1	0.9	0.5	0.2	1.8
CZ	7.0	5.5	0.3	0.1	0.0	38.9	1.1	2.6	0.2	0.6	4.2	2.2	0.1	0.3	6.2	0.6	3.6	0.2	0.4	0.1	0.1	2.9	7.1	0.3	0.8	12.2	0.7	1.6
DE	9.7	6.6	0.3	0.1	8.3	0.0	3.4	5.1	0.3	1.6	11.9	5.7	0.2	0.2	6.6	1.6	8.9	0.2	1.9	0.1	0.1	10.6	7.5	1.0	1.1	3.2	0.7	3.2
DK	1.3	4.0	0.2	0.0	1.7	24.2	0.0	2.3	0.4	6.7	5.5	7.5	0.2	0.2	6.4	1.9	2.9	0.6	1.1	0.4	0.3	7.0	5.0	0.3	0.3	0.6	0.2	18.7
ES	1.5	6.3	2.7	0.1	2.1	19.5	1.6	0.0	0.1	0.7	22.0	5.3	0.4	0.1	1.4	1.3	10.8	0.1	0.8	0.1	0.1	6.1	2.7	10.7	0.7	0.8	0.6	1.4
EE	1.5	3.6	0.3	1.0	0.8	8.9	5.6	2.5	0.0	18.9	1.9	2.6	0.2	0.1	0.9	0.9	1.5	4.8	1.6	9.5	0.7	4.2	3.0	0.3	0.1	0.5	0.2	23.7
FI	1.8	6.3	0.1	0.1	1.3	23.3	3.6	2.7	4.4	0.0	4.1	4.3	0.2	0.1	1.3	5.7	4.1	0.8	0.5	1.0	0.1	11.8	5.2	0.3	0.3	0.5	0.2	15.9
FR	1.7	13.1	0.2	0.0	2.3	23.9	1.4	12.2	0.1	0.6	0.0	7.9	0.2	0.1	1.9	2.7	10.0	0.1	3.3	0.0	0.2	9.8	2.7	1.2	0.7	1.6	0.3	1.9
GB	1.1	8.0	0.1	0.2	1.4	16.8	2.6	2.7	0.1	0.9	10.8	0.0	0.2	0.1	1.1	14.7	4.8	0.1	17.4	0.1	1.5	8.8	1.8	0.5	0.4	0.3	0.2	3.3
GR	2.3	7.4	8.6	3.4	1.5	17.5	1.8	3.9	0.1	0.7	5.3	8.3	0.0	0.6	1.0	0.8	17.7	0.2	1.4	0.0	0.3	5.0	3.0	0.7	4.6	0.6	1.0	2.2
HR	13.0	7.5	0.6	0.1	2.4	16.4	1.4	0.9	0.1	0.3	2.5	2.1	0.9	0.0	8.2	0.9	16.1	0.0	1.0	0.0	0.4	2.6	1.7	0.2	0.8	1.9	15.6	2.4
HU	9.2	3.1	0.5	0.0	6.6	35.1	0.9	3.2	0.4	0.5	3.7	2.8	0.1	0.9	0.0	1.7	6.4	0.2	1.1	0.1	0.0	4.9	4.8	0.3	3.9	6.7	1.2	1.7
IE	1.2	11.6	0.2	0.0	1.5	13.3	2.4	4.2	0.1	1.3	6.6	16.8	0.2	0.1	1.5	0.0	6.7	0.1	13.2	0.1	0.7	12.6	2.1	0.5	0.4	0.3	0.1	2.5
IT	4.5	4.0	0.6	0.1	3.2	27.7	1.6	8.2	0.2	0.8	18.2	5.1	0.5	0.7	3.1	2.0	0.0	0.2	2.1	0.1	0.5	3.7	4.9	1.2	2.1	1.7	1.5	1.5
LT	2.7	5.4	0.1	0.1	2.3	16.9	10.3	1.6	5.4	2.1	5.2	3.0	0.1	0.0	2.0	1.0	3.1	0.0	0.3	10.0	0.0	8.4	10.4	0.4	0.3	0.8	1.3	7.0
LU	3.1	13.8	0.3	0.8	1.5	20.7	1.6	1.2	0.2	0.6	7.5	2.7	0.4	0.1	1.7	9.5	5.1	0.1	0.0	0.1	9.2	14.9	1.2	0.6	0.3	0.5	0.3	2.2
LV	2.2	3.9	0.1	1.7	1.4	11.6	9.0	3.2	15.5	3.4	3.4	4.8	0.2	0.0	0.8	2.1	1.9	10.1	0.5	0.0	0.4	5.0	5.6	0.2	0.1	0.5	1.0	11.2
MT	6.5	5.7	1.5	1.7	2.2	3.9	9.0	0.3	0.6	0.3	5.1	9.7	1.2	0.8	1.9	2.0	10.2	0.5	8.1	0.2	0.0	10.0	2.6	0.1	5.9	0.5	0.4	9.1
NL	1.1	18.7	0.1	0.0	1.5	39.4	1.5	2.0	0.2	0.9	8.3	5.0	0.1	0.1	1.2	7.2	6.3	0.1	0.7	0.1	0.9	0.0	1.6	0.4	0.2	0.4	0.2	1.7
PL	3.0	4.4	0.3	0.1	11.9	36.2	2.6	2.9	1.0	1.1	5.1	3.4	0.1	0.2	4.8	1.3	4.4	1.2	0.6	0.5	0.2	4.8	0.0	0.2	1.2	4.5	0.5	3.4
PT	1.2	8.1	0.3	0.0	1.6	16.0	1.0	31.4	0.1	0.9	14.6	5.1	0.3	0.0	1.5	1.4	5.5	0.1	0.6	0.0	0.1	5.6	1.4	0.0	0.6	0.7	0.1	1.8
RO	7.2	6.6	2.5	0.2	3.2	28.9	1.0	3.2	0.4	0.3	7.2	1.8	0.6	0.3	9.2	0.9	11.0	0.1	3.5	0.0	0.1	4.3	2.8	0.3	0.0	2.0	0.8	1.5
SK	9.3	3.3	0.2	0.0	20.3	27.5	0.7	1.7	0.1	0.3	3.2	2.7	0.1	0.3	10.1	1.3	4.8	0.3	0.8	0.1	0.1	2.1	7.4	0.2	1.2	0.0	1.0	0.9
SI	16.7	4.0	0.4	0.1	4.0	27.7	1.1	1.3	0.1	0.3	4.1	1.4	0.1	6.0	6.7	0.6	14.0	0.1	0.8	0.1	0.0	1.9	3.0	0.2	0.9	3.2	0.0	1.2
SE	2.4	8.9	0.1	0.1	1.9	19.9	15.6	2.4	1.7	8.7	6.2	4.7	0.2	0.1	1.3	3.0	3.7	0.6	1.1	0.4	1.2	9.8	4.3	0.5	0.3	0.6	0.2	0.0

Note: Green cells: 5-15%, red cells: >15%.
Source: WIOD Release 2016. wiiw calculations.

Table 4.6: RVC trade: Bilateral matrix (source country-ultimate production partner), total economy, 2014, in % of RVC trade

	Ultimate production partner																											
Reporter	AT	BE	BG	CY	CZ	DE	DK	ES	EE	FI	FR	GB	GR	HR	HU	IE	IT	LT	LU	LV	MT	NL	PL	PT	RO	SK	SI	SE
AT	1.4	2.9	0.4	0.1	4.3	37.9	1.5	3.7	0.1	0.9	8.4	5.4	0.4	1.0	4.9	0.9	9.1	0.2	0.5	0.1	0.3	2.9	4.1	0.6	1.5	2.9	1.5	2.2
BE	2.5	1.7	0.3	0.1	2.2	24.9	2.4	4.7	0.2	1.1	15.4	8.7	0.5	0.2	1.5	2.4	8.0	0.2	3.3	0.1	0.2	10.1	3.3	0.9	0.8	0.9	0.3	3.0
BG	4.4	7.8	0.3	0.2	3.1	22.1	1.8	5.2	0.2	1.2	9.8	5.7	2.3	0.5	3.1	1.5	11.2	0.2	0.6	0.2	0.3	5.0	3.3	1.2	3.7	1.8	1.2	2.1
CY	3.2	3.6	0.5	0.3	2.1	8.5	10.4	1.3	1.4	0.9	4.5	12.3	2.2	0.3	2.1	1.3	5.8	0.3	2.0	0.3	22.4	3.5	3.0	0.2	2.1	0.8	0.3	4.3
CZ	5.2	4.4	0.4	0.1	0.9	35.6	1.7	4.1	0.2	0.9	7.8	5.3	0.3	0.4	4.3	0.8	6.1	0.2	0.4	0.1	0.1	3.0	5.7	0.6	1.2	7.5	0.6	2.1
DE	6.3	5.6	0.4	0.1	5.8	8.5	3.3	6.2	0.3	1.6	13.3	8.4	0.4	0.4	4.9	1.8	9.6	0.3	1.1	0.2	0.1	6.3	5.9	1.1	1.3	3.0	0.6	3.3
DK	2.3	4.2	0.3	0.1	2.0	24.3	1.2	3.7	0.5	4.3	8.8	9.5	0.4	0.3	3.4	2.2	5.5	0.5	0.9	0.4	0.2	5.4	4.9	0.6	1.1	1.0	0.3	12.0
ES	2.0	5.3	1.3	0.1	2.1	22.2	2.0	2.9	0.1	1.0	19.4	8.3	0.6	0.2	1.5	1.5	10.5	0.2	0.7	0.1	0.1	4.1	3.1	6.2	1.1	1.1	0.4	1.9
EE	1.8	3.8	0.3	0.4	1.3	15.1	6.8	3.3	0.6	11.1	6.2	6.9	0.5	0.1	1.1	1.3	4.3	3.4	1.1	4.1	0.7	4.3	3.8	0.6	0.5	0.7	0.2	15.9
FI	2.3	5.2	0.2	0.1	1.8	22.0	4.3	4.0	2.3	1.3	8.9	8.0	0.5	0.2	1.5	4.6	6.4	0.7	0.5	0.7	0.1	6.9	4.8	0.7	0.7	0.8	0.2	10.0
FR	2.2	8.8	0.3	0.1	2.3	24.4	2.0	10.6	0.1	0.9	5.4	9.5	0.4	0.2	1.8	2.7	10.0	0.1	1.9	0.1	0.2	6.1	3.2	1.5	1.0	1.5	0.3	2.3
GB	1.9	6.1	0.2	0.2	1.6	19.3	2.8	4.1	0.2	1.2	12.0	5.3	0.6	0.2	1.2	11.5	7.2	0.2	10.0	0.1	1.3	5.2	2.5	0.8	0.7	0.6	0.2	3.0
GR	2.8	5.6	3.8	1.5	1.9	20.9	2.5	4.9	0.2	1.0	9.8	9.4	0.8	0.5	1.4	1.2	13.8	0.2	0.9	0.1	0.6	4.4	3.3	1.0	3.2	1.0	0.7	2.5
HR	8.4	5.1	0.6	0.1	2.5	22.0	1.9	2.8	0.1	0.8	7.5	5.1	1.0	0.6	5.0	1.1	14.5	0.1	0.8	0.1	0.3	2.8	3.0	0.5	1.5	1.9	7.4	2.4
HU	6.3	3.4	0.5	0.1	4.8	34.0	1.5	4.4	0.3	0.8	7.2	5.5	0.3	0.8	0.5	1.6	8.0	0.2	0.8	0.1	0.1	3.9	4.3	0.6	2.5	4.6	0.8	2.1
IE	1.8	7.9	0.2	0.1	1.7	17.3	2.8	4.9	0.1	1.3	10.4	15.8	0.5	0.2	1.4	0.7	8.5	0.1	7.7	0.1	0.5	7.9	2.7	0.9	0.7	0.6	0.2	2.8
IT	3.8	4.0	0.5	0.1	2.8	26.8	2.0	8.2	0.2	1.1	16.7	7.5	0.6	0.6	2.5	1.9	3.0	0.2	1.4	0.1	0.4	3.4	4.3	1.3	1.7	1.7	0.9	2.1
LT	2.7	4.6	0.3	0.1	2.2	20.1	9.3	3.3	2.9	2.7	8.2	6.5	0.3	0.2	1.7	1.3	5.5	0.4	0.4	4.8	0.1	5.7	7.3	0.6	0.7	1.0	0.7	6.3
LU	3.2	8.7	0.3	0.4	1.9	21.7	2.0	3.1	0.3	1.0	10.4	9.0	0.6	0.2	1.6	7.1	7.3	0.1	0.2	0.2	4.2	8.6	2.3	0.8	0.9	0.8	0.3	2.8
LV	2.3	3.8	0.3	0.6	1.6	16.3	8.7	3.6	6.3	4.2	7.2	8.0	0.6	0.2	1.1	2.1	4.6	6.5	0.5	0.9	0.5	4.5	5.0	0.6	0.6	0.8	0.6	8.1
MT	4.5	5.1	1.0	0.9	2.0	13.3	8.0	2.2	0.4	1.1	8.6	10.5	1.4	0.6	1.8	2.5	10.1	0.4	5.1	0.2	0.1	5.9	2.8	0.5	3.2	0.7	0.4	6.7
NL	3.2	10.0	0.2	0.1	2.3	27.8	2.5	4.0	0.3	1.1	12.1	8.5	0.5	0.2	1.5	5.5	7.9	0.2	0.8	0.1	0.5	1.9	3.7	0.8	0.8	0.9	0.3	2.5
PL	3.2	4.2	0.3	0.1	7.1	32.9	2.9	4.4	0.7	1.3	8.4	6.3	0.3	0.3	3.6	1.4	6.4	0.8	0.5	0.4	0.2	3.9	1.6	0.6	1.2	3.4	0.5	3.3
PT	1.7	5.6	0.4	0.1	1.7	18.7	1.6	22.8	0.1	0.9	15.9	7.8	0.5	0.1	1.4	1.5	7.3	0.1	0.6	0.1	0.1	3.7	2.3	1.0	0.9	0.9	0.2	2.1
RO	5.0	5.1	1.3	0.1	2.9	29.0	1.6	4.6	0.3	0.8	10.0	5.2	0.8	0.4	5.7	1.2	10.6	0.1	2.0	0.1	0.2	3.9	3.2	0.7	0.8	2.0	0.6	2.0
SK	6.5	3.5	0.3	0.0	11.0	31.3	1.3	3.4	0.1	0.7	6.9	5.4	0.3	0.4	6.2	1.4	6.8	0.3	0.6	0.1	0.1	2.5	5.9	0.5	1.5	0.6	0.7	1.7
SI	9.1	3.4	0.4	0.1	3.4	29.0	1.6	3.2	0.1	0.7	8.1	4.7	0.4	3.6	4.7	0.8	12.8	0.2	0.6	0.1	0.1	2.5	3.6	0.5	1.3	2.7	0.3	1.8
SW	2.4	7.7	0.2	0.1	1.9	20.4	12.2	3.8	1.1	5.5	9.0	7.9	0.4	0.2	1.4	2.8	5.5	0.5	0.9	0.4	0.7	6.5	4.1	0.7	0.7	0.9	0.2	1.8

Note: Green cells: 5-15%, red cells: >15%.
Source: WIOD Release 2016. wiiw calculations.

An important issue when investigating the geographic orientation in VC trade of EU Member States (as well as other countries) is that the outcome is strongly influenced by country size. The most prominent example in this respect is Germany. As has been shown, Germany is, also due to its economic size, the main production partner for other EU Member States. Since Germany cannot engage in regional production sharing with itself, it ends up having a comparatively lower amount of RVC trade. In order to take this aspect into account, the above analysis is complemented with an investigation of the revealed export preferences (RXP) index applied to VC trade. The RXP index is an indicator for the geographic focus of country *i*'s trade flows towards a country or region, relative to that of all other countries' trade intensity with the same region (see Cingolani et al., 2016). In this context the RXP index is calculated for the EU as the partner region, though applied to VC trade this means that the partner region is a pair of immediate and ultimate production partner. This way a proper measure for the relative focus on joint production with EU Member States is obtained for any reporting economy.

Methodologically the RXP index is based on a homogeneous bilateral trade intensity index (*HI*) defined as

$$HI_{i,r} = \frac{DVAre_{i,r}/DVAre_{i,world}}{DVAre_{world^{ex\,i},r}/DVAre_{world^{ex\,i},world}}$$

where *i* denotes the reporting country and *r* refers to the sum of intra-regional trading partners. As always $DVAre$ denotes VC trade flows and the index $world^{ex\ i}$ denotes all countries except for the reporting economy. Hence, for example, $DVAre_{world^{ex\,i},r}$, refers to VC trade with value added originating from all countries in the world except for country *i*, and including EU Member States as immediate and ultimate production partners[22].

The RXP index for VC trade, applied to regions, is then defined as

$$RTP_{i,r} = \frac{HI_{i,r} - \left[\left(1 - \frac{DVAre_{i,r}}{DVAre_{i,world}}\right)/\left(1 - DVAre_{world^{ex\,i},r}/DVAre_{world^{ex\,i},world}\right)\right]}{HI_{i,r} + \left[\left(1 - \frac{DVAre_{i,r}}{DVAre_{i,world}}\right)/\left(1 - DVAre_{world^{ex\,i},r}/DVAre_{world^{ex\,i},world}\right)\right]}$$

The term in squared brackets is the 'extra-regional' trade intensity index *(HE)*, i.e. the complement of the *HI*. Hence, the RXP index can be written more conveniently as[23]

$$RXP_{i,r} = \frac{HI_{i,r} - HE_{i,r}}{HI_{i,r} + HE_{i,r}}$$

The RXP index is symmetrically around the value 0 which indicates 'geographic neutrality' and ranges from -1, indicating no joint production with pairs of EU Member States, to +1, indicating only joint production with pairs of EU Member States (Cingolani et al., 2016). Note again that as before any combination that involves an EU partner and a non-EU partner is treated as extra-regional production sharing and is hence attributed to the 'extra-regional' trade intensity index. Intuitively, this RXP index for the EU as production partner measures in relative terms how intensive is production sharing among EU members compared to

[22] The particularity of VC trade implies that the 'EU region' does not include only 28 'countries' but 756 (27*28) country-pairs for EU countries and 784 (28*28) country-pairs for non-EU countries.

[23] The reason for including the HE into the formula is to avoid the dynamic ambiguity problem (the possibility that both the HE and the HI may be increasing over time).

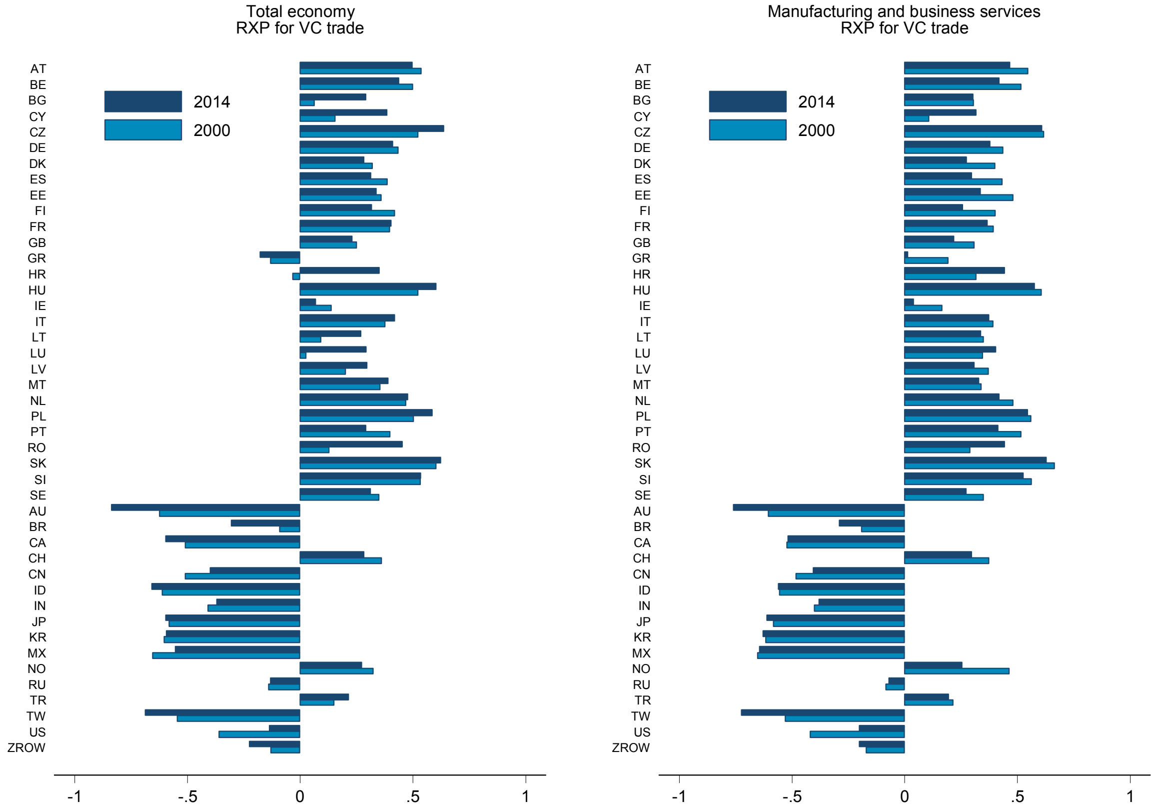
production shares between the world average and EU Member States (Cingolani et al., 2016).

A first obvious pattern that is revealed by Figure 4.16 is that, in general, the RXP index is positive for EU Member States and negative for third countries. This is as expected because the RXP index emphasises the role of geography in shaping trade and – in this particular application – its role for joint production. The only exceptions from this general pattern are the two EFTA countries in the sample, Norway and Switzerland, as well as Turkey. The explanation for this is that these countries, while geographically close to the EU, do not form part of 'Factory Europe' – neither on the reporter side nor on the production partner side – because 'Factory Europe' is defined to comprise the EU only. This holds true for both value added originating from all industries in the economy (left panel) and value added originating from manufacturing and business services (right panel).

The case of Switzerland is particularly interesting due to its geographic location amidst EU Member States. This geographic location means that a comparison with countries such as Germany and Austria are useful in order to get an indicative idea about the role of the Single Market for the organisation of production sharing with the EU. More precisely, if it were only geography that is relevant for international production sharing, with no role for the Single Market, Switzerland should have a similar RXP index for VC trade as Germany and Austria. However, in 2014, the RXP index of Austria was more than 20 index points higher than that of Switzerland. One possible explanation for this difference might be that it is due to different size structures of firms because Switzerland is home to much more multinational companies that are truly global players than Austria. This would be an explanation because, as Cingolani et al. (2016) point out, the RXP index need not necessarily reflect regional integration but could reflect structural problems and difficulties of countries to integrate into global markets. If that were the case, however, one should expect that Germany has a much lower RXP index for VC trade than Switzerland. This is, however, not the case. On the contrary, Germany's RXP index is 13 index points higher than that of Switzerland. This is an indication that the Single Market may further facilitate the formation of regional production networks. The interpretation receives further support from the fact that also the remaining neighbouring countries of Switzerland – France and Italy – have markedly higher RXP indices.

One of the main findings from the split of VC trade into RVC trade and GVC trade is that the members of the CE Manufacturing Core, apart from Germany, are among those with the highest shares of RVC trade in total VC trade. Though this finding is influenced by country size, it is again fully confirmed by the RXP index for the EU. Figure 4.16 shows that the members of the CE Manufacturing Core are those with the highest RXP indices, reaching more than 0.6 in 2014 in the case of the Czech Republic, Slovakia and Hungary. With 0.59 and 0.50, respectively, also Poland and Austria have very high RXP indices. With regards to Germany, it is worth mentioning that with an index value of 41 the country is still markedly below that of the aforementioned countries but the difference is less striking than for the share of RVC trade in total RVC trade. This is mainly because the RXP index controls for the fact that Germany cannot have any RVC trade with itself, which tends to lower its RVC share compared to other countries.

Figure 4.16: Revealed export preferences for VC trade with 'Factory Europe', 2000 and 2014

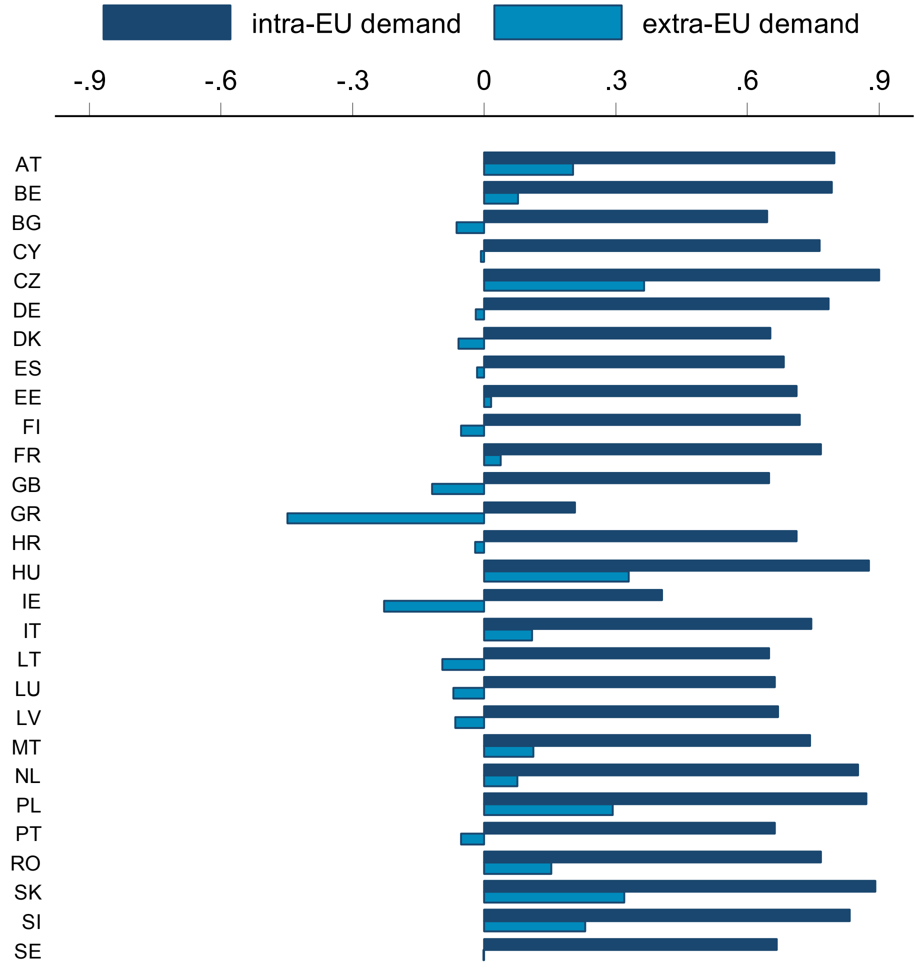


Source: WIOD Release 2016. wiiw calculations.
Note: RXP calculation based on pairs of immediate production partner – ultimate production partner. VC trade with the EU includes all flows where both the immediate production partner and the ultimate production partner are EU Member States. Naturally, for non-EU countries, the RXP index for VC trade with the EU does not constitute RVC trade but GVC trade.

It was equally shown that the demand patterns, distinguishing only between final demand coming from intra-EU or extra-EU partners, matters for the organisation of international production sharing. This is made explicit in Figure 4.17, which depicts the RXP index defined as above but with separate calculations for value added that is produced to serve intra-EU demand, on the one hand, and extra-EU demand, on the other. The result is striking. All EU Member States tend to have significantly more joint production with other Member States than the world average when the value added is finally absorbed within the EU. In fact, the RXP index for some Member States is really astonishingly high, reaching e.g. 0.9 for the Czech Republic in 2014. The picture changes when considering extra-EU demand. In this case there are quite a few Member States that have negative RXP indices, which means that the intensity to produce with EU partner countries is lower than that of the global average. For Greece, which has already been shown to be less involved in regional production sharing, and Ireland, which is a favourite location choice for multinational enterprises, this is less of a surprise but it is unexpected for other countries such as Denmark or Finland.[24]

[24] To some extent, these patterns are influenced by certain sub-categories of the DVAre. For example, exported valued added that is re-imported in the case of EU Member States by definition serves intra-EU demand. Likewise,

Figure 4.17: RXP of VC trade within 'Factory Europe' by type of final demand, total economy, 2014



Source: WIOD Release 2016. wiiw calculations.
Note: RXP calculation based on pairs of immediate production partner – ultimate production partner. VC trade with the EU includes all flows where both the immediate production partner and the ultimate production partner are EU Member States.

Focusing on RVC trade for satisfying EU demand, it is possible to show to what extent the RXP index of RVC trade (involving only EU Member States as production partners) exceeds the RXP index of VAX that are destined for the EU market. This is shown in Figure 4.18. While it is true that the countries with the highest RXP indices for RVC trade in the subset of value added that serves EU final demand also have high RXP indices for VAX trade satisfying EU demand, the degree of focusing on trade and production integration, respectively, with EU partners varies significantly. For the extreme cases, such as the Czech Republic and Slovakia, this difference is between 37 and 30 index points. The discrepancies between the two RXP indices are often equally large and for some countries even larger although the level of the RXP indices is comparatively lower. This is also true for Greece, which records a negative RXP index (-0.11) for the VAX destined for the EU-28 but a positive RXP index (+0.21) for the RVC trade producing value added for EU partners, resulting in a 0.32 index points difference.

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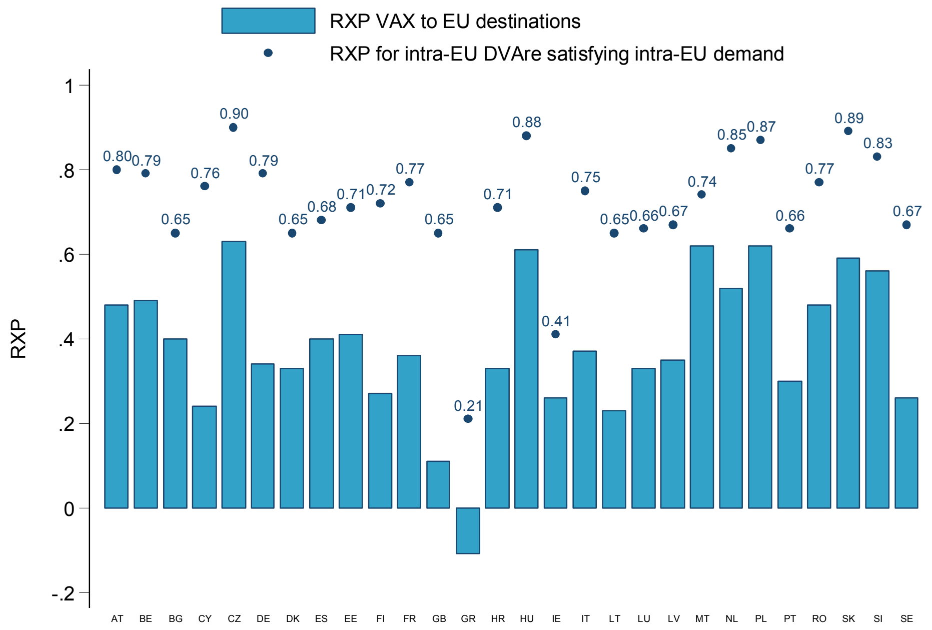
there can be no re-export of intermediate goods that are absorbed by extra-EU demand because in this category of DVAre trade the ultimate production partner coincides with the country of absorption.

It may be argued that this type of comparison is misleading to some extent because the RXP indices are based on different reference flows – world trade in the case of the RXP index for VAX and trade with the EU-28 as destination country in the case of the DVAre-based RXP index. Also, the RXP index actually reflects the geographic orientation of the production-related trade in the case of DVAre, while in the case of the RXP index for the DVAre it reflects the geographic orientation of trade to the final destination.

Figure 4.18: RXP of VC trade within 'Factory Europe' and RXP of VAX for serving intra-EU demand, total economy, 2014

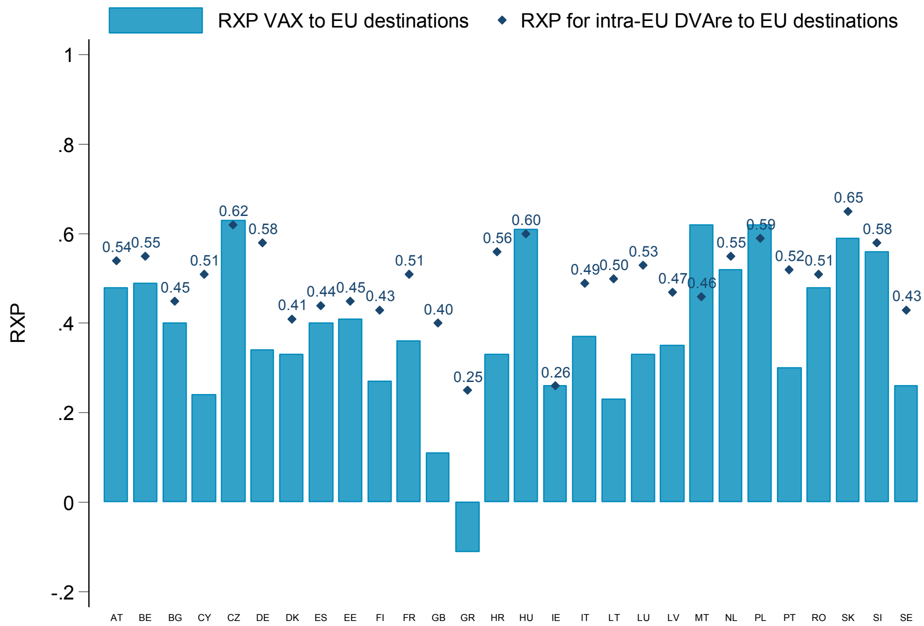


Source: WIOD Release 2016. wiiw calculations.
Note: RXP calculation for intra-EU *DVAre* based on pairs of immediate production partner – ultimate production partner. Reference trade flows are DVAre absorbed in the EU. RXP calculation for the RXP of VAX is based on destinations. VC trade with the EU includes all flows where both the immediate production partner and the ultimate production partner are EU Member States.

Hence, an alternative type of comparison is to use total DVAre flows as the reference (instead of differentiating between intra-EU and extra-EU markets) and calculate the RXP index based on triplets (instead of pairs) where any partner j is a triplet of the immediate production partner, the ultimate production partner and the destination. This can be calculated for each EU Member State for the partner-triplet where the immediate production partner and the ultimate production partner and the destination are EU Member States. The result for this way of calculating the RXP index is shown in Figure 4.19. This comparison suggests somewhat less pronounced differences between VAX- and *DVAre*-based RXP indices of EU Member States. The reason is that the reference trade in this variant of the RXP calculation is trade with the world (instead of intra-EU trade). Nevertheless, Figure 4.19 indicates that for the overwhelming majority of Member States, the RXP indices of *DVAre* produced by Factory Europe for Europe exceed the VAX-based RXP indices for trade orientation towards the EU-28 by a comfortable margin. There are exceptions, however. These exceptions are either countries that are in the EU's periphery, such as Malta and

Ireland, or countries whose overall trade orientation (i.e. the RXP index of VAX) is already very high. This is true for the Czech Republic, Hungary and Poland. For this second set of countries, it may be argued that the very high trade orientation towards EU partners is presumably not entirely voluntary but is also the result of difficulties with engaging successfully in trade with extra-EU partners.

Figure 4.19: RXP of VC trade within 'Factory Europe' producing for EU markets and RXP of VAX for serving intra-EU demand, total economy, 2014



Source: WIOD Release 2016. wiiw calculations.
Note: RXP calculation for intra-EU *DVAre* based on triplets of immediate production partner – ultimate production partner – destination. Reference trade flows are DVAre absorbed in the world. RXP calculation for the RXP of VAX is based on destinations. VC trade with the EU includes all flows where both the immediate production partner and the ultimate production partner are EU Member States.

An interesting comparison is also that between Germany and France. With regards to the overall trade orientation towards the EU (RXP index of VAX) the two countries have similar RXP indices, with the index of France being even slightly higher (0.36 for France against 0.34 for Germany in 2014). In contrast, the RXP index for RVC trade producing for satisfying intra-EU demand is considerably higher (by 7 index points) in Germany than in France. This would support the claim that Germany has a special role as the main hub for organising production within value chains (Baldwin and Lopez-Gonzalez, 2013; IMF, 2013). In fact, Germany's RXP index for RVC trade serving EU markets is almost as high of that of the top ranking Member States such as Slovakia, the Czech Republic and Hungary. This means that when serving EU markets, also Germany makes use of the advantages of geographic proximity (which should imply lower co-ordination costs of offshoring) and of the amenities of the Single Market (lower co-ordination costs of offshoring but also lower trade barriers, especially lower non-tariff barriers) and is collaborating intensively with other Member States within 'Factory Europe'.

To summarise, this section split up European value chain trade (VC trade) into regional (RVC trade, involving only partners from within the European Union) and global value chain trade (GVC trade, involving partners from outside). While RVC trade satisfies predominantly demand from the Single Market, GVCs are more strongly oriented towards third markets. Both types of VC trade increased between 2000 and 2014, but global value chain trade slightly faster, mostly due to faster rising international demand. Thus GVC trade has gained a larger share in VC trade throughout the economy and its aggregates, reaching finally 51% of VC trade in 2014 for the total economy.

How important is 'Factory Europe' (i.e. EU RVCs) in satisfying EU demand compared to GVCs and 'foreign' value chains? Factory Europe is serving 36%, EU GVC trade 9% and foreign value chains about 55% of EU demand (2014). Thus, Factory Europe has slightly lost shares between 2000 and 2014 (2 percentrage points), while foreign VC trade gained in shares (4 percentage points).

Within Factory Europe (defined as EU RVC trade only), the Central and Eastern European Member States expanded their shares in EU regional value chains, while the United Kingdom, France and Italy lost within the EU. Germany has a special role within Factory Europe. Between 2000 and 2014, it showed the largest increase in EU regional value chain shares within manufacturing, advanced manufacturing as well as in manufacturing and business services (note: not in the total economy), due to the evolvement of the 'German-CE Manufacturing Core'. In addition, Germany serves as the most important destination of value added exports from Member States as the immediate or ultimate production partner. The United Kingdom, France and Italy also serve as main ultimate production partners.

4.3.2. Regional value chains: Comparing EU, NAFTA and the Asia-5

So far, it has been shown that – due to 'gravity factors' (i.e. the role of distance) – EU Member States are typically more than proportionately involved in VC trade with EU partners than it is the case for third countries. Another question is how strong this regional focus of production-cooperation is within 'Factory Europe' compared to other regional trading blocs, notably NAFTA. A similar comparison can be made with important economies in Asia (Japan, Korea, China, Taiwan and Indonesia) which will be referred to as Asia-5[25].

Table 4.7 thus first looks at the absolute size of VC trade in these three regional trading blocs, splitting it up into three components. These components are RVC trade, a 'mixed VC' component and a 'pure GVC' trade component. RVC trade is defined as above, meaning VC trade among countries from within the same region. Hence, in this context RVC trade involving EU Member States is denoted as 'Factory Europe', 'Factory North America' refers to RVC trade by NAFTA members and 'Factory Asia-5' is RVC trade where the region is made up of Japan, Korea, China, Taiwan and Indonesia. The 'mixed VC' trade and the 'pure GVC' trade together equal the GVC trade component. Mixed VC trade refers to joint production where the reporting economy is producing jointly with at least one partner from the region and at least one partner from another region. In contrast, 'pure GVC' trade is a constellation where the reporting economy engages in production sharing only with partners from outside its own region.

In this comparison, 'Factory Europe' emerges by far as the largest of the three regional factories with EUR 463 billion in RVC trade, followed by 'Factory Asia' with EUR 101 billion and 'Factory North America' with EUR 93 billion. Hence, Factory Europe is about five times as large

[25] The fact that not all major South Eastern and Eastern Asian countries are covered by the WIOD will bias downwards the intra-regional VC trade of Asia-5 (because some intra-regional partners are included in the Rest of the World); however, the inclusion in the WIOD of the three largest economies makes it worthwhile to look also at Asia-5. One may argue the same for Factory Europe for another reason, which is that Factory Europe was defined to comprise the EU-28 only, hence excluding EFTA and some other partners in the region.

as Factory North America. The result may be expected qualitatively, but in terms of magnitude it is surprising given that the ratio between overall VC trade of the two trading blocs is about 2 to 1 (EUR 947 billion for the EU, EUR 416 billion for NAFTA).

The importance of Factory Europe (i.e. RVC trade of EU Members States) is also revealed by the fact that the share of RVC trade accounted for 49% of the EU's total VC trade compared to 22% for NAFTA and 19% for the Asia-5. The differences are less pronounced in what is termed 'mixed' value chain in Table 4.7, which represents VC trade that involves one production partner from within the region and one production partner from another region. Mixed VC trade accounts for a quarter of total VC trade for the EU-28 and the Asia-5 and 15% for NAFTA. This implies that 'purely' global VC trade is much less important for Factory Europe than for Factory North America and Factory Asia-5.

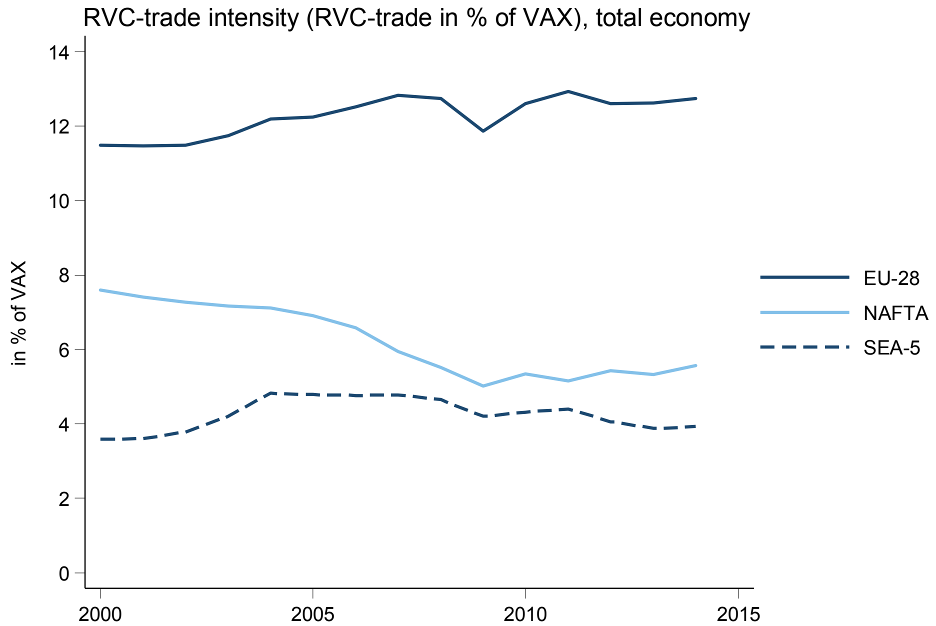
Obviously, these comparisons are influenced by the fact that EU Member States have much more regional production partners to engage in production sharing with.

Table 4.7: VC trade of main regional factories, total economy, 2014, in EUR billion

	RVC	mixed VC	'pure' GVC	VC trade
EU	463	238	246	947
	49%	25%	26%	
NAFTA	93	61	262	416
	22%	15%	63%	
Asia-5	101	133	294	528
	19%	25%	56%	
Sum by type	657	432	802	1,891
	35%	23%	42%	

Source: WIOD Release 2016. wiiw calculations.
Note: RVC = DVAre from respective factory involving production partners from the same factory only. Mixed VC = DVAre from respective factory with one production partner from the same factory and one extra-regional production partner. 'Pure' GVC = DVAre from respective factory involving extra-regional production partners only.

Figure 4.20: Comparison of RVC trade intensity across trading blocs, total economy

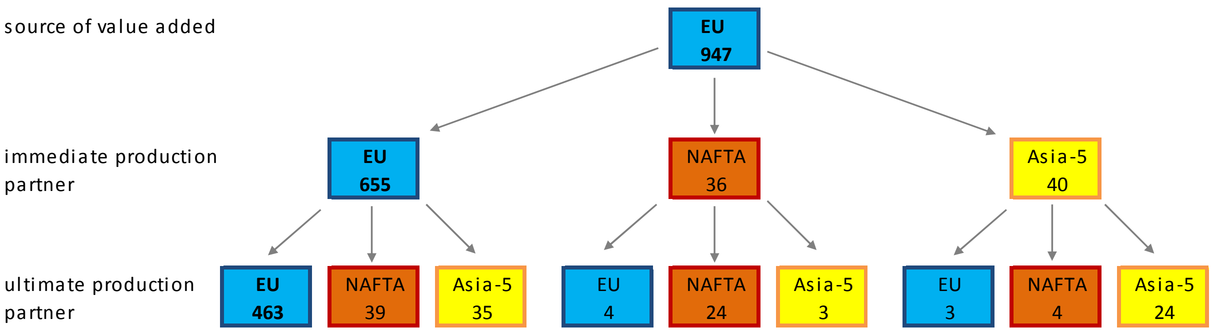


Source: WIOD Release 2016. wiiw calculations.

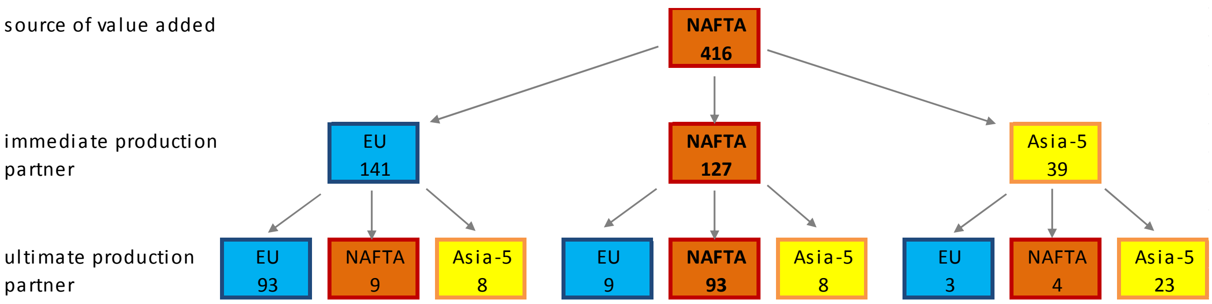
Switching from an absolute to a relative comparison of the magnitude of intra-regional intensity of VC trade, for which the ratio between RVC trade and overall value added exports (VAX) is used, the importance of Factory Europe is fully confirmed. As shown in Figure 4.20, according to this metric too, Factory Europe shows the highest VC trade intensity (12.7%), followed by Factory North America (5.6%) and Factory Asia-5 (3.9%). While the relative size of Factory Europe grew over time, that of Factory North America declined steadily. Factory Asia-5's relative intensity first grew (up until 2004) but then also declined slightly.

Figure 4.21: VC trade linkages between main regional factories, total economy, 2014, in EUR billion

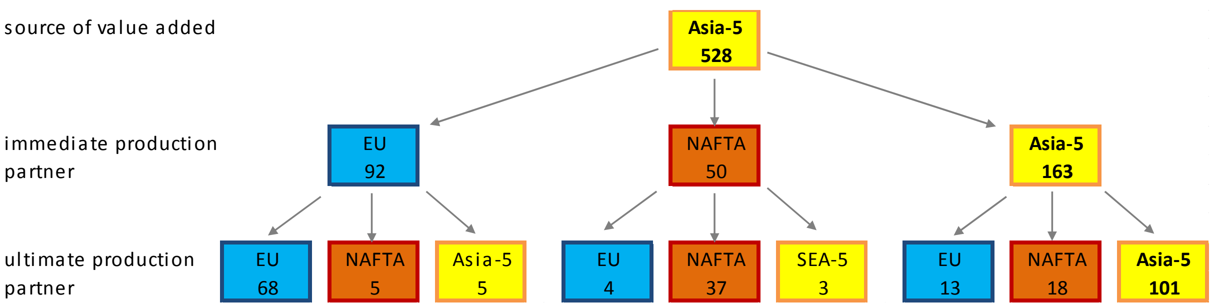
(a) Production linkages (VC trade) of the EU



(b) Production linkages (VC trade) of NAFTA



(c) Production linkages (VC trade) of the Asia-5



Source: WIOD Release 2016. wiiw calculations.
Note: Numbers refer to DVAre between the respective regional blocs. Numbers in the lower layers do not add up to the number in the above layer because EFTA and other countries are not shown.

The patterns of international production cooperation can be further explored by looking at the existing production linkages between the three major trading blocs, in addition to production cooperation within the regional factories[26]. Figure 4.21 shows these production linkages between the blocs, in absolute terms, for the total economy in 2014. Each of the three panels depicts one of the trading blocs as the reporter and shows the interconnectedness with the two other trading blocs, taking into account the immediate production partner and the ultimate production partner. The strong 'within-factory' production sharing presented in Table 4.7 is also discernible in Figure 4.21. It is represented by the high numbers (shown in bold) for the linkages of the blocs EU, NAFTA and the Asia-5 with themselves, which are of course the regional factories described in detail above. In the EU and the Asia-5 the 'within-factory link' is the strongest, while NAFTA in this respect is exceptional because the production links with EU partners (both as immediate and ultimate partner) are of equal importance (EUR 93 billion) as 'Factory North America'.

It is also noticeable that once an immediate production partner from a region is chosen, e.g. the EU as source region (panel a) producing with a country from Asia-5 as the immediate production partner, also the second production partner is likely to be from the Asia-5 region. This pattern is expected as the DVAre indicator on which this analysis is based traces forward value chains and not networks. In the terminology of Baldwin and Venables (2013) this analysis is focused on the 'snake'-type of production where single bits of value are added sequentially to the product, neglecting the 'spider-type' production in which several parts are coming together to form a product.

Note also that the VC trade with partners outside the three trading blocs shown in the figure is most important for the Asia-5; this is due to the fact that some intra-regional partners are part of Rest of the World in the WIOD database. In 2014 it amounted to approximately EUR 220 billion in VC trade, which is much more than for the EU-28 despite the fact that for the latter also VC trade with EFTA is significant and EFTA members were defined to be not part of 'Factory Europe'

It has already been mentioned that the economic size of the trading blocs and the number of potential production partners in the region are influencing the indicators such as the share of RVC trade versus GVC trade. One way of taking into consideration these factors is the revealed export preferences (RXP) index, which was presented in the previous subsection. It will also be an appropriate metric for comparing the geographic orientation of the three trading blocs. More precisely, what is useful in this context is the intra-regional RXP index where the reporting region coincides with the partner region, which in the case of VC trade are the two production partners (immediate production partner and ultimate production partner). This intra-regional RXP index ($RXP_{r,r}$) is equivalent to the regional introversion index *(RII)* suggested in Iapadre (2006).

Therefore, the methodology used for the comparison between the trading blocs based on the RII is fully consistent with the RXP index investigated in Section 4.1.1. Hence, for any region *r* the RII is defined as

[26] Production linkages to EFTA countries and other countries covered in the WIOD are not shown. For this reason, the numbers at each level do not sum up to the number indicated in the level above. For example, in the case of the EU, VC trade involving the EU (EUR 463 bn), NAFTA (EUR 36 bn) and Asia-5 (EUR 40 bn) do not add up to the EU's total VC trade (EUR 947 bn) because some of these EUR 947 bn of total VC trade is with EFTA (EUR 32 bn) and other countries.

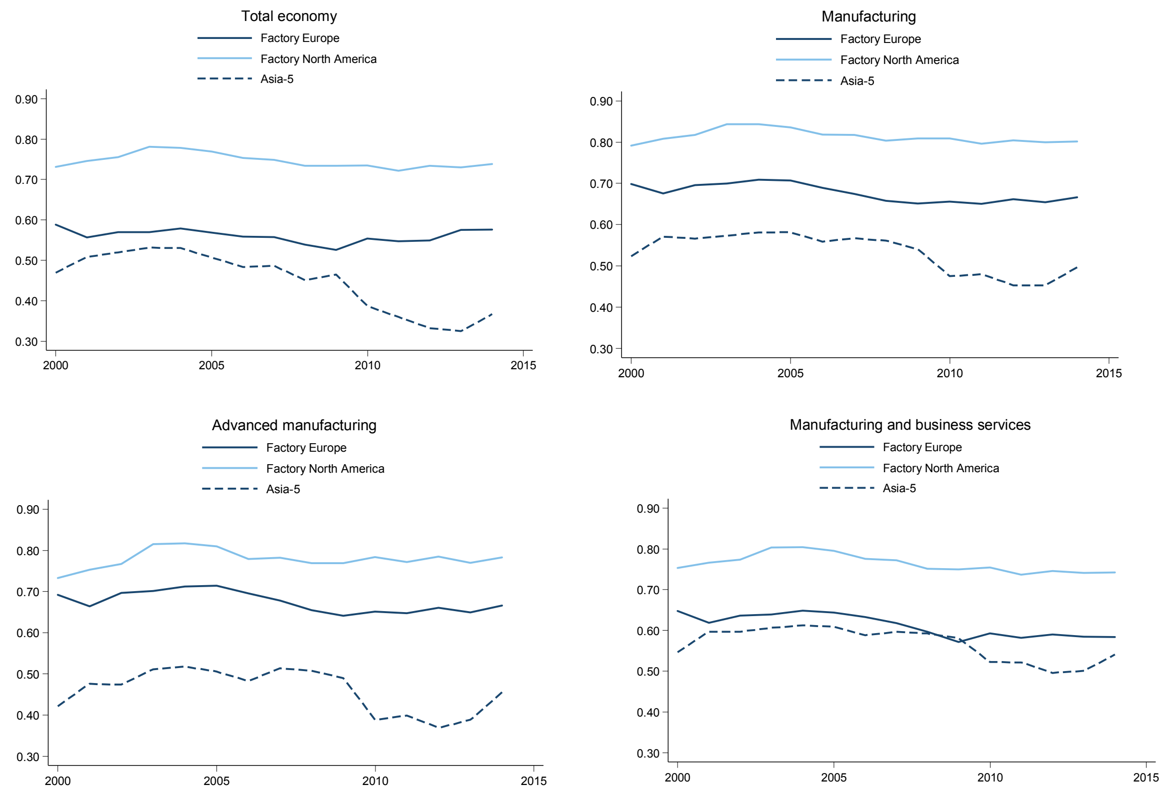
$$RII = \frac{HI_{r,r} - \left[\left(1 - \frac{X_{r,r}}{X_{r,world}}\right) / \left(1 - X_{world^{ex\,r},r} / X_{world^{ex\,r},world}\right)\right]}{HI_{r,r} + \left[\left(1 - \frac{X_{r,r}}{X_{r,world}}\right) / \left(1 - X_{world^{ex\,r},r} / X_{world^{ex\,r},world}\right)\right]}$$

which, in analogy to the RXP index, can be written more compactly as:

$$RII = \frac{HI_{r,r} - HE_{r,r}}{HI_{r,r} + HE_{r,r}}$$

The application of this RII to the EU-28, NAFTA and Asia-5, which represent Factory Europe, Factory North America and Factory Asia-5 respectively, establishes a clear ranking between the three factories with respect to the intra-regional focus in international production cooperation. The strongest regional inversion exists in Factory North America, where this index amounted to 0.74 in 2014 for value added originating from any sector in the economy. This is almost exactly the same value as back in the year 2000 with, however, an interim high around the years 2003 and 2004. With an index of around 0.7, regional introversion is slightly lower in the EU-28. In the case of Factory Europe, the RII was declining slightly between 2000 and 2009 when it went down to 0.53, but it increased again to reach 0.58 in 2014. Finally, the RII is considerably lower when considering the Asia-5. This is partly explained by a relatively strong decline in the RII of Factory Asia-5, at least when the total economy is considered, between 2003 and 2012 when a low of 0.33 was reached. Since then, a slight recovery has been recorded.

Figure 4.22: Comparison of regional introversion across regional 'Factories', 2000-2014



Source: WIOD Release 2016. wiiw calculations.
Note: RII calculation based on DVAre for pairs of immediate production partner – ultimate production partner.

Figure 4.22 illustrates that the ranking is quite consistent across the four aggregates shown. In general, regional introversion seems to be highest when value added from the manufacturing sector is considered. Also, the difference between regional introversion in the EU-28 and in NAFTA varies across the aggregates. More precisely, the difference between the two trading blocs is much smaller in the case of manufacturing and advanced manufacturing than in the total economy. In contrast, in manufacturing and business services, the EU-28's RII is much closer to that of the Asia-5 with the former even dropping briefly below the latter in 2009.

The main reason for the high value for NAFTA is, first of all, the very strong dependence of the Mexican economy on the United States, which is also reflected in the RII. Secondly, for the EU-28, the fact that some important regional partners (especially the EFTA members) are not included in Factory Europe tends to lower the RII. The same is true for Asia-5 because some important regional trading partners cannot be identified individually in the data.

Moreover, it should be stressed that the level of the RII per se is not necessarily a good or a bad thing. A high RII can be seen as an advantage as it signals strong regional integration. At the same time, it may also indicate that there are high barriers to production sharing with partner countries from outside the region. Likewise, it can indicate that the members of the region are not capable of linking into GVCs, i.e. value chains that involve extra-regional partners. Hence, as long as it is unclear whether RVC trade and GVC trade have systematically different implications for countries' economic performance, it is difficult to interpret changes in the RII. Further, it needs to be taken into account that the RII is also influenced by demand patterns. If a region is increasingly exporting value added to extra-regional destinations, this will impact the international organisation of production as was shown in the previous subsection. This helps explaining, for example, the strong decline in the RII of Asia-5 (+ China and composition effect).

Taken together, the results from the analysis of the RII and of the different types of VC trade can be seen as evidence for the fact that Factory Europe is very well developed. In particular, geographic proximity of countries, the absence of tariff barriers and the comparatively low regulatory cross-country barriers within the Single Market have led to a situation where joint production within Factory Europe is more developed than in the two other Factories. Certainly, this outcome is also driven by the fact that within the EU there are much more regional partners to engage with in international production sharing. At the same time, the regional introversion index showed that, when this latter factor is controlled for, the EU is not a closed bloc as compared, for instance, to NAFTA.

4.4. Involvement in value chains, specialisation and competitiveness

4.4.1. Introduction

This subsection addresses the potential consequences of countries' participating in value chains for specialisation patterns, on the one hand, and competitiveness, on the other hand.

Changes in the specialisation patterns will be captured by the share of manufacturing value added in GDP. If participation in value chains – be they regional or global – facilitates the build-up of manufacturing capacity it becomes an interesting tool for European industrial policy as already alluded to in the European Commission's latest Industrial Policy

Communication[27]. Since the specialisation patterns regarding manufacturing also reflect structural change, this set of regressions will be referred to as the '*structural models*'. With regards to competitiveness, two indicators are considered. Firstly, the relationship between labour productivity (both economy-wide and manufacturing-specific) and value chain trade is investigated. Labour productivity growth serves as a direct measure of competitiveness although it is acknowledged that competitiveness at the country or industry level is a more complex phenomenon than at the firm level. This analysis is labelled '*competitiveness model*'. A second commonly-used measure for competitiveness is the ability to sell in international markets. This is an export-oriented view on competitiveness which boils down to an economy's export performance. In line with the value added perspective in this task, changes in world market shares of value added exports serve as an export performance measure. This third investigation constitutes an '*export competitiveness model*'.

In all three models – the structural model, the competitiveness model and the export competitiveness model – the main interest is with the relationship of value chain integration, on the one hand, and structural change (affecting the extent of manufacturing activity), competitiveness and export competitiveness respectively, on the other hand. Importantly, the value chain trade measure in the econometric work is an *intensity*. More precisely, for each country it is the re-exported domestic value added *(DVAre)* – explained in the previous tasks – in relation to value added exports. The reason to focus on such an intensity measure is that the analysis should indicate to what extent (forward) participation in VCs is affecting manufacturing change and competitiveness *relative* to trade in general. This focus on VC trade intensities instead of levels of VC trade is explained by the fact that VC integration is a particular form of trade and as such can be expected to foster both specialisation in manufacturing – which is the main tradables-producing sector in EU Member States – as well as productivity growth and in particular world market shares. Therefore the more interesting question which is addressed here is whether VC integration has any merits in addition to trade in general.

This question is investigated econometrically first of all for the world as a whole for the three models mentioned above. This reveals some general patterns for the impact of VC trade on structural change and competitiveness for the 43 countries in the sample. In a second step, the sample is reduced to the 28 EU Member States, which are all covered in the WIOD 2016 Release. For the EU-specific regressions a linear model and a non-linear model are estimated. The non-linearities are introduced by inserting an interaction term between the VC intensity measure and a dummy variable for the economies forming the Central European Manufacturing Core (CEMC). This additional flexibility in the model allows for the possibility that value chains have differentiated effects on EU Member States' specialisation patterns which is essential both from an industrial policy as well as a cohesion perspective. The following subsection explains in more detail the three types of models to be estimated.

4.4.2. Specialisation in manufacturing: structural models

The structural models aim at revealing the relationship between changes in the specialisation patterns which is proxied by changes in the value added share of manufacturing and the VC intensity. The econometric approach investigating this specialisation-value chain nexus is similar to that in Stöllinger (2016), with the basic model taking the following form:

[27] See: 'For a European Industrial Renaissance' (European Commission, 2014).

(Eq. 4-1) $$\Delta SPEC_{c,t}^{mf} = \alpha + \beta_1 \cdot VC_{c,t-1}^{mf} + \iota \cdot SPEC_{c,t-1}^{mf} + X_{c,t-1} \cdot \varphi + \delta_t + \mu_c + \varepsilon_{c,t}$$

where $\Delta SPEC_{c,t}^{mf}$ is the change in the manufacturing share of country *c* between time *t* and *t-1*. Throughout the section, *c* denotes the country index and *t* is the time index. In order to exploit the relatively short time period available (2000-2014) the model is estimated in annual changes.

The main explanatory variable is the VC trade intensity measure *($VC_{c,t-1}^{mf}$)*. Since it is crucial for understanding the estimation results, it should be emphasised again that this measure is the *DVAre* expressed in per cent of country *c*'s value added exports.[28] The VC trade intensity enters the regression with a time lag of one period so that, for example, the change in the manufacturing share occurring between 2000 and 2001 is explained by the VC trade intensity in the year 2000.[29]

The variable $SPEC_{c,t-1}^{mf}$ captures the initial conditions, i.e. the initial value added share of manufacturing. The initial share of manufacturing is intended to control for potential level effects as countries with initially higher manufacturing shares may also be more prone to 'de-industrialise'. According to this type of convergence hypothesis, which Rodrik (2013) has recently shown to hold unconditionally for manufacturing industries at the global level, the initial share of manufacturing is negatively correlated with the change in the manufacturing share. Put differently, countries with initially low shares of manufacturing in GDP should see the relative size of the sector increase by more (or decrease by less) than countries which initially had higher shares – if this convergence hypothesis holds true. For this reason a negative sign for the coefficient of $SPEC_{c,t-1}^{mf}$ is expected.

Since the three definitions of the manufacturing sector introduced earlier[30] are investigated, it is useful to point out that in all cases the initial conditions correspond to the respective 'aggregate' under consideration.

The matrix $X_{c,t-1}$ comprises a set of control variables while μ_c and δ_t are country and time fixed effects respectively and $\varepsilon_{c,t}$ denotes the error term. The control variables included are an exchange rate measure; the share of advanced labour in total labour as a measure for human capital; the gross expenditure on R&D in per cent of GDP, i.e. R&D intensity; GDP per capita; and population as an additional control for country size (on top of the country fixed effect).

When estimating the structural model for the global sample, the role of the exchange rate is captured by the overvaluation measure developed by Dollar (1992) and used, for example, in McMillan and Rodrik (2011) in their regression explaining their measure of (economy-wide) structural upgrading and also in Stöllinger (2016) who also investigates the GVC–structural change nexus. In essence, this measure of exchange rate overvaluation exploits the empirical regularity that the price level of consumption in an economy is correlated with the GDP per capita by regressing the former on the latter in a panel regression including time fixed effects for the period 2000-2014 for all countries available in the Penn World Tables,

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28 If the sector is the total economy, then these are the gross exports. If the sector is manufacturing, this is the value added (both foreign and domestic) created in manufacturing industries that is exported.

29 The reverse causality issue is already remedied by the fact that the dependent variable is in differences.

30 These are the manufacturing sector as commonly defined (NACE Rev. 2 sector C); advanced manufacturing industries; and an expanded manufacturing sector which includes business services).

version 9 (PWT 9). The difference between the predicted price level and the actual price level indicates the degree of exchange rate overvaluation. The rationale for including the real exchange rate into the structural model is that in open economies, the real exchange rate is an important determinant of export competitiveness. Since the manufacturing sector is the main tradables-producing sector for EU economies, a rising real exchange rate can be expected to hamper exports and to result in negative manufacturing structural change. Therefore a negative coefficient for the real exchange rate is expected.

For the EU Member States, full information on the unit labour cost-based real effective exchange rate (based on 28 partner countries) is available from Eurostat, which is why for the EU-specific structural model this indicator is used. More precisely, since the real effective exchange rate is reported as an index, the year-to-year changes in this index enter the model.

To control for the possibility that structural change regarding the manufacturing sector is affected by the availability of skilled labour, the share of 'advanced labour' in the total labour force is included. The definition of advanced labour follows the International Standard Classification of Education (ISCED), which comprises the skill categories 5-6 in the ISCED-97 and the categories 5-8 in the ISCED-2011. The data source is the ILO for the global sample and Eurostat for the EU-28 sample.

A further control is the R&D intensity, which is intended to capture the fact that the manufacturing sector accounts for the lion's share of the R&D expenditures by firms (see European Commission, 2013; Stöllinger et al., 2013). Therefore it can be expected that higher R&D intensities are positively correlated with the evolution of the manufacturing share. The data come mainly from the OECD database, supplemented with information from the World Bank's World Development Indicators (WDI).

Following Chenery (1960), Chenery and Syrquin (1975) and more recently Haraguchi and Rezonja (2011) the initial GDP per capita (in logarithmic form) is included as a control for general demand conditions. Chenery and Syrquin (1975) estimate a model explaining changes in the industry share[31] and find a positive coefficient for GDP per capita and a negative one for the squared term[32]. This suggests that the higher demand associated with higher income supports structural change in favour of the industrial sector and that this effect weakens with a higher level of incomes. However, there is also the de-industrialisation hypothesis (Clark, 1940), which suggests that with rising incomes, the economic structure will shift increasingly towards services to the detriment of the manufacturing sector. According to Baumol (1967), these de-industrialisation tendencies are due to faster productivity growth in manufacturing. According to the de-industrialisation hypothesis, the coefficient of the initial GDP per capita should have a negative sign, i.e. the opposite result as that obtained by Chenery and Syrquin (1975).

GDP per capita data are taken from the WDI in the case of the global sample and from Eurostat in the EU-specific estimations.

Finally, the population of each country is included (in logarithmic form) in order to have an additional control for country size, although the regressions already include a country fixed

[31] Chenery and Syrquin (1975) use changes in the share of industry and not changes in the manufacturing sector as a dependent variable (see their regression 5b in Table 5, p. 38).

[32] The latter is omitted in the structural model employed in this section.

effect. As for GDP per capita, the population data come from the WDI in the case of the global sample and from Eurostat in the EU-specific estimations.

For the EU-28 sample a more flexible model than that in equation Eq. 4-1 is estimated. The additional flexibility is introduced via an interaction term between the VC trade intensity variable and a dummy variable for the countries belonging to the CEMC. The interaction term allows for a differentiated impact of VC integration on specialisation in manufacturing for the members of the CEMC and the remainder of the EU Member States. This non-linear regression takes the form

(Eq. 4-2) $$\Delta SPEC_{c,t}^{mf} = \alpha + \beta \cdot VC_{c,t-1}^{mf} + \gamma \cdot VC_{c,t-1}^{mf} \times CEMC + \iota \cdot SPEC_{c,t-1}^{mf} + X_{c,t-1} \cdot \varphi + \delta_t + \mu_c + \varepsilon_{c,t}$$

where $CEMC$ is a dummy variable taking the value 1 for Austria, the Czech Republic, Germany, Hungary, Poland and Slovakia and 0 for all other Member States.

In addition to the models in Eq. 4-1 and Eq. 4-2, several variants of the structural model are estimated which distinguish between regional value chains and global value chains as defined in subsection 4.1.4. In this respect, a model including exclusively the RVC intensity defined as a country's RVC trade over that country's total VAX; a model including exclusively the GVC intensity defined as a country's GVC trade over that country's total VAX; and a model containing both elements are estimated.[33] This distinction is made in order to see whether it is possible to identify a qualitative difference between GVC integration and RVC integration with respect to the impact of specialisation in manufacturing activities.

Moreover, the structural model for the EU-28 also incorporates additional control variables. These are average wages in the manufacturing sector (in logarithmic form), which are taken from Eurostat. Moreover, the potential influences of government effectiveness, obtained from the World Bank's World Governance Indicators (WGI), and of labour regulations, taken from the Fraser Institute's Economic Freedom Database, are included into the model. The latter index, which ranges from 0 to 10, is to be understood as freedom from regulation. Hence, a country is assigned high marks in the labour market regulation indicator if it allows market forces to determine wages and establish the conditions of hiring and firing.[34]

4.4.3.Labour productivity: competitiveness models

The theoretical literature on offshoring, which is tightly linked to value chain trade, provides some clear predictions for the implications of offshoring with regards to labour productivity. Already in the one-sector model by Feenstra and Hanson (1996), offshoring increases productivity in the 'headquarter economy' because activities are outsourced as long as the differences in wages between the offshoring economy and the economy where the activities are offshored to equal the costs of offshoring which differ across activities. This implies that up to the 'marginal activity' that is offshored, there is a productivity gain for firms re-locating parts of their production abroad. Similarly, also in the more general, multi-sector offshoring

[33] This way of defining regional and global VC trade intensity ensures that $\frac{RVC}{VAX} + \frac{GVC}{VAX} = \frac{VC}{VAX}$. Moreover, defining the RVC trade intensity and the GVC trade intensity as RVC trade and GVC trade as ratios to regional and global VAX is problematic as VAX include also direct exports for which the distinction between regional and global makes less sense. The only way to proceed in this direction would have been to assign all directly exported value added (in the form of final goods) to the regional part of VAX because production is done uniquely by the reporting country and hence 'within the region'. This would bias the measure and result in high GVC intensities and very low RVC intensities.

[34] See https://www.fraserinstitute.org/economic-freedom/approach

model by Grossman and Rossi-Hansberg (2008) "*improvements in the technology for offshoring low-skill tasks are isomorphic to (low-skilled) labor-augmenting technological progress*" (p. 1979) so that wages (and hence labour productivity) in the headquarter economies increases. Hence, increased VC trade – if it mirrors reduced costs of offshoring brought about by improved communication technologies and lower trade costs – should entail increases in productivity. Therefore, in contrast to structural change, where the implications depend strongly on the the types of activities (or 'tasks') offshored and the sectors which are offshoring, the offshoring literature predicts a positive relationship between VC trade and labour productivity growth. This can be shown in the data. The question to be explored in this section though is, to which extent VC trade is fostering labour productivity relative to trade in general. Since trade models also predict productivity gains from overall trade due to improved allocative efficiency, it is a priori not entirely clear whether VC trade particularly prone to foster labour productivity. Therefore an econometric model for analysing the relationship between labour productivity – which also serves as a measure of competitiveness – and VC integration, which strongly resembles the structural model, is set up. Given data restrictions for data on labour productivity, this model is estimated at the level of the total economy and for the manufacturing sector as commonly defined. The basic regression takes the following form:

(Eq. 4-3) $$\Delta lnLP_{c,t}^{i} = \alpha + \beta \cdot VC_{c,t-1}^{i} + \iota \cdot lnLP_{c,t-1}^{i} + X_{c,t-1} \cdot \varphi + \delta_t + \mu_c + \varepsilon_{c,t}$$

where $\Delta lnLP_{c,t}^{i}$ refers to the log growth rate of labour productivity of country *c* between time *t* and *t-1*. The index *i* indicates the sector, which in this case may be the total economy or the manufacturing sector.

The competitiveness model also controls for initial conditions ($lnLP_{c,t}^{i}$) but it omits the GDP per capita because of the high correlation with labour productivity. Moreover, since there are no trade and specialisation patterns involved, there is no need to control for the exchange rate. From the set of control variables mentioned in the context of the structural model, the share of advanced labour in the labour force and the R&D intensity is maintained. A higher R&D intensity is expected to support labour productivity growth. Similarly, a positive impact of the advanced labour share on labour productivity is expected.

Also in this case, for the EU-28 sample the model features an interaction term between the VC trade intensity and the dummy variable for the CEMC:

(Eq. 4-4) $$\Delta lnLP_{c,t}^{i} = \alpha + \beta \cdot VC_{c,t-1}^{i} + \gamma \cdot VC_{c,t-1}^{i} \times CEMC + \iota \cdot lnLP_{c,t-1}^{i} + X_{c,t-1} \cdot \varphi + \delta_t + \mu_c + \varepsilon_{c,t}$$

With regards to the additional control variables, some specifications of the model described by Eq. 4-4 will also include the average wage (in logarithmic form) – either for the total economy or the manufacturing sector, depending on the aggregate under consideration –, government effectiveness and labour market regulations. In addition, also capital intensity, i.e. gross fixed capital formation in per cent of GDP, is included because a larger capital base should equally support labour productivity growth.

4.4.4. World market shares: export competitiveness models

The regression model for the export competitiveness models mirrors that of the structural model and the competitiveness model above but using the world market shares in value added exports ($\Delta wmsVAX_{c,t}^{i}$). This results in the following model:

(Eq. 4-5) $\Delta wmsVAX^{i}_{c,t} = \alpha + \beta \cdot VC^{i}_{c,t-1} + \iota \cdot wmsVAX^{i}_{c,t-1} + X_{c,t-1} \cdot \varphi + \delta_t + \mu_c + \varepsilon_{c,t}$

For the regressions at the global level, the control variables comprise the exchange rate overvaluation, the share of advanced labour and the R&D intensity.

In line with the approach for the structural model and the competitiveness model, there is also a non-linear version of the export competitiveness model which is estimated for the EU-28:

(Eq. 4-6) $\Delta wmsVAX^{i}_{c,t} = \alpha + \beta \cdot VC^{i}_{c,t-1} + \gamma \cdot VC^{i}_{c,t-1} \times CEMC + \iota \cdot wmsVAX^{i}_{c,t-1} + X_{c,t-1} \cdot \varphi + \delta_t + \mu_c + \varepsilon_{c,t}$

In addition to the controls used in the estimation for the global sample, where the exchange rate overvaluation is replaced by the unit labour cost-based real effective exchange rate, also the average wage (in logarithmic form), labour market regulations and government effectiveness are included into the model.

For both the competitiveness models and the export competitiveness models, specifications that differentiate between RVC trade intensity and GVC trade intensity are run.

4.4.5. Results

Estimation results at the global level

The results are first reported for the global sample (comprising 43 reporting economies), starting with the *structural models* (Table 4.8). Two sets of results are reported. A first one in which the control variables are limited to the initial conditions and the exchange rate overvaluation and a second model which contains the full set of controls.

The main result that emerges from the regressions is that VC trade intensity overall does not seem to affect changes in the value added share of manufacturing. However, in the more parsimonious model, a weakly significant and positive effect for the GVC trade intensity is obtained. This is regardless of whether only the GVC trade intensity or both, RVC and GVC trade intensity are included in the model. However, the statistical significance is lost in the specification with the full set of controls. Also, the coefficient even of the GVC trade intensity is not statistically significant for the specifications for the advanced manufacturing industries and the manufacturing sector including business services.[35]

While the model is relatively disappointing as concerns the VC intensities, the other outcomes are mainly as expected. In particular, a strong negative coefficient is obtained for the initial share of manufacturing, signalling a convergence effect with regards to specialisation in manufacturing as suggested by Rodrik (2013). Moreover, an overvalued exchange rate is suggested to hamper the specialisation in manufacturing. The effect of the exchange rate overvaluation disappears, however, when introducing the R&D intensity, advanced labour share, GDP per capita and population. The R&D intensity is supporting the value added share of manufacturing, while the coefficient of GDP per capita is negative, supporting the hypothesis that countries tend to move out of manufacturing as they grow richer.

[35] These results are not reported.

Table 4.8: Structural models, manufacturing, global sample

Aggregate:	**Manufacturing**							
Sample:	**Global**							
Dependent Variable:	**Δvalue added share of manufacturing**							
	Model SPEC 1				Model SPEC 2			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
	VC	RVC	GVC	RVC+GVC	VC	RVC	GVC	RVC+GVC
VC intensity	0.0486				0.0417			
	(0.0292)				(0.0314)			
RVC intensity		0.0352		0.0330		0.0256		0.0244
		(0.0302)		(0.0303)		(0.0320)		(0.0334)
GVC intensity			0.0769*	0.0753*			0.0699	0.0692
			(0.0388)	(0.0398)			(0.0448)	(0.0453)
share manufacturing	-0.2233***	-0.2259***	-0.2142***	-0.2188***	-0.2638***	-0.2650***	-0.2596***	-0.2612***
	(0.0392)	(0.0377)	(0.0372)	(0.0378)	(0.0565)	(0.0549)	(0.0563)	(0.0562)
real FX overevaluation	-0.0123***	-0.0123***	-0.0124***	-0.0123***	-0.0092	-0.0089	-0.0090	-0.0092
	(0.0041)	(0.0041)	(0.0041)	(0.0041)	(0.0056)	(0.0056)	(0.0055)	(0.0056)
advanced labour share					0.0218	0.0220	0.0199	0.0207
					(0.0132)	(0.0135)	(0.0138)	(0.0140)
R&D intensity					0.3659**	0.3535**	0.3817**	0.3780**
					(0.1753)	(0.1746)	(0.1856)	(0.1814)
ln GDP per capita					-0.0109**	-0.0114**	-0.0102**	-0.0104**
					(0.0052)	(0.0054)	(0.0050)	(0.0051)
ln population					-0.0477**	-0.0483**	-0.0484***	-0.0479***
					(0.0177)	(0.0179)	(0.0174)	(0.0174)
constant	0.0270***	0.0360***	0.0267***	0.0241***	0.9223***	0.9468***	0.9284***	0.9182***
	(0.0089)	(0.0071)	(0.0069)	(0.0083)	(0.3279)	(0.3346)	(0.3197)	(0.3207)
Observations	602	602	602	602	555	555	555	555
R-squared	0.3787	0.3754	0.3781	0.3795	0.4089	0.4062	0.4091	0.4098
R-sq. dj.	0.312	0.309	0.312	0.312	0.337	0.334	0.337	0.337
F-test	19.41	21.82	19.53	19.45	23.77	22.58	25.49	23.90

Note: All specifications include country and time fixed effects. *, ** and *** indicate statistical significance at the 1%, 5% and 10% level respectively. Within-group robust standard errors in parentheses. All explanatory variables are lagged by one period.

Proceeding to the competitiveness models for the total economy[36] (Table 4.9), the pattern obtained resembles to some extent the one in the structural models. In particular with regard to the VC trade intensity, the more parsimonious version of the competitiveness model (model COMP 1) delivers no significant estimates for the overall VC trade intensity, but there is a positive and mildly statistically significant effect of GVC trade intensity on real labour productivity growth when only the GVC trade intensity is included. In the second model (COMP 2), which takes on board the share of advanced labour in the labour force and the R&D intensity, the GVC intensity is also positive and statistically significant at the 10% level, this time in both specifications, the one including only the GVC trade intensity and also the one that includes both GVC and RVC trade intensity.

[36] At the global level only economy-wide real labour productivity data are available.

Table 4.9: Competitiveness models, total economy, global sample

Aggregate:	**Total economy**							
Sample:	**Global**							
Dependent Variable:	**Labour productivity growth**							
	Model COMP 1				Model COMP 2			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
	VC	RVC	GVC	R+G	VC	RVC	GVC	R+G
VC intensity	-0.0173				0.0090			
	(0.0623)				(0.0560)			
RVC intensity		-0.1713		-0.1485		-0.1438		-0.1144
		(0.1137)		(0.1024)		(0.0966)		(0.0792)
GVC intensity			0.1681*	0.1400			0.1764*	0.1516*
			(0.0918)	(0.0901)			(0.0917)	(0.0842)
ln labour productivity	-0.0503*	-0.0497*	-0.0455	-0.0461*	-0.0935***	-0.0910***	-0.0883***	-0.0870***
	(0.0275)	(0.0261)	(0.0279)	(0.0265)	(0.0274)	(0.0268)	(0.0281)	(0.0277)
advanced labour share					0.0084	0.0022	0.0027	-0.0013
					(0.0220)	(0.0232)	(0.0242)	(0.0253)
R&D intensity					0.0904	0.0146	0.2091	0.1391
					(0.4019)	(0.3978)	(0.4119)	(0.4095)
constant	0.5747*	0.5811**	0.4897	0.5160*	1.0440***	1.0377***	0.9611***	0.9653***
	(0.3042)	(0.2872)	(0.3133)	(0.2955)	(0.2996)	(0.2855)	(0.3139)	(0.3046)
Observations	602	602	602	602	555	555	555	555
R-squared	0.6366	0.6406	0.6399	0.6428	0.6099	0.6130	0.6141	0.6160
R-sq. dj.	0.599	0.603	0.602	0.605	0.565	0.569	0.570	0.571
F-test	9.210	9.135	9.237	9.293	28.52	24.47	18.54	20.30

Note: All specifications include country and time fixed effects. *, ** and *** indicate statistical significance at the 1%, 5% and 10% level respectively. Within-group robust standard errors in parentheses. All explanatory variables are lagged by one period.

Finally, the results for the export competitiveness models are reported in Table 4.10. As in the structural model, the export competitiveness model picks up the expected convergence tendencies in international trade as evidenced by the negative coefficient of the initial world market share in VAX and the negative impact of an overvalued real exchange rate. At the same time the export competitiveness model is unsuccessful in detecting any relationship between VC trade intensity and world market shares in value added exports, be it regional or global VC integration. One way of interpreting this result is that integration in VCs is not facilitating the capture of additional world market shares. Put differently, there is no evidence for the possibility that VC integration provides a great potential for countries to make inroads into global markets in terms of domestic value added as mentioned, for example, in Collier and Venables (2007).

Table 4.10: Export competitiveness models, total economy, global sample

Aggregate:	**Total economy**							
Sample:	**Global**							
Dependent Variable:	**Δworld market share of VAX**							
	Model EXCO 1				Model EXCO 2			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
	VC	RVC	GVC	RVC+GVC	VC	RVC	GVC	RVC+GVC
VC intensity	-0.0074				0.0023			
	(0.0084)				(0.0073)			
RVC intensity		-0.0077		-0.0086		-0.0009		0.0002
		(0.0116)		(0.0123)		(0.0083)		(0.0090)
GVC intensity			-0.0043	-0.0059			0.0051	0.0052
			(0.0047)	(0.0057)			(0.0060)	(0.0070)
wms VAX	-0.0408	-0.0410	-0.0408	-0.0408	-0.1888***	-0.1857***	-0.1898***	-0.1899***
	(0.0415)	(0.0423)	(0.0431)	(0.0415)	(0.0286)	(0.0297)	(0.0310)	(0.0289)
real FX overevaluation	-0.0032***	-0.0032***	-0.0032***	-0.0032***	-0.0021**	-0.0021**	-0.0020**	-0.0020**
	(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0008)	(0.0008)	(0.0008)	(0.0008)
advanced labour share					0.0034	0.0033	0.0032	0.0032
					(0.0022)	(0.0021)	(0.0020)	(0.0020)
R&D intensity					0.0537**	0.0504**	0.0547**	0.0549**
					(0.0262)	(0.0244)	(0.0263)	(0.0264)
ln GDP per capita					0.0050***	0.0049***	0.0050***	0.0050***
					(0.0016)	(0.0015)	(0.0016)	(0.0016)
ln population					0.0057*	0.0058*	0.0054	0.0054
					(0.0033)	(0.0033)	(0.0033)	(0.0033)
constant	0.0031	0.0020	0.0019*	0.0030	-0.1442**	-0.1449**	-0.1405**	-0.1406**
	(0.0026)	(0.0016)	(0.0010)	(0.0023)	(0.0680)	(0.0686)	(0.0683)	(0.0685)
Observations	602	602	602	602	555	555	555	555
R-squared	0.4840	0.4831	0.4816	0.4841	0.3792	0.3790	0.3798	0.3798
R-sq. dj.	0.429	0.428	0.426	0.428	0.304	0.304	0.304	0.303
F-test	3.447	3.360	4.107	4.101	32.79	36.64	41.97	43.10

Note: All specifications include country and time fixed effects. *, ** and *** indicate statistical significance at the 1%, 5% and 10% level respectively. Within-group robust standard errors in parentheses. All explanatory variables are lagged by one period.

Estimation results for the EU-28

This section repeats and expands the analysis at the global level for the EU Member States. Apart from additional control variables, the regressions include non-linearities in the form of interaction terms between the VC intensities and a dummy variable for the members of the CEMC.

Table 4.11 reports the first set of results for a structural model which includes the same set of controls as the one at the global level. First of all, it is reassuring that the real exchange rate development, which is now proxied by changes in the ULC-based real effective exchange rate, delivers again the expected negative sign. Likewise, the negative and highly statically significant coefficient of the manufacturing share is evidence for the convergence tendencies within manufacturing production (see Rodrik, 2013). When it comes to the VC intensities, the results are mixed. To start with, there is no evidence for a general EU-wide positive impact of VC trade intensity on the specialisation in manufacturing – neither for the overall VC trade intensity, nor for the GVC and RVC trade intensity as evidenced by the linear models throughout all specifications. This changes, though, when differentiated effects for the countries belonging to the CEMC and the other EU Member States are allowed for. According to the non-linear version of specification (1), a one percentage point increase in the VC trade intensity would accelerate the shift into (or reduce the shift out of) the manufacturing sector by 0.16 (0.027+0.131) percentage points for the members of the CEMC. No such effect is detectible for the other EU Member States. These results confirm the findings in Stöllinger (2016) which are based, however, on different measures of value chain integration. The result also holds when RVC and GVC trade intensities are considered separately. In this case the model assigns a positive impact of VC integration to the GVC trade intensity which is statistically significant at the 5% level, irrespective of whether or not the RVC trade intensity is included. In terms of magnitudes, the effect is about twice as large when the GVC intensity is considered compared to the overall VC intensity.

Table 4.11: Structural models, manufacturing, EU-28 sample (model 1)

Aggregate:	**Manufacturing**							
Sample:	**EU-28**							
Dependent Variable:	**Δvalue added share of manufacturing**							
	Model SPEC 1							
	(1)		(2)		(3)		(4)	
	VC intensity		RVC intensity		GVC intensity		RVC+GVC intensity	
	linear	non-linear	linear	non-linear	linear	non-linear	linear	non-linear
VC intensity	0.0372	0.0270						
	(0.0409)	(0.0388)						
VC intensity x CEMC		0.1310**						
		(0.0617)						
RVC intensity			0.0308	0.0222			0.0322	0.0350
			(0.0423)	(0.0407)			(0.0430)	(0.0454)
RVC intensity x CEMC				0.1573				-0.0310
				(0.1213)				(0.1161)
GVC intensity					0.0477	0.0328	0.0500	0.0368
					(0.0665)	(0.0698)	(0.0684)	(0.0721)
GVC intensity x CEMC						0.2599**		0.2779**
						(0.0996)		(0.1033)
share manufacturing	-0.2257***	-0.2523***	-0.2268***	-0.2398***	-0.2202***	-0.2520***	-0.2243***	-0.2559***
	(0.0530)	(0.0573)	(0.0509)	(0.0544)	(0.0497)	(0.0530)	(0.0504)	(0.0543)
Δreal FX (ULC based)	-0.0201**	-0.0205**	-0.0202**	-0.0198**	-0.0201**	-0.0216***	-0.0201**	-0.0217***
	(0.0084)	(0.0079)	(0.0085)	(0.0084)	(0.0082)	(0.0076)	(0.0083)	(0.0077)
constant	0.0277**	0.0264**	0.0334***	0.0305***	0.0308***	0.0317***	0.0266**	0.0277**
	(0.0120)	(0.0123)	(0.0103)	(0.0107)	(0.0079)	(0.0091)	(0.0113)	(0.0118)
Observations	364	364	364	364	364	364	364	364
R-squared	0.4316	0.4391	0.4306	0.4338	0.4306	0.4406	0.4316	0.4418
R-sq. dj.	0.357	0.364	0.356	0.358	0.356	0.365	0.355	0.363
F-test	46.20	49.29	38.19	52.26	49.53	81.71	47.75	121.2

Note: All specifications include country and time fixed effects. *, ** and *** indicate statistical significance at the 1%, 5% and 10% level respectively. Within-group robust standard errors in parentheses. All explanatory variables are lagged by one period. Specifications with interaction terms use centred values of the variables forming the interaction term.

This result is robust to the inclusion of further control variables as shown in Table 4.12. In fact, the addition of further control variables suggests that the relationship with VC trade intensity and GVC trade intensity, respectively, is even stronger. In the case of the latter, an increase by 1 percentage point would accelerate manufacturing specialisation by 0.37 percentage points for the CEMC members. Note that despite this stronger result no overall effect for any of the VC measures is detected for the EU members as a whole (i.e. in the linear models).[37]

Table 4.12: Structural models, manufacturing, EU-28 sample (model 2)

Aggregate:	**Manufacturing**							
Sample:	**EU-28**							
Dependent Variable:	**Δvalue added share of manufacturing**							
	Model SPEC 2							
	(1)		(2)		(3)		(4)	
	VC intensity		RVC intensity		GVC intensity		RVC+GVC intensity	
	linear	non-linear	linear	non-linear	linear	non-linear	linear	non-linear
VC intensity	-0.0060	-0.0188						
	(0.0369)	(0.0365)						
VC intensity x CEMC		0.1834**						
		(0.0804)						
RVC intensity			0.0134	0.0046			0.0173	0.0332
			(0.0386)	(0.0396)			(0.0388)	(0.0467)
RVC intensity x CEMC				0.1485				-0.1087
				(0.1426)				(0.1012)
GVC intensity					-0.0571	-0.0929	-0.0600	-0.0960
					(0.0895)	(0.0917)	(0.0892)	(0.0898)
GVC intensity x CEMC						0.4072***		0.4664***
						(0.1201)		(0.1198)
share manufacturing	-0.3921***	-0.4364***	-0.3938***	-0.4088***	-0.3932***	-0.4509***	-0.3948***	-0.4508***
	(0.0963)	(0.1029)	(0.0958)	(0.1023)	(0.0926)	(0.0929)	(0.0923)	(0.0935)
Δreal FX (ULC based)	-0.0230**	-0.0248***	-0.0230**	-0.0236**	-0.0224**	-0.0244***	-0.0222**	-0.0241***
	(0.0101)	(0.0085)	(0.0101)	(0.0095)	(0.0101)	(0.0081)	(0.0102)	(0.0082)
advanced labour share	0.0411*	0.0507**	0.0426*	0.0444**	0.0439*	0.0610**	0.0456*	0.0644**
	(0.0209)	(0.0235)	(0.0216)	(0.0215)	(0.0226)	(0.0278)	(0.0235)	(0.0291)
R&D intensity	0.5861**	0.4912**	0.5787**	0.5573**	0.5936**	0.4417*	0.5886**	0.4264*
	(0.2502)	(0.2280)	(0.2476)	(0.2411)	(0.2450)	(0.2161)	(0.2446)	(0.2100)
ln GDP per capita	-0.0385***	-0.0445***	-0.0385***	-0.0389***	-0.0408***	-0.0532***	-0.0410***	-0.0548***
	(0.0106)	(0.0113)	(0.0107)	(0.0105)	(0.0117)	(0.0137)	(0.0119)	(0.0143)
ln population	-0.0871***	-0.0994***	-0.0886***	-0.0916***	-0.0884***	-0.1078***	-0.0899***	-0.1107***
	(0.0267)	(0.0288)	(0.0261)	(0.0269)	(0.0244)	(0.0263)	(0.0250)	(0.0267)
ln wage manufacturing	0.0154**	0.0178***	0.0152**	0.0157***	0.0156**	0.0193***	0.0154**	0.0191***
	(0.0057)	(0.0056)	(0.0057)	(0.0055)	(0.0058)	(0.0059)	(0.0058)	(0.0060)
labour market regulation	0.0021**	0.0022**	0.0019*	0.0020*	0.0020**	0.0022**	0.0019*	0.0020**
	(0.0009)	(0.0009)	(0.0010)	(0.0010)	(0.0009)	(0.0009)	(0.0010)	(0.0009)
government effectiveness	-0.0056	-0.0061	-0.0057	-0.0060	-0.0060	-0.0065*	-0.0061	-0.0065*
	(0.0036)	(0.0037)	(0.0036)	(0.0037)	(0.0038)	(0.0038)	(0.0038)	(0.0038)
constant	1.6552***	1.8853***	1.6791***	1.7241***	1.7017***	2.1009***	1.7291***	2.1634***
	(0.4903)	(0.5240)	(0.4912)	(0.5010)	(0.4469)	(0.4829)	(0.4587)	(0.4899)
Observations	330	330	330	330	330	330	330	330
R-squared	0.5578	0.5689	0.5579	0.5601	0.5587	0.5775	0.5589	0.5789
R-sq. dj.	0.482	0.494	0.482	0.483	0.483	0.504	0.482	0.502
F-test	24.04	51.21	21.56	33.96	20.66	33.16	18.14	27.58

[37] An EU-wide effect of VC integration is found solely in the specifications using the enlarged manufacturing sector which includes business services (see Appendix 4).

Also some of the additional control variables are worth mentioning in this context. First of all, the regression result suggests that lower wages do not help to increase the manufacturing share. In contrast, the coefficient of the wage variable is positive and statistically significant at the 1% and 5% level, respectively, depending on the specification.[38] Hence, it is higher, not lower wages that are associated with increases in the value added shares of manufacturing. In combination with the positive coefficient obtained for the R&D intensity and the advanced labour share, this is fully compatible with the view that for European manufacturing to be successful it ought to opt for the high road strategy (Aiginger and Vogel, 2015) for competitiveness, i.e. high wages and high quality, instead of the low road strategy based on low wages and low energy prices. At the same time, more flexible labour markets, i.e. less labour market regulations reflecting a high score in the Economic Freedom index, are equally suggested to foster specialisation in manufacturing.

Taken together, the result suggests that integration in value chains, and in particular in global value chains, supports the development of the manufacturing sector only in a subset of EU Member States which are already relatively strongly specialised in manufacturing production and which have all been gaining market share in EU-wide value added exports since the year 2000. As such, the results can be seen as evidence for strong agglomeration forces which are due to a variety of factors, including potentially geographic proximity, skill complementarities, increasing returns to scale and path dependencies in location choices of FDI investors. At the same time, the convergence results also indicate that the specialisation processes are rather complex and that in parallel to these implied agglomeration effects there is also convergence detectable between countries with different value added shares of manufacturing. Hence, various agglomeration and convergence forces seem to be at play, together with institutional factors such as labour market regulations, which all impact on manufacturing specialisation.

The main results regarding the relationships between changes in the manufacturing share and VC trade integration also hold when only advanced manufacturing industries or a broader manufacturing sector which also comprises business services are considered (see Appendix 4).

Following the investigation of the relationship between VC intensity and the specialisation in manufacturing, the role of VC integration for competitiveness as proxied by labour productivity is analysed.

The results for the first competitiveness models are presented in Table 4.13. In contrast to the structural model, and also in comparison to the competitiveness model at the global level, VC trade intensity does not seem to matter for labour productivity growth. The strong convergence effect suggesting that countries with initially lower labour productivity experience higher labour productivity growth remains intact also in this context but all the VC trade intensity measures fail to pick up any effect. This result may come as a surprise given the existing results in the literature, especially the findings of Kummritz (2016), who reports a statistically significant relationship between labour productivity and his measures of forward and backward production integration. Importantly, however, the hypothesis tested therein differs from the analysis here as it is performed on levels of VC trade instead of intensities (for further explanations see Box 4.2)

[38] It should be mentioned though that there is a relatively high (0.91) correlation between GDP per capita and manufacturing wages.

Table 4.13: Competitiveness models, total economy, EU-28 sample (model 1)

Aggregate:	**Total economy**							
Sample:	**EU-28**							
Dependent Variable:	**labour productivity growth**							
	Model COMP 1							
	(1)		(2)		(3)		(4)	
	VC intensity		RVC intensity		GVC intensity		RVC+GVC intensity	
	linear	non-linear	linear	non-linear	linear	non-linear	linear	non-linear
VC intensity	-0.0154	-0.0125						
	(0.0541)	(0.0538)						
VC intensity x CEMC		-0.0419						
		(0.1225)						
RVC intensity			0.0081	0.0014			0.0086	-0.0109
			(0.0616)	(0.0603)			(0.0602)	(0.0594)
RVC intensity x CEMC				0.0566				0.1198
				(0.2136)				(0.2119)
GVC intensity					-0.0955	-0.0892	-0.0956	-0.0802
					(0.1594)	(0.1625)	(0.1602)	(0.1653)
GVC intensity x CEMC						-0.2941		-0.3439
						(0.1978)		(0.2105)
ln labour productivity	-0.1191***	-0.1187***	-0.1188***	-0.1191***	-0.1239***	-0.1244***	-0.1241***	-0.1248***
	(0.0143)	(0.0141)	(0.0141)	(0.0137)	(0.0189)	(0.0197)	(0.0191)	(0.0195)
constant	1.2780***	1.2764***	1.2700***	1.2722***	1.3380***	1.3503***	1.3393***	1.3518***
	(0.1581)	(0.1580)	(0.1497)	(0.1465)	(0.2173)	(0.2286)	(0.2188)	(0.2269)
Observations	366	366	366	366	366	366	366	366
R-squared	0.6397	0.6398	0.6397	0.6398	0.6401	0.6414	0.6401	0.6417
R-sq. dj.	0.594	0.593	0.594	0.593	0.595	0.595	0.593	0.593
F-test	36.83	35.86	34.98	32.65	39.77	42.11	37.00	34.71

Note: All specifications include country and time fixed effects. *, ** and *** indicate statistical significance at the 1%, 5% and 10% level respectively. Within-group robust standard errors in parentheses. All explanatory variables are lagged by one period. Specifications with interaction terms use centred values of the variables forming the interaction term.

Table 4.14 indicates that the inclusion of a large set of additional control variables does not alter the result. Neither real investments nor investment in R&D (both expressed in per cent of GDP) seem to affect labour productivity growth. Not even the economy-wide wages are capable of explaining a part of labour productivity growth. Switching from the economy-wide analysis to the manufacturing-specific level does not change the results either. These results are therefore not reported.

Box 4.2 : Productivity and international value chain integration

Recalling that value chain (VC) trade is a particular type of trade, i.e. the one involving at least two border crossings, leads to the expectation that VC trade and labour productivity should be positively related. This relationship could be nurtured by productivity gains through specialisation along comparative advantages and through fixed cost spreading in the case of increasing returns to scale. In fact, this relationship has been tested by Kummritz (2016), who found a positive relationship between the logarithm of labour productivity and the logarithm of his forward production integration measure (the domestic value added in foreign exports). Using the OECD Inter-Country Input-Output (ICIO) Tables comprising some 60 countries, he reports a statistically highly significant coefficient for the (log of) domestic value added in foreign exports on (the log of) labour productivity in the order of 0.78 for the country-level model.

Table 4.14: Competitiveness models, total economy, EU-28 sample (model 2)

Aggregate:	**Total economy**							
Sample:	**EU-28**							
Dependent Variable:	**labour productivity growth**							
	Model COMP 2							
	(1)		(2)		(3)		(4)	
	VC intensity		RVC intensity		GVC intensity		RVC+GVC intensity	
	linear	non-linear	linear	non-linear	linear	non-linear	linear	non-linear
VC intensity	-0.0159	-0.0074						
	(0.0984)	(0.1036)						
VC intensity x CEMC		-0.1010						
		(0.1483)						
RVC intensity			0.0586	0.0682			0.0715	0.0729
			(0.1196)	(0.1350)			(0.1109)	(0.1244)
RVC intensity x CEMC				-0.0696				-0.0307
				(0.2327)				(0.2266)
GVC intensity					-0.2757	-0.2695	-0.2868	-0.2833
					(0.2207)	(0.2243)	(0.2212)	(0.2315)
GVC intensity x CEMC						-0.3300		-0.3103
						(0.2820)		(0.2729)
ln labour productivity	-0.1248***	-0.1244***	-0.1240***	-0.1244***	-0.1363***	-0.1341***	-0.1367***	-0.1349***
	(0.0388)	(0.0391)	(0.0347)	(0.0347)	(0.0419)	(0.0427)	(0.0413)	(0.0426)
advanced labour share	0.0089	0.0051	0.0101	0.0093	0.0142	0.0065	0.0159	0.0083
	(0.0510)	(0.0527)	(0.0519)	(0.0522)	(0.0500)	(0.0534)	(0.0510)	(0.0543)
R&D intensity	0.3380	0.4002	0.3670	0.3807	0.3927	0.5432	0.4255	0.5722
	(0.5790)	(0.6071)	(0.5798)	(0.5870)	(0.5788)	(0.6298)	(0.5830)	(0.6403)
ln wage (total economy)	0.0070	0.0074	0.0065	0.0071	0.0038	0.0021	0.0030	0.0016
	(0.0157)	(0.0158)	(0.0164)	(0.0164)	(0.0143)	(0.0144)	(0.0148)	(0.0149)
investment intensity	0.0273	0.0261	0.0276	0.0252	0.0232	0.0299	0.0230	0.0283
	(0.0620)	(0.0613)	(0.0603)	(0.0587)	(0.0650)	(0.0658)	(0.0641)	(0.0640)
labour regulation	0.0022	0.0022	0.0016	0.0016	0.0023	0.0023	0.0018	0.0019
	(0.0027)	(0.0027)	(0.0028)	(0.0028)	(0.0023)	(0.0023)	(0.0028)	(0.0029)
government effectiveness	-0.0027	-0.0030	-0.0034	-0.0036	-0.0013	-0.0017	-0.0019	-0.0023
	(0.0113)	(0.0113)	(0.0112)	(0.0112)	(0.0110)	(0.0109)	(0.0110)	(0.0108)
constant	1.2462***	1.2433***	1.2336***	1.2348***	1.4307***	1.4306***	1.4374***	1.4396***
	(0.3181)	(0.3194)	(0.2551)	(0.2549)	(0.3833)	(0.3888)	(0.3754)	(0.3866)
Observations	333	333	333	333	333	333	333	333
R-squared	0.6424	0.6429	0.6428	0.6429	0.6452	0.6468	0.6459	0.6475
R-sq. dj.	0.586	0.586	0.587	0.585	0.590	0.590	0.589	0.588
F-test	50.19	91.89	58.74	89.44	34.28	60.72	51.38	840.9

Note: All specifications include country and time fixed effects. *, ** and *** indicate statistical significance at the 1%, 5% and 10% level respectively. Within-group robust standard errors in parentheses. All explanatory variables are lagged by one period. Specifications with interaction terms use centred values of the variables forming the interaction term.

Box 4.2 (continued): Productivity and value chain integration

How does that fit to the comparatively disappointing outcomes in the competitiveness models reported in Table 4.13 and Table 4.14? The explanation is that the hypothesis under investigation is completely different. The purpose of the investigation in this subsection is geared towards the identification of any stimulating effects of VC integration beyond the general effects of trade. This is why the VC intensity, that is, the VC trade measure relative to the value added exports (VAX), was chosen as the main explanatory variable. The regression model in this box demonstrates that also for the EU-28 sample, a positive relationship between the log-level of VC trade and the log-level of labour productivity can be detected (specification B1).

Box 4.2 (continued): Productivity and value chain integration

However, specification B2 also shows that this effect is not very different from that of trade in general, proxied by VAX. In fact, when the two trade measures enter the regression model simultaneously (specification B3), only the VAX are found to be statistically significant, with the VC trade measure losing its statistical significance. Specification B4 then shows that in this regression set-up, the VC intensity delivers a negative coefficient, indicating that the impact of VC trade on labour productivity is smaller than that of the overall VAX.

Table 4.15: Labour productivity and trade, total economy, EU-28

Aggregate:	**Total economy**			
Sample:	**EU-28**			
Dependent Variable:	**ln productivity growth**			
	(B1)	(B2)	(B3)	(B4)
	VC trade	VAX	VC trade + VAX	VC intensity
ln VC	0.2102***		-0.0865	
	(0.0528)		(0.1022)	
ln VAX		0.2213***	0.3001***	
		(0.0621)	(0.1077)	
VC intensity				-0.9758**
				(0.4074)
advanced labour share	-0.2225	-0.2060	-0.1998	-0.2090
	(0.3463)	(0.3668)	(0.3747)	(0.3616)
R&D intensity	0.5553	0.1858	0.0534	0.1341
	(2.1680)	(2.3486)	(2.3879)	(2.6481)
government effectiveness	0.0976**	0.0980**	0.1058**	0.2452***
	(0.0457)	(0.0471)	(0.0432)	(0.0514)
constant	8.5174***	8.0982***	8.0396***	10.3699***
	(0.4271)	(0.5700)	(0.5659)	(0.1286)
Observations	368	368	368	368
R-squared	0.9960	0.9965	0.9965	0.9937
R-sq. dj.	0.995	0.996	0.996	0.993
F-test	40.23	49.13	47.58	29.97

Note: All specifications include country and time fixed effects. *, ** and *** indicate statistical significance at the 1%, 5% and 10% level respectively. Within-group robust standard errors in parentheses. All explanatory variables are lagged by one period.

The last model that remains to be investigated is the export competitiveness model dealing with the potential impact of VC intensity on world market shares of value added trade. The results for the total economy are reported in Table 4.16 (model 1) and Table 4.17 (model 2). In the first export competitiveness model (Table 4.16) no effects for the overall VC intensity can be identified (specification 1). However, the split into RVC intensity and GVC intensity would in this context suggest that a high RVC intensity helps a Member State gain additional world market shares. This is true for all Member States (linear model, specification 2) and even more so for the members of the CEMC as indicated by the positive interaction term (non-linear model, specification 2). At the same time, specification 3 delivers a negative coefficient for the GVC trade intensity which is suggested to be uniform across EU Member States. This negative coefficient also remains in specification 4 which includes simultaneously RVC and GVC trade intensities. It has, however, a counterweight in the form of a positive coefficient of the RVC trade intensity, including the interaction term with the CEMC dummy. Taking the two together, it seems again that VC trade intensity does not have a more than proportionate effect on world market shares.

Table 4.16: Export competitiveness Models, total economy, EU-28 sample (model 1)

Aggregate:	**Total economy**							
Sample:	**EU-28**							
Dependent Variable:	**Δworld market share of VAX**							
	Model EXCO 1							
	(1)		(2)		(3)		(4)	
	VC intensity		RVC intensity		GVC intensity		RVC+GVC intensity	
	linear	non-linear	linear	non-linear	linear	non-linear	linear	non-linear
VC intensity	0.0013	0.0014						
	(0.0017)	(0.0018)						
VC intensity x CEMC		-0.0016						
		(0.0054)						
RVC intensity			0.0080*	0.0071*			0.0077**	0.0057**
			(0.0042)	(0.0039)			(0.0035)	(0.0027)
RVC intensity x CEMC				0.0112*				0.0204**
				(0.0065)				(0.0091)
GVC intensity					-0.0139**	-0.0127**	-0.0136**	-0.0115*
					(0.0064)	(0.0058)	(0.0064)	(0.0057)
GVC intensity x CEMC						-0.0267		-0.0354*
						(0.0193)		(0.0204)
wms VAX	-0.0684***	-0.0678***	-0.0757***	-0.0784***	-0.0748***	-0.0726***	-0.0824***	-0.0837***
	(0.0150)	(0.0139)	(0.0169)	(0.0167)	(0.0150)	(0.0192)	(0.0176)	(0.0231)
Δreal FX (ULC based)	-0.0007	-0.0007	-0.0007	-0.0006	-0.0009	-0.0008	-0.0008	-0.0005
	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0009)	(0.0008)	(0.0008)	(0.0007)
constant	0.0006	0.0007	0.0000	-0.0003	0.0030***	0.0034**	0.0020**	0.0021**
	(0.0004)	(0.0005)	(0.0004)	(0.0004)	(0.0010)	(0.0014)	(0.0008)	(0.0010)
Observations	364	364	364	364	364	364	364	364
R-squared	0.3829	0.3830	0.3894	0.3916	0.3917	0.3991	0.3981	0.4112
R-sq. dj.	0.302	0.300	0.310	0.310	0.312	0.318	0.317	0.328
F-test	45.19	81.57	41.44	42.89	36.63	16.12	31.13	16.42

Note: All specifications include country and time fixed effects. *, ** and *** indicate statistical significance at the 1%, 5% and 10% level respectively. Within-group robust standard errors in parentheses. All explanatory variables are lagged by one period. Specifications with interaction terms use centred values of the variables forming the interaction term.

Qualitatively, the results seem to be similar as more control variables are added into the model (Table 4.17). One difference is worth mentioning, though, which is the fact that the positive coefficients for the RVC trade intensity as well as the negative coefficient for the GVC trade intensity are statistically significant only for the interaction term between the respective VC measure and the CEMC dummy. Moreover, the negative effect for the RVC trade intensity comes out stronger in terms of statistical significance in both, specification 2 and specification 4.

Table 4.17: Export competitiveness Models, total economy, EU-28 sample (model 2)

Aggregate:	**Total economy**							
Sample:	**EU-28**							
Dependent Variable:	**Δworld market share of VAX**							
	Model EXCO 2							
	(1)		(2)		(3)		(4)	
	VC intensity		RVC intensity		GVC intensity		RVC+GVC intensity	
	linear	non-linear	linear	non-linear	linear	non-linear	linear	non-linear
VC intensity	0.0025	0.0024						
	(0.0036)	(0.0036)						
VC intensity x CEMC		0.0031						
		(0.0032)						
RVC intensity			0.0063	0.0052			0.0066	0.0046
			(0.0048)	(0.0046)			(0.0047)	(0.0042)
RVC intensity x CEMC				0.0148**				0.0211***
				(0.0065)				(0.0076)
GVC intensity					-0.0053	-0.0050	-0.0059	-0.0043
					(0.0045)	(0.0043)	(0.0047)	(0.0044)
GVC intensity x CEMC						-0.0114		-0.0202*
						(0.0110)		(0.0110)
wms VAX	-0.1320***	-0.1332***	-0.1359***	-0.1392***	-0.1276***	-0.1261***	-0.1351***	-0.1369***
	(0.0264)	(0.0256)	(0.0275)	(0.0274)	(0.0211)	(0.0230)	(0.0273)	(0.0306)
Δreal FX (ULC based)	-0.0011	-0.0011	-0.0011	-0.0010	-0.0011	-0.0010	-0.0010	-0.0009
	(0.0010)	(0.0010)	(0.0010)	(0.0009)	(0.0010)	(0.0010)	(0.0010)	(0.0009)
advanced labour share	0.0025	0.0027	0.0028	0.0030	0.0026	0.0022	0.0030	0.0026
	(0.0023)	(0.0024)	(0.0024)	(0.0024)	(0.0023)	(0.0024)	(0.0024)	(0.0024)
R&D intensity	0.0122	0.0107	0.0153	0.0131	0.0122	0.0164	0.0167	0.0206
	(0.0124)	(0.0127)	(0.0122)	(0.0125)	(0.0117)	(0.0119)	(0.0120)	(0.0129)
ln wage (total economy)	0.0012	0.0012	0.0012	0.0012	0.0010	0.0010	0.0011	0.0010
	(0.0008)	(0.0008)	(0.0007)	(0.0007)	(0.0007)	(0.0007)	(0.0007)	(0.0007)
labour market regulation	-0.0001	-0.0001	-0.0001	-0.0001	-0.0000	-0.0000	-0.0001	-0.0001
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0001)	(0.0001)	(0.0002)	(0.0002)
government effectiveness	0.0004*	0.0005*	0.0004	0.0004*	0.0004	0.0004	0.0003	0.0004
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
constant	-0.0117	-0.0120	-0.0115*	-0.0121*	-0.0088	-0.0082	-0.0096	-0.0098
	(0.0074)	(0.0074)	(0.0067)	(0.0068)	(0.0064)	(0.0062)	(0.0069)	(0.0068)
Observations	335	335	335	335	335	335	335	335
R-squared	0.4620	0.4623	0.4644	0.4672	0.4623	0.4636	0.4657	0.4717
R-sq. dj.	0.376	0.374	0.379	0.380	0.376	0.376	0.378	0.381
F-test	308.2	420.4	198.0	194.2	377.7	229.0	280.9	362.3

Note: All specifications include country and time fixed effects. *, ** and *** indicate statistical significance at the 1%, 5% and 10% level respectively. Within-group robust standard errors in parentheses. All explanatory variables are lagged by one period. Specifications with interaction terms use centred values of the variables forming the interaction term.

Another interesting aspect is that the negative coefficient of the RVC trade intensity disappears as one considers the manufacturing sector only. Table 4.18 contains the results for model 2 of the export competitiveness model, this time with both world export market shares and the VC trade intensities limited to manufacturing value added.

Table 4.18: Export competitiveness Models, manufacturing, EU-28 sample (model 2)

Aggregate:	**Manufacturing**							
Sample:	**EU-28**							
Dependent Variable:	**Δworld market share of VAX**							
	Model EXCO 2							
	(1)		(2)		(3)		(4)	
	VC intensity		RVC intensity		GVC intensity		RVC+GVC intensity	
	linear	non-linear	linear	non-linear	linear	non-linear	linear	non-linear
VC intensity	0.0061	0.0060						
	(0.0053)	(0.0053)						
VC intensity x CEMC		0.0026						
		(0.0064)						
RVC intensity			0.0046	0.0037			0.0040	0.0025
			(0.0061)	(0.0060)			(0.0058)	(0.0053)
RVC intensity x CEMC				0.0142				0.0226*
				(0.0122)				(0.0131)
GVC intensity					0.0112	0.0113	0.0108	0.0101
					(0.0081)	(0.0081)	(0.0081)	(0.0078)
GVC intensity x CEMC						-0.0034		-0.0146
						(0.0112)		(0.0102)
wms VAX	-0.1742***	-0.1757***	-0.1705***	-0.1733***	-0.1713***	-0.1700***	-0.1744***	-0.1729***
	(0.0551)	(0.0549)	(0.0542)	(0.0551)	(0.0507)	(0.0499)	(0.0549)	(0.0561)
Δreal FX (ULC based)	-0.0002	-0.0003	-0.0002	-0.0002	-0.0003	-0.0003	-0.0003	-0.0002
	(0.0014)	(0.0014)	(0.0014)	(0.0013)	(0.0014)	(0.0014)	(0.0014)	(0.0013)
advanced labour share	0.0059	0.0060*	0.0059	0.0061*	0.0053	0.0052	0.0056	0.0055
	(0.0035)	(0.0035)	(0.0035)	(0.0035)	(0.0033)	(0.0034)	(0.0036)	(0.0035)
R&D intensity	0.0483*	0.0473*	0.0501*	0.0482*	0.0484*	0.0495*	0.0477*	0.0494*
	(0.0245)	(0.0246)	(0.0246)	(0.0245)	(0.0238)	(0.0242)	(0.0241)	(0.0247)
ln wage manufacturing	0.0016	0.0016	0.0015	0.0016	0.0017	0.0017	0.0017	0.0017
	(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0010)
labour market regulation	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
government effectiveness	0.0005	0.0005	0.0004	0.0004	0.0005	0.0005	0.0005	0.0005
	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0004)	(0.0004)	(0.0004)	(0.0004)
Constant	-0.0181	-0.0184	-0.0164	-0.0174*	-0.0189*	-0.0187*	-0.0191*	-0.0198*
	(0.0109)	(0.0109)	(0.0097)	(0.0098)	(0.0107)	(0.0105)	(0.0110)	(0.0108)
Observations	330	330	330	330	330	330	330	330
R-squared	0.4400	0.4402	0.4379	0.4395	0.4398	0.4399	0.4407	0.4436
R-sq. dj.	0.349	0.347	0.347	0.346	0.349	0.347	0.347	0.346
F-test	79.25	90.14	127.0	247.9	76.77	70.26	72.31	91.71

Note: All specifications include country and time fixed effects. *, ** and *** indicate statistical significance at the 1%, 5% and 10% level respectively. Within-group robust standard errors in parentheses. All explanatory variables are lagged by one period. Specifications with interaction terms use centred values of the variables forming the interaction term.

The table reveals that, while the RVC trade intensity also seems to matter more than the GVC trade intensity when the manufacturing sector is considered (which is the opposite outcome from the structural model), the estimated coefficient is positive and weakly statistically significant. So it seems that the effect of VC integration also depends on the aggregate under consideration. For the export competition model this means that the results are rather shaky, though the model focusing on manufacturing may be read as supporting by and large the outcome of the structural model, which suggested that VC trade intensity helps the members of the CEMC to increase their manufacturing share. The difference that remains, however, is that the export competition model assigns a VC trade intensity effect to RVCs while in the structural model the effect is captured by GVCs.

4.5. Exports, value chain trade and the income elasticity of trade

4.5.1. Introduction

Since 2011, (global as well as EU) exports have developed rather sluggishly – after an extended period of growth until the early 2000s (but particularly since the 1990s), the deep but short-lived crisis-induced Great Trade Collapse in 2008/09 and the rather quick rebound shortly thereafter. As already mentioned in Section 4.2, for all these developments GVCs are considered to play a non-negligible role, both as a key source of export growth since the 1990s as well as a propagating and amplifying mechanism of economic developments, such as the crisis of 2008/09 (Freund, 2009). This 'Global Trade Slowdown' has become the subject of economic debate that seeks to identify its underlying causes (see Constantinescu et al., 2015 or Hoekman, 2015). In particular, Section 4.2 has demonstrated for the EU-28 that in the aftermath of the crisis, the domestic value added component in exports has gained importance, but not to the detriment of VC trade.

In this context, the next section takes a closer look at the Trade Slowdown phenomenon from the perspective of the EU-28 and not only investigates the prevalence and extent of the Trade Slowdown but also sheds light on the roles played by both the domestic value added component in exports and VC trade. For this purpose, the ensuing analysis takes a stepwise and comparative approach. First, for gross exports (EXP), value added exports (VAX) and re-exported domestic value added (DVAre), it establishes whether there has been a systematic change in the relationship between GDP and export growth, as captured by export- and import-to-GDP elasticities. The latter demand-side perspective has so far been neglected in this line of literature but is of utmost importance for export growth. Second, a comparison of results then sheds light on the role played by the domestic value added component in exports and VC trade for the potential EU-28 Trade Slowdown.

4.5.2. Methodological approach

For this purpose, the following export gravity equation is specified:

(Eq. 4-7)
$$lnEXP_{ijt} = \alpha_0 + \beta_1 lnGDP_{it} + \beta_2 lnGDP_{jt} + \beta_3 lnPOP_{it} + \beta_4 lnPOP_{jt} + \sum_{k=2}^{K} \gamma_k D_k + \sum_{k=2}^{K} \delta_k D_k * lnGDP_{it} + \sum_{k=2}^{K} \tau_k D_k * lnGDP_{jt} + \varphi_{ij} + \epsilon_{ijt}$$

where $lnEXP_{ijt}$ denotes exports from country i to country j at time t, measured in terms of the logarithm of either (i) gross exports (EXP), (ii) value added exports (VAX), or (iii) re-exported domestic value added (DVAre). The VAX indicator explicitly accounts for the value added embodied in intermediate flows and avoids double counting so characteristic of gross exports while the DVAre indicator is a sub-component of VAX and a forward production integration measure (VC trade), which exclusively comprises domestic value added. Furthermore, $lnGDP_{it}$ and $lnGDP_{jt}$ refer to the logarithm of real GDP (in USD) of country i and j, respectively. The analysis of gross exports uses the logarithm of gross output (in USD) of country i and j instead. $lnPOP_{it}$ and $lnPOP_{jt}$ are the logarithm of the population of country i and j, respectively. D_k are dummy variables for four different time periods which correspond to and capture particular developments in export growth before, during and after the crisis. --

In particular, D_1 refers to the pre-crisis period between 2000 and 2008 (as reference period), D_2 captures the crisis period of 2009 which triggered the Great Trade Collapse and saw both national GDPs, but even more so trade collapse temporarily, D_3 and D_4 refer to the two post-crisis recovery periods 2010-2011 and 2012-2014, respectively, during which trade rebounded, particularly during the former period. $D_k * lnGDP_{it}$ and $D_k * lnGDP_{jt}$ are interaction terms between either of the k different time dummies D_k and the logarithm of real GDP of countries i and j, respectively. Hence, β_1 and β_2 in equation (3-5-1) measure the elasticities of exports to own (exporter) and foreign (importer) GDP for the reference period 2000 to 2003, respectively. In contrast, δ_2 to δ_4 as well as τ_2 to τ_4 measure the change in the elasticities of exports to own and foreign GDP, respectively, relative to the pre-crisis reference period and capture whether, how and how permanently gross and value added export elasticities have changed on the eve of, during as well as in the aftermath of the Great Trade Collapse. Finally, φ_{ij} refers to time-invariant country-pair fixed effects while ϵ_{ijt} is the error term.

The gravity analysis looks at four different industry aggregates[39], namely (i) the economy as a whole, (ii) the manufacturing sector, (iii) advanced manufacturing industries, and (iv) an extended manufacturing sector (including business services). Furthermore, it differentiates between three types of EU-28 exports according to the region of destination, namely (i) total EU-28 exports (as EU-28 exports to both EU-28 and non-EU-28 Member States), (ii) intra-EU-28 exports (as EU-28 exports to other EU-28 Member States only), and (iii) extra-EU-28 exports (as EU-28 exports to non-EU-28 Member States only).

4.5.3.Results for gross exports

Table 4.19 reports results for gross exports for the period 2000 to 2014. Columns (1) to (3) refer to the total economy, columns (4) to (6) to the total manufacturing sector, columns (7) to (9) to advanced manufacturing while columns (10) to (12) refer to extended manufacturing (including business services). Furthermore, columns (1), (4), (7) and (10) refer to total EU-28 exports, columns (2), (5), (8) and (11) to intra-EU-28 exports only while columns (3), (6), (9) and (12) refer to extra-EU-28 exports only.

Generally, in the pre-crisis period from 2000 to 2008, elasticities of gross exports to own and foreign GDP (gross-output-based) are diverse and differ by industry aggregate considered but almost consistently lie below 1. For the economy as a whole as well as advanced manufacturing, the home market effect dominates the foreign market effect. In particular, for the economy as a whole, the elasticities of exports to own GDP range between 0.9 and 1.0, which is slightly above the elasticities of exports to foreign GDP, which lie between 0.7 and 0.8. The difference in the elasticities of exports to own and foreign GDP is more pronounced for advanced manufacturing, where the elasticities of exports to own GDP are slightly above 1 whereas the elasticities of exports to foreign GDP range between 0.6 and 0.8 only. In contrast, the foreign market effect is slightly stronger than the home market effect for total manufacturing and extended manufacturing. Furthermore, elasticities of exports to own and foreign GDP also differ by the region of destination of exports. Patterns are particularly diverse as concerns the elasticity of exports to own GDP. For both total manufacturing and extended manufacturing, the elasticity of exports to own GDP is strongest for extra-EU-28 exports, followed by total EU-28 exports and intra-EU-28 exports. By contrast, the order is reversed for total manufacturing where the elasticity of exports to own GDP is strongest for

[39] All as defined in Appendix 3.

intra-EU-28 exports, followed by total EU-28 exports and, finally, extra-EU-28 exports. For advanced manufacturing the elasticity of exports to own GDP is strongest for intra-EU-28 exports, followed by extra-EU-28 export and total EU-28 exports. Furthermore, as concerns the foreign market effect, except for advanced manufacturing, the elasticity of exports to foreign GDP is strongest for intra-EU-28 exports, followed by total exports and extra-EU-28 exports.

However, after 2008, elasticities of exports to both own and foreign GDP were lower and continuously deteriorated relative to the 2000-2008 reference period. Furthermore, except for total extra-EU-28 exports, elasticities of exports to own GDP experienced a considerably more pronounced drop and declined almost twice as strongly as elasticities of exports to foreign GDP. Moreover, the observable decreases in export elasticities were far from uniform and differed not only across the four industry aggregates but also across the regions of destination of EU-28 exports considered. In particular, elasticities of exports to own GDP continuously declined in all industry aggregates but total and extended manufacturing, where own income export elasticities remained unchanged. In contrast, elasticities of exports to foreign GDP declined most consistently in the economy as a whole but underwent mostly positive but insignificant changes in total manufacturing.[40] As concerns regional differences, elasticities of exports, particularly to own GDP, experienced a more pronounced drop in intra-EU-28 exports, which was between two to three times higher as compared to extra-EU-28 exports.

Furthermore, population size and EU-28 exports are negatively related. This is particularly true for own EU-28 population size whose elasticities are rather pronounced and range between -1.5 and -5. The own EU-28 population effect is generally strongest in advanced manufacturing and is consistently most pronounced for extra-EU-28 exports. In contrast, with elasticities ranging between -0.6 and -1.5, foreign population size only exerts a very limited negative effect on EU-28 exports and even fails to have any significant effect at all in extended manufacturing.

4.5.4. Results for value added exports

Table 4.20 reports the results for value added exports for the period 2000 to 2014. Again, columns (1) to (3) refer to the total economy, columns (4) to (6) to the total manufacturing sector, columns (7) to (9) to advanced manufacturing while columns (10) to (12) refer to extended manufacturing (including business services). Furthermore, columns (1), (4), (7) and (10) refer to total EU-28 exports, columns (2), (5), (8) and (11) to intra-EU-28 exports only while columns (3), (6), (9) and (12) refer to extra-EU-28 exports only.

For the pre-crisis period between 2000 and 2008, elasticities of value added exports to own and foreign GDP are very similar to those of gross exports reported in Table 4.19. In particular, except for advanced manufacturing whose elasticities of value added exports to own GDP are slightly above 1, elasticities of value added exports to own and foreign GDP lie – partly well – below 1. Again, the home market effect tends to dominate the foreign market effect; differences are, however, minor, except for the case of advanced manufacturing. Elasticities of exports to own and foreign GDP again differ by the region of destination of EU-28 exports and are exactly in the same order as for gross exports.

[40] This is in line with Stehrer et al. (2016) where, for the manufacturing sector as a whole, elasticities of gross exports to foreign GDP were positive and increasing for total, extra- as well as intra-EU-28 exports. Differences in extra-EU-28 export elasticities to foreign GDP are the result of differences in data source and sample size.

As concerns changes in home- and foreign-income elasticities of exports after 2008 – relative to the pre-crisis period – there are certain similarities between gross exports and value added exports: First, after 2008, elasticities of value added exports to own and foreign GDP followed a similar, continuously deteriorating trend. This stresses that income elasticities of both gross exports as well as value added exports have consistently been falling over the past years. Second, except for the economy as a whole, home-income elasticities of exports again underwent a more pronounced decline than foreign-income elasticities of exports. Third, with respect to regional differences, income elasticities of exports experienced the most pronounced drop in intra-EU-28 exports, particularly as far as home-income elasticities are concerned. Taken together, the latter two points indicate that the home-income effect has increasingly lost importance for both, EU-28 exports, in general, and intra-EU-28 exports, in particular. However, changes in value added and gross exports to GDP elasticities also differ in some important respects: First and most importantly, declines in both home- and foreign-income elasticities were more pronounced with regard to value added exports than to gross exports. This indicates that the post-crisis decline in the (home- and foreign-) income elasticities of exports was predominantly driven by the even stronger decline in the (home- and foreign-) income elasticities of the domestic value added component in exports. Second, drops in the home- and foreign-income elasticities of value added exports are more consistent across the four industry aggregates analysed, particularly as far as home elasticities are concerned.

Similar to results for gross exports, the relationship between population size and EU-28 value added exports is negative. Again, the own EU-28 population effect is consistently above 1 (in absolute terms) and well exceeds the foreign population effect in all industry aggregates considered. With respect to regional differences, own EU-28 population effects are strongest for extra-EU-28 value added exports while foreign population effects tend to be strongest for intra-EU-28 trade.

4.5.1.Results for re-exported domestic value added

Table 4.21 reports results for VC trade (in terms of re-exported domestic value added) for the period 2000 to 2014. Columns (1) to (3) again refer to the total economy, columns (4) to (6) to the total manufacturing sector, columns (7) to (9) to advanced manufacturing while columns (10) to (12) refer to extended manufacturing (including business services). Furthermore, columns (1), (4), (7) and (10) refer to total EU-28 exports, columns (2), (5), (8) and (11) to intra-EU-28 exports only while columns (3), (6), (9) and (12) refer to extra-EU-28 exports only.

As concerns the pre-crisis period between 2000 and 2008, elasticities of re-exported domestic value added to own and foreign GDP are of similar magnitude to those of gross exports (Table 4.19) or value added exports (Table 4.20). Particularly, elasticities of re-exported domestic value added to both own and foreign GDP lie partly well below 1, with the former again dominating the latter, except for the case of manufacturing as a whole. Elasticities to own and foreign GDP again differ by the region of destination of EU-28 exports. However, as concerns VC trade, the foreign market effect is consistently stronger for extra-EU-28 exports than for intra-EU-28 exports.

Additionally, regarding changes in home- and foreign-income elasticities of re-exported domestic value added after 2008, there are certain similarities to value added exports. For instance, relative to the pre-crisis period, elasticities of re-exported domestic value added to own GDP have also fallen during the post-crisis period. From a regional perspective, the decline in the own market effect was stronger for intra-EU-28 exports than extra-EU-28 exports. However, the extent of the decline was much weaker and only half to one third as strong as for value added exports. Furthermore, the decline also seems to be levelling off already, as indicated by the more or less unchanging coefficients of the interaction terms between the last two periods. Hence, taken together, this indicates that VC trade played only a negligible role – if any at all – for the relatively strong decline in the home-income elasticities of value added exports. In contrast, a somewhat different picture emerges for the post-crisis foreign market effect, which is associated with the region of destination of EU-28 exports. For extra-EU-28 exports, the familiar decline in the elasticities of re-exported domestic value added to foreign GDP is observable. However, the fall in the coefficients (in absolute terms) of the interaction terms between the periods 2010-2011 and 2012-2014 suggests that a rebound is already under way. For intra-EU-28 exports, on the other hand, elasticities of re-exported domestic value added to foreign GDP have increased relative to the pre-crisis period, which made foreign GDP a relatively more important determinant of VC trade. However, the unchanging or partly falling coefficients of the interaction terms suggest that this process has also levelled off already. These findings together again indicate that VC trade played no role for the relatively strong decline in the foreign-income elasticities of value added exports.

Similar to the results for gross exports and value added exports, the relationship between population size and EU-28 re-exported domestic value added is negative, with an own EU-28 population effect that is consistently above 1 (in absolute terms) and well exceeds the foreign population effect in all industry aggregates considered. Again, with respect to regional differences, own EU-28 population effects are strongest for extra-EU-28 exports while foreign population effects tend to be strongest for intra-EU-28 exports.

Table 4.19: Gravity regression results: gross exports, 2000-2014

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	All	Intra	Extra	All	Intra	Extra	All	Intra	Extra	All	Intra	Extra
VARIABLES	Total economy			Manufacturing			Advanced manufacturing			Extended manufacturing		
$lnGO_{it}$	0.902***	0.935***	0.856***	0.724***	0.697***	0.766***	1.008***	1.120***	1.043***	0.798***	0.778***	0.824***
	(0.036)	(0.052)	(0.059)	(0.038)	(0.053)	(0.064)	(0.053)	(0.079)	(0.082)	(0.038)	(0.054)	(0.062)
$lnGO_{jt}$	0.761***	0.782***	0.709***	0.829***	0.856***	0.739***	0.751***	0.618***	0.712***	0.806***	0.851***	0.708***
	(0.034)	(0.049)	(0.055)	(0.038)	(0.050)	(0.064)	(0.048)	(0.071)	(0.077)	(0.036)	(0.051)	(0.058)
$lnPop_{it}$	-2.107***	-1.490***	-3.123***	-3.814***	-3.251***	-4.799***	-4.164***	-3.482***	-5.017***	-2.895***	-2.113***	-4.231***
	(0.306)	(0.376)	(0.487)	(0.282)	(0.325)	(0.493)	(0.399)	(0.478)	(0.696)	(0.307)	(0.383)	(0.465)
$lnPop_{jt}$	-0.551**	-0.328	-0.689	-0.781***	-1.200***	0.001	-0.766**	-1.463***	-0.462	-0.261	-0.241	-0.014
	(0.257)	(0.336)	(0.488)	(0.243)	(0.302)	(0.548)	(0.332)	(0.405)	(0.683)	(0.254)	(0.336)	(0.511)
$D2*lnGO_{it}$	-0.060***	-0.080***	-0.024	-0.011	-0.015	-0.006	-0.046***	-0.057***	-0.016	-0.033***	-0.046***	-0.012
	(0.011)	(0.014)	(0.016)	(0.009)	(0.012)	(0.015)	(0.012)	(0.015)	(0.019)	(0.010)	(0.014)	(0.014)
$D3*lnGO_{it}$	-0.072***	-0.091***	-0.040**	-0.037***	-0.047***	-0.021	-0.079***	-0.090***	-0.052**	-0.059***	-0.078***	-0.027*
	(0.011)	(0.013)	(0.019)	(0.010)	(0.012)	(0.018)	(0.013)	(0.016)	(0.023)	(0.011)	(0.014)	(0.016)
$D4*lnGO_{it}$	-0.083***	-0.112***	-0.035*	-0.054***	-0.067***	-0.032	-0.102***	-0.123***	-0.057**	-0.074***	-0.101***	-0.031
	(0.013)	(0.015)	(0.021)	(0.012)	(0.015)	(0.020)	(0.015)	(0.018)	(0.027)	(0.012)	(0.015)	(0.019)
$D2*lnGO_{jt}$	-0.031***	-0.036***	-0.027	0.003	0.001	-0.031	-0.010	-0.023*	-0.060**	-0.022**	-0.029**	-0.025
	(0.010)	(0.012)	(0.019)	(0.008)	(0.010)	(0.020)	(0.011)	(0.014)	(0.024)	(0.009)	(0.012)	(0.019)
$D3*lnGO_{jt}$	-0.031***	-0.033***	-0.060***	0.011	0.016	-0.013	-0.011	-0.033**	-0.048*	-0.019*	-0.024*	-0.029
	(0.010)	(0.013)	(0.021)	(0.008)	(0.010)	(0.021)	(0.011)	(0.014)	(0.027)	(0.010)	(0.013)	(0.021)
$D4*lnGO_{jt}$	-0.036***	-0.040***	-0.063***	0.009	0.006	-0.024	-0.017	-0.061***	-0.058*	-0.025**	-0.033**	-0.033
	(0.011)	(0.014)	(0.022)	(0.010)	(0.012)	(0.024)	(0.013)	(0.017)	(0.030)	(0.011)	(0.013)	(0.023)
Time dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Constant	-9.581***	-11.918***	-5.625***	-4.613***	-5.078***	-5.147**	-7.627***	-7.567***	-6.745**	-8.523***	-10.147***	-6.415***
	(0.934)	(1.076)	(1.998)	(0.805)	(0.886)	(2.090)	(1.109)	(1.207)	(2.681)	(0.972)	(1.165)	(2.031)
Observations	18,060	11,340	6,720	18,060	11,340	6,720	18,060	11,340	6,720	18,060	11,340	6,720
R-squared	0.975	0.976	0.976	0.978	0.982	0.972	0.969	0.971	0.966	0.977	0.980	0.974

Source: WIOD.

Note: Within-group robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. All refers to EU-28 exports to all (EU-28 and non-EU-28 MS), intra refers to EU-28 exports to EU-28 MS only while extra refers to EU-28 exports to non-EU-28 MS only.

Table 4.20: Gravity regression results: value added exports, 2000-2014

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	All	Intra	Extra	All	Intra	Extra	All	Intra	Extra	All	Intra	Extra
	Total economy			Manufacturing			Advanced manufacturing			Extended manufacturing		
$\ln GDP_{it}$	0.921***	0.958***	0.886***	0.704***	0.665***	0.775***	1.005***	1.104***	1.080***	0.804***	0.786***	0.844***
	(0.036)	(0.055)	(0.059)	(0.037)	(0.054)	(0.062)	(0.051)	(0.079)	(0.079)	(0.037)	(0.055)	(0.060)
$\ln GDP_{jt}$	0.734***	0.757***	0.680***	0.818***	0.859***	0.709***	0.756***	0.630***	0.695***	0.778***	0.829***	0.673***
	(0.035)	(0.053)	(0.054)	(0.037)	(0.052)	(0.062)	(0.047)	(0.073)	(0.072)	(0.035)	(0.054)	(0.055)
$\ln Pop_{it}$	-2.051***	-1.465***	-2.976***	-3.889***	-3.362***	-4.791***	-3.861***	-3.214***	-4.583***	-2.838***	-2.055***	-4.133***
	(0.305)	(0.375)	(0.481)	(0.277)	(0.322)	(0.484)	(0.389)	(0.467)	(0.674)	(0.310)	(0.391)	(0.462)
$\ln Pop_{jt}$	-0.422	-0.032	-0.981**	-0.755***	-1.005***	-0.348	-0.766**	-1.382***	-0.751	-0.097	0.117	-0.306
	(0.263)	(0.341)	(0.491)	(0.242)	(0.309)	(0.539)	(0.323)	(0.404)	(0.651)	(0.263)	(0.348)	(0.495)
$D2^*\ln GDP_{it}$	-0.061***	-0.080***	-0.029**	-0.023***	-0.026**	-0.018	-0.063***	-0.078***	-0.030*	-0.047***	-0.060***	-0.025*
	(0.010)	(0.013)	(0.014)	(0.009)	(0.011)	(0.014)	(0.011)	(0.014)	(0.018)	(0.010)	(0.013)	(0.014)
$D3^*\ln GDP_{it}$	-0.077***	-0.096***	-0.044**	-0.056***	-0.067***	-0.037**	-0.105***	-0.120***	-0.072***	-0.079***	-0.100***	-0.043***
	(0.010)	(0.012)	(0.018)	(0.010)	(0.012)	(0.016)	(0.012)	(0.015)	(0.020)	(0.010)	(0.013)	(0.016)
$D4^*\ln GDP_{it}$	-0.087***	-0.117***	-0.038**	-0.069***	-0.085***	-0.043**	-0.127***	-0.151***	-0.077***	-0.092***	-0.122***	-0.042**
	(0.012)	(0.014)	(0.019)	(0.011)	(0.014)	(0.017)	(0.014)	(0.017)	(0.024)	(0.011)	(0.014)	(0.017)
$D2^*\ln GDP_{jt}$	-0.036***	-0.046***	-0.031*	0.001	-0.005	-0.037*	-0.010	-0.025*	-0.062***	-0.028***	-0.042***	-0.027
	(0.010)	(0.013)	(0.018)	(0.008)	(0.010)	(0.021)	(0.011)	(0.014)	(0.023)	(0.010)	(0.013)	(0.019)
$D3^*\ln GDP_{jt}$	-0.041***	-0.050***	-0.070***	0.003	0.002	-0.024	-0.014	-0.039***	-0.049*	-0.032***	-0.045***	-0.040*
	(0.010)	(0.013)	(0.021)	(0.008)	(0.010)	(0.021)	(0.011)	(0.014)	(0.025)	(0.010)	(0.014)	(0.021)
$D4^*\ln GDP_{jt}$	-0.048***	-0.059***	-0.069***	0.001	-0.010	-0.031	-0.019	-0.066***	-0.055*	-0.039***	-0.059***	-0.039*
	(0.011)	(0.014)	(0.022)	(0.009)	(0.011)	(0.022)	(0.012)	(0.016)	(0.028)	(0.011)	(0.014)	(0.023)
Time dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Constant	-9.091***	-11.614***	-3.763*	-3.453***	-4.177***	-2.591	-7.402***	-7.376***	-5.664**	-8.065***	-9.986***	-4.320**
	(0.938)	(1.071)	(1.983)	(0.803)	(0.896)	(2.017)	(1.076)	(1.179)	(2.530)	(1.001)	(1.187)	(1.974)
Observations	18,060	11,340	6,720	18,060	11,340	6,720	18,060	11,340	6,720	18,060	11,340	6,720
R-squared	0.976	0.976	0.978	0.980	0.984	0.975	0.971	0.972	0.969	0.978	0.980	0.977

Source: WIOD.

Note: Within-group robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. All refers to EU-28 exports to all (EU-28 and non-EU-28 MS), intra refers to EU-28 exports to EU-28 MS only while extra refers to EU-28 exports to non-EU-28 MS only.

Table 4.21: Gravity regression results: re-exported domestic value added (DVAre), 2000-2014

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	All	Intra	Extra	All	Intra	Extra	All	Intra	Extra	All	Intra	Extra
Variables		Total economy			Manufacturing			Advanced manufacturing			Extended manufacturing	
$\ln GDP_{it}$	0.821***	0.838***	0.807***	0.706***	0.703***	0.749***	0.883***	0.983***	0.920***	0.812***	0.819***	0.839***
	(0.016)	(0.023)	(0.025)	(0.018)	(0.027)	(0.029)	(0.028)	(0.041)	(0.041)	(0.017)	(0.026)	(0.025)
$\ln GDP_{jt}$	0.784***	0.768***	0.786***	0.838***	0.819***	0.824***	0.719***	0.577***	0.768***	0.805***	0.781***	0.799***
	(0.014)	(0.021)	(0.020)	(0.017)	(0.026)	(0.024)	(0.025)	(0.037)	(0.037)	(0.015)	(0.025)	(0.021)
$\ln Pop_{it}$	-1.667***	-1.699***	-1.597***	-3.570***	-3.509***	-3.631***	-2.383***	-2.023***	-2.666***	-2.113***	-1.984***	-2.278***
	(0.122)	(0.163)	(0.167)	(0.136)	(0.183)	(0.189)	(0.242)	(0.322)	(0.353)	(0.143)	(0.196)	(0.185)
$\ln Pop_{jt}$	-0.504***	-0.673***	-0.306	-0.572***	-0.898***	-0.399*	-0.666***	-1.093***	-1.067***	-0.495***	-0.754***	-0.366*
	(0.097)	(0.122)	(0.189)	(0.114)	(0.147)	(0.227)	(0.178)	(0.222)	(0.364)	(0.105)	(0.135)	(0.193)
$D2*\ln GDP_{it}$	-0.043***	-0.050***	-0.030***	-0.004	-0.008*	0.004	-0.006	-0.004	-0.003	-0.046***	-0.052***	-0.034***
	(0.003)	(0.005)	(0.004)	(0.003)	(0.005)	(0.005)	(0.005)	(0.006)	(0.007)	(0.004)	(0.005)	(0.005)
$D3*\ln GDP_{it}$	-0.055***	-0.063***	-0.039***	-0.024***	-0.027***	-0.016***	-0.032***	-0.031***	-0.025***	-0.070***	-0.078***	-0.055***
	(0.004)	(0.005)	(0.005)	(0.004)	(0.005)	(0.006)	(0.005)	(0.006)	(0.007)	(0.005)	(0.006)	(0.006)
$D4*\ln GDP_{it}$	-0.057***	-0.065***	-0.042***	-0.023***	-0.027***	-0.014	-0.037***	-0.037***	-0.028**	-0.072***	-0.080***	-0.055***
	(0.005)	(0.007)	(0.007)	(0.006)	(0.008)	(0.009)	(0.007)	(0.009)	(0.012)	(0.006)	(0.008)	(0.008)
$D2*\ln GDP_{jt}$	0.008***	0.015***	-0.016**	0.015***	0.018***	-0.025***	0.013***	0.005	-0.029**	0.013***	0.016***	-0.017**
	(0.003)	(0.004)	(0.008)	(0.003)	(0.005)	(0.008)	(0.005)	(0.007)	(0.012)	(0.003)	(0.005)	(0.008)
$D3*\ln GDP_{jt}$	0.004	0.011**	-0.028***	0.016***	0.019***	-0.030***	0.014**	0.002	-0.035**	0.011***	0.014**	-0.025***
	(0.003)	(0.005)	(0.008)	(0.003)	(0.005)	(0.008)	(0.006)	(0.008)	(0.014)	(0.004)	(0.005)	(0.008)
$D4*\ln GDP_{jt}$	0.002	0.004	-0.022**	0.013***	0.013*	-0.023*	0.013*	-0.011	-0.024	0.010**	0.007	-0.019*
	(0.004)	(0.005)	(0.010)	(0.005)	(0.006)	(0.012)	(0.007)	(0.010)	(0.018)	(0.004)	(0.006)	(0.010)
Time dummies	yes	Yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Constant	-10.027***	-9.924***	-10.456***	-6.299***	-5.777***	-6.807***	-10.331***	-10.177***	-8.180***	-10.034***	-9.806***	-10.125***
	(0.313)	(0.361)	(0.774)	(0.374)	(0.421)	(0.924)	(0.604)	(0.648)	(1.471)	(0.360)	(0.437)	(0.814)
Observations	18,060	11,340	6,720	18,060	11,340	6,720	18,060	11,340	6,720	18,060	11,340	6,720
R-squared	0.995	0.995	0.995	0.995	0.995	0.994	0.991	0.991	0.991	0.995	0.995	0.995

Source: WIOD.
Note: Within-group robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. All refers to EU-28 exports to all (EU-28 and non-EU-28 MS), intra refers to EU-28 exports to EU-28 MS only while extra refers to EU-28 exports to non-EU-28 MS only.

4.6. Summary and Policy Implications

The availability of new international input-output data for a set of 43 countries including all EU Member States, allowed for a first thorough analysis of the developments of value chain trade since the Great Recession of 2008/2009. Based on a forward production integration measure for value chain trade, which is the re-exported domestic value added, the data confirms the conjecture that the expansion of international value chains has come to a halt in the post-crisis period (2011-2014). The comparison of the dynamics of different exports flows can serve as suggestive evidence that in the EU-28, despite the levelling off of value chain integration, so far there has been no massive dismantling of international value chains. At the global level a more worrying trend is discernible since VC trade was growing at a lower pace than value added exports and gross exports in the post-crisis period. This constellation may signal that some value chains are on the retreat. Therefore future developments need to be observed vigilantly and, if the current trend persisted, the underlying causes need to be identified. This is because there are numerous reasons for why VC trade loses dynamism, ranging from more nationalistic economic policies, over a lack of new impetus from global trade liberalisation to reduced incentives for offshoring activities by multinational firms due to a declining share of labour cost in total costs. For the EU it seems that the European Single Market, due to the guaranteed free movement of goods, services and investments and accompanying regulations such as the competition rules, acts as a reinsurance mechanism against potential protectionist tendencies which would be one explanation why the growth of VC trade could keep pace with overall trade.

Another aspect that is highlighted in this report is the geographical scope of value chains where the stylised facts established by the literature would suggest that regional value chains are most prevalent. The approach in this reports exploits the complexity of VC trade which implies that more than one partner countries are involved. Apart from the source country, which is the origin of the value added, an immediate production partner and the ultimate production partner, i.e. the last link in the production chain, can be identified. Obviously there is also the country of final demand which is where the value added is absorbed. By identifying the production partners that are involved in joint production, VC trade can be separated into regional value chain (RVC) trade on the one hand, and global value chain (GVC) trade on the other. The former includes all VC trade which involves only partners from within the region of the source country. European RVCs include VC trade where only EU Member States act as producers. In contrast, all European GVC trade is VC trade which involves also third countries as production partners. With this way of defining the regional scope of value chains the existing stylised fact that VC trade is mainly regional in scope is challenged to some extent. According to this definition the split between RVC trade and GVC trade for the EU-28 is about half-half with only modest shifts towards GVC trade between 2000 and 2014.

One of the most striking results in the context of RVCs and GVCs is the extent to which demand is shaping the organisation of production. In models of offshoring, the extent of production relocation and hence cross-border production sharing is typically determined by the trade-off between the coordination costs of offshoring and the advantages resulting from the wage differential. The empirical data, however, suggest that the demand patterns are strongly influencing the decisions where to locate production. Qualitatively this result is not surprising since also within international VCs trade costs are incurred but quantitatively it is. In fact, the influence of final demand is so strong that it is fair to summarise that the EU's RVCs produce to serve intra-EU demand while European GVCs produce to satisfy extra-EU demand.

The extent of a country's inclination to engage in production sharing can be assessed with the help of revealed export preferences (RXP) which is a form of a trade specialisation index. The data reveals a strong tendency of Member States to engage in joint production with other EU Member States, highlighting the role of geographic proximity. Exceptions in this context are Greece, which is actually less involved in RVC trade than the average country in the world, and Ireland, which has also only a small positive RXP index. But distance is not the whole story as the example of Switzerland demonstrates. Located amidst EU Member States, its RXP index is strongly positive but still much lower than that of all its neighbouring countries such as Austria, Germany, France and Italy. This suggests that the Single Market, in addition to geographic proximity, facilitates cross-border production sharing, possibly due to lower non-tariff barriers within the Single Market.

In order to put the extent of RVC trade of EU Member States in perspective, 'Factor Europe' is compared to 'Factory North America' (comprising the United States, Canada and Mexico) and 'Factory Asia' (comprising Japan, Korea, China, Indonesia and Taiwan). Such a comparison reveals that 'Factory Europe' is by far the largest of the three regional factories, and about five times larger than Factory North America. For comparison, the EU's total VC trade is only about twice as large as that of NAFTA members. This confirms the high degree of economic and institutional integration that has been reached in the EU which facilitated the development of 'Factory Europe'. Apart from geographic proximity of countries, the absence of tariff barriers and the comparatively low regulatory cross-country barriers within the Single Market have led to a situation where joint production within Factory Europe is more developed than in the other main regional Factories. At the same time, the regional introversion index (RII), which indicates how much countries of a trading bloc trade more with each other than with other countries, shows that EU is not a closed bloc by international standards. In fact, it is in between NAFTA, which is the most inwards oriented bloc by this metric, and Factory Asia. It is worth emphasising that the level of the RII per se is not necessarily a good nor a bad thing. A high RII can be seen as an advantage as it signals strong regional integration. At the same time, it may also indicate that there are high barriers to production sharing with partner countries from outside the region. Likewise, it can indicate that the members of the region are not capable of linking into GVCs, i.e. value chains that involve extra-regional partners. Hence, as long as it is unclear whether RVC trade and GVC trade have systematically different implications for countries' economic performance, it is difficult to interpret changes in the RII.

The implications of RVC on the one hand and GVC on the other hand are indeed hard to assess, where the primary interest in this report is with the implications of VCs for structural change and competitiveness. A first question here is to what extent VC trade as a whole is indeed qualitatively different from overall trade. This can be addressed by looking at the economic impact of the VC trade *intensity*, i.e. the ratio of VC trade over VAX. In this context structural change is measured by changes in the value added share of manufacturing in total GDP, while labour productivity and world market shares in value added exports serve as measures of competitiveness. The key insight is that there seem to be little extra effects from VC trade *in addition* to the effects of overall trade. Clearly, VC trade is conducive to labour productivity growth in Member States, but so is value added trade (i.e. overall trade). Hence, there are no additional productivity gains to be expected from VC trade *relative* to trade in general. With regards to structural change, there is one interesting result which suggests that higher VC trade intensity is not fostering the manufacturing sector across Member States in general. However, there is a positive effect of VC trade intensity for the members of the CE Manufacturing Core (comprising Germany, Austria, the Czech Republic, Slovakia, Poland and Hungary) which seems to stem from the GVC part of VC trade. This result is compatible with the view that for international production sharing to be successful – even if regional production sharing plays an important role – it should not take place in an entirely self-contained manner. Instead, a balanced approach to production integration should be pursued, where the advantages of RVCs such as geographic proximity and reduced trade costs within the Single Market should be fully exploited without renouncing on global production co-operations in cases where lower costs or better quality can be achieved.

For the EU as a whole, the asymmetric effect detected by the structural model also points towards strong agglomeration forces which, however, seem to coexist with a strong convergence effect too. Especially the agglomeration forces, which play out strongly due to a variety of factors including path dependencies, increasing returns to scale, skill complementarities and geographic proximity, should be carefully monitored. Due attention should be paid to this phenomenon as specialisation patterns and, in particular, the manufacturing sector in its role as the main tradables-producing sector for EU Member States also have wider macroeconomic implications.

Interesting insights also come from a gravity analysis of various types of exports of EU Member States which takes a closer look at the Trade Slowdown phenomenon from the perspective of the EU-28 and sheds light on the different roles played by various types of exports in this context. Generally, results point to a break in the relationship between trade and (own and foreign) income, with, however, diverse patterns that differ by industry aggregate and region of destination of EU-28 exports considered. More specifically, it demonstrates that, in line with the related literature, in the aftermath of the crisis, elasticities of exports to *own* GDP have fallen continuously. This decline in export elasticities to own GDP was most pronounced for advanced manufacturing and two to three times stronger for intra-EU-28 exports as compared to extra-EU-28 exports. Likewise, elasticities of exports to *foreign* GDP have followed a similar continuous downward trend. However, relative to export elasticities to own GDP, the decline in elasticities of exports to foreign GDP was only half as strong and clearly less consistent across industry aggregates considered. In a regional context, the drop in elasticities of exports to foreign GDP was less consistent across industry aggregates but, if significant, somewhat stronger for extra-EU-28 exports.

Hence, these results corroborate the notion of 'peak trade' and suggest that the EU-28 trade slowdown is structural in nature and therefore more permanent; thus, no full return to pre-crisis export to income elasticities – but some further upward adjustments (Altomonte et al., 2016) – can be expected. This implies that, if GDP growth picks up, associated export growth is not as strong as before the crisis. Furthermore, intra-EU-28 exports – and therefore trade within the Single Market – consistently experienced the most pronounced fall in export to GDP elasticities. This emphasises that, relative to the pre-crisis period, the EU Single Market has become a considerably less important source of recent (and future) EU export growth.

Importantly, a comparison of results for gross exports, value added exports (VAX) and VC trade highlights that the post-crisis decline in the (home- and foreign-) income elasticities of exports was predominantly driven by the even stronger decline in the (home- and foreign-)

income elasticities of the domestic value added component in exports. However, VC trade played no significant role for these persistent and sizeable losses in (home- and foreign-) income elasticities of value added exports.

4.7. References

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4.8. Appendix to Chapter 4

4.8.1. Appendix 1: List of countries and country groupings

country	ISO-2 code	broad groups	narrow groups	geographic region
AUS	AU	non-EU	non-EU	Other
AUT	AT	West/North EU	CE Manufacturing Core	EU
BEL	BE	West/North EU	other EU	EU
BGR	BG	Central and Eastern EU	enlarged CEMC	EU
BRA	BR	non-EU	non-EU	Other
CAN	CA	non-EU	non-EU	NAFTA
CHE	CH	non-EU	non-EU	EFTA
CHN	CN	non-EU	non-EU	Asia-5
CYP	CY	South EU	EU South	EU
CZE	CZ	Central and Eastern EU	CE Manufacturing Core	EU
DEU	DE	West/North EU	CE Manufacturing Core	EU
DNK	DK	West/North EU	other EU	EU
ESP	ES	South EU	EU South	EU
EST	EE	Central and Eastern EU	other EU	EU
FIN	FI	West/North EU	other EU	EU
FRA	FR	West/North EU	Western deindustrialiser	EU
GBR	GB	West/North EU	Western deindustrialiser	EU
GRC	GR	South EU	EU South	EU
HRV	HR	Central and Eastern EU	EU South	EU
HUN	HU	Central and Eastern EU	CE Manufacturing Core	EU
IDN	ID	non-EU	non-EU	Asia-5
IND	IN	non-EU	non-EU	Other
IRL	IE	South EU	other EU	EU
ITA	IT	South EU	Western deindustrialiser	EU
JPN	JP	non-EU	non-EU	Asia-5
KOR	KO	non-EU	non-EU	Asia-5
LTU	LT	Central and Eastern EU	other EU	EU
LUX	LU	West/North EU	Benelux	EU
LVA	LV	Central and Eastern EU	other EU	EU
MEX	MX	non-EU	non-EU	NAFTA
MLT	MT	South EU	EU South	EU
NLD	NL	West/North EU	other EU	EU
NOR	NO	non-EU	non-EU	EFTA
POL	PL	Central and Eastern EU	CE Manufacturing Core	EU
PRT	PT	South EU	EU South	EU
ROU	RO	Central and Eastern EU	enlarged CEMC	EU
RUS	RU	non-EU	non-EU	Other
SVK	SK	Central and Eastern EU	CE Manufacturing Core	EU
SVN	SI	Central and Eastern EU	other EU	EU
SWE	SE	West/North EU	other EU	EU
TUR	TR	non-EU	non-EU	Other
TWN	TW	non-EU	non-EU	Asia-5
USA	US	non-EU	non-EU	NAFTA
ZROW	-	non-EU	non-EU	Other

4.8.2. Appendix 2: List of industries

NACE Rev 2. Industry code	Industry description
A01	Crop and animal production, hunting and related service activities
A02	Forestry and logging
A03	Fishing and aquaculture
B	Mining and quarrying
C10-C12	Manufacture of food products, beverages and tobacco products
C13-C15	Manufacture of textiles, wearing apparel and leather products
C16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
C17	Manufacture of paper and paper products
C18	Printing and reproduction of recorded media
C19	Manufacture of coke and refined petroleum products
C20	Manufacture of chemicals and chemical products
C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
C22	Manufacture of rubber and plastic products
C23	Manufacture of other non-metallic mineral products
C24	Manufacture of basic metals
C25	Manufacture of fabricated metal products, except machinery and equipment
C26	Manufacture of computer, electronic and optical products
C27	Manufacture of electrical equipment
C28	Manufacture of machinery and equipment n.e.c.
C29	Manufacture of motor vehicles, trailers and semi-trailers
C30	Manufacture of other transport equipment
C31-C32	Manufacture of furniture; other manufacturing
C33	Repair and installation of machinery and equipment
D35	Electricity, gas, steam and air conditioning supply
E36	Water collection, treatment and supply
E37-E39	Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services
F	Construction
G45	Wholesale and retail trade and repair of motor vehicles and motorcycles
G46	Wholesale trade, except of motor vehicles and motorcycles
G47	Retail trade, except of motor vehicles and motorcycles
H49	Land transport and transport via pipelines
H50	Water transport
H51	Air transport
H52	Warehousing and support activities for transportation
H53	Postal and courier activities
I	Accommodation and food service activities
J58	Publishing activities
J59-J60	Motion picture, video and television programme production, sound recording and music publishing activities; programming and broadcasting activities
J61	Telecommunications
J62-J63	Computer programming, consultancy and related activities; information service activities
K64	Financial service activities, except insurance and pension funding
K65	Insurance, reinsurance and pension funding, except compulsory social security
K66	Activities auxiliary to financial services and insurance activities
L68	Real estate activities
M69-M70	Legal and accounting activities; activities of head offices; management consultancy activities
M71	Architectural and engineering activities; technical testing and analysis
M72	Scientific research and development
M73	Advertising and market research
M74-M75	Other professional, scientific and technical activities; veterinary activities
N	Administrative and support service activities
O84	Public administration and defence; compulsory social security
P85	Education
Q	Human health and social work activities
R-S	Other service activities
T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use
U	Activities of extraterritorial organisations and bodies

4.8.3. Appendix 3: Industry aggregates

Economy

NACE Rev. 2 Sectors A-U

Manufacturing

NACE Rev. 2 Sector C

Advanced manufacturing industries

NACE Rev. 2 Industry C21

NACE Rev. 2 Industry C26

NACE Rev. 2 Industry C27

NACE Rev. 2 Industry C28

NACE Rev. 2 Industry C29

NACE Rev. 2 Industry C30

Manufacturing and business services

NACE Rev. 2 Sector C

NACE Rev. 2 Industry J62-J63

NACE Rev. 2 Industry M69-M70

NACE Rev. 2 Industry M71

NACE Rev. 2 Industry M72

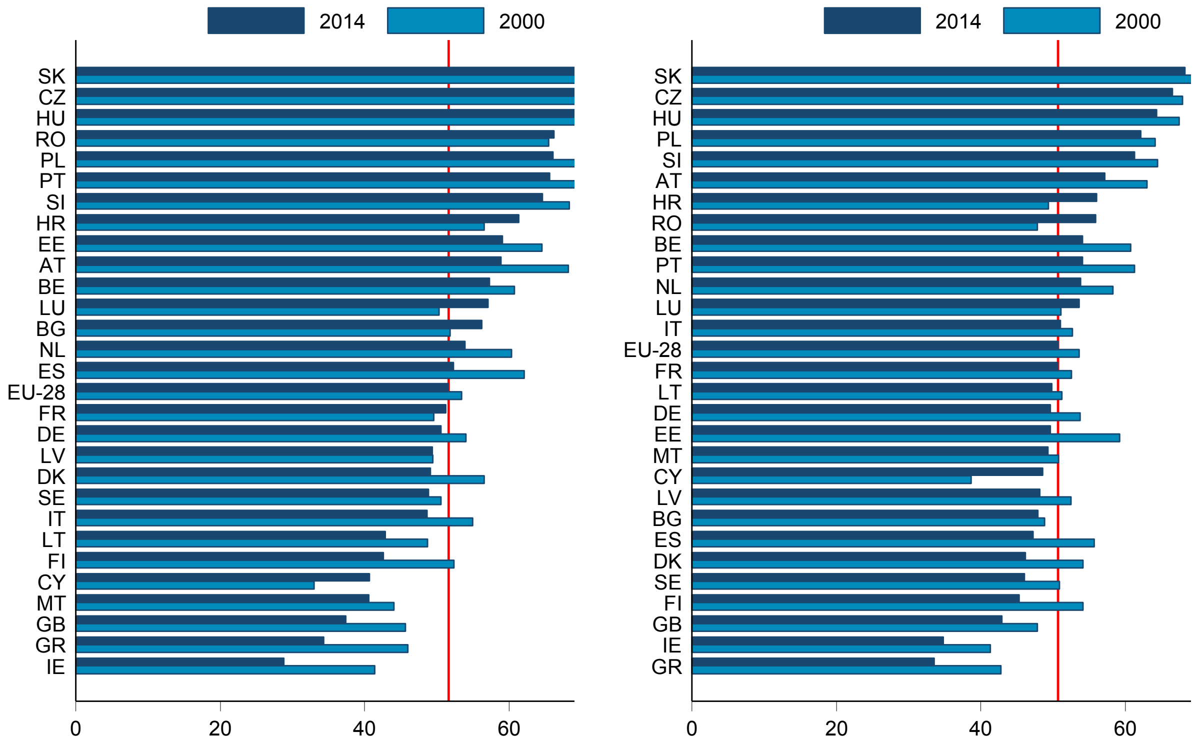
NACE Rev. 2 Industry M73

NACE Rev. 2 Industry M74-M75

4.8.4.Appendix 4: Additional descriptive results

Figure A4.1: RVC trade share in % of total VC trade by Member States

Advanced manufacturing *Manufacturing and business services*



Source: WIOD Release 2016. wiiw calculations.

Table A4.1: Regional value chain-trade (EU-28 = 100), shares and p.p. change

	Manufacturing				Advanced manufacturing				Manufacturing and business services		
	2000	2014	PP. Change		2000	2014	PP. Change		2000	2014	PP. Change
AT	4.1	4.4	0.4	AT	4.2	4.7	0.5	AT	3.6	3.8	0.3
BE	5.9	4.3	-1.6	BE	3.3	2.3	-1.0	BE	5.8	4.8	-1.0
BG	0.0	0.3	0.2	BG	0.0	0.2	0.2	BG	0.0	0.3	0.2
CY	0.0	0.0	0.0	CY	0.0	0.0	0.0	CY	0.0	0.1	0.1
CZ	1.6	4.2	2.6	CZ	1.5	5.2	3.7	CZ	1.4	3.4	2.0
DE	26.8	30.4	3.6	DE	31.5	36.6	5.1	DE	25.9	27.2	1.3
DK	1.5	1.2	-0.2	DK	1.5	1.3	-0.3	DK	1.4	1.2	-0.2
EE	0.1	0.2	0.1	EE	0.1	0.2	0.1	EE	0.1	0.2	0.1
ES	4.5	4.5	0.1	ES	3.8	3.6	-0.2	ES	4.7	4.0	-0.6
FI	2.5	1.5	-1.0	FI	1.8	1.0	-0.8	FI	2.1	1.4	-0.7
FR	11.7	9.3	-2.4	FR	10.9	8.9	-2.0	FR	13.0	10.6	-2.4
GB	13.2	6.3	-6.9	GB	15.2	6.1	-9.1	GB	14.2	9.3	-4.9
GR	0.2	0.3	0.1	GR	0.1	0.0	0.0	GR	0.2	0.3	0.1
HR	0.2	0.3	0.1	HR	0.1	0.2	0.0	HR	0.1	0.3	0.1
HU	1.0	2.2	1.2	HU	1.5	3.2	1.6	HU	0.9	1.9	1.0
IE	1.8	1.2	-0.6	IE	3.0	1.5	-1.5	IE	1.6	1.5	-0.1
IT	9.8	9.7	0.0	IT	9.5	8.9	-0.7	IT	9.9	8.9	-1.0
LT	0.1	0.4	0.3	LT	0.1	0.1	0.0	LT	0.1	0.3	0.2
LU	0.3	0.2	-0.1	LU	0.1	0.1	0.0	LU	0.3	0.4	0.1
LV	0.1	0.1	0.1	LV	0.0	0.0	0.0	LV	0.0	0.1	0.1
MT	0.0	0.0	0.0	MT	0.1	0.0	0.0	MT	0.1	0.1	0.0
NL	6.5	5.9	-0.6	NL	4.1	3.8	-0.3	NL	7.0	8.3	1.3
PL	2.0	4.9	2.9	PL	1.7	4.2	2.5	PL	1.8	4.3	2.4
PT	0.8	1.1	0.3	PT	0.6	0.8	0.2	PT	0.7	0.9	0.2
RO	0.3	1.4	1.1	RO	0.3	1.7	1.4	RO	0.3	1.3	1.0
SE	4.3	3.4	-0.9	SE	4.3	3.4	-0.9	SE	4.0	3.3	-0.7
SI	0.4	0.7	0.3	SI	0.3	0.6	0.3	SI	0.3	0.6	0.3
SK	0.5	1.7	1.2	SK	0.3	1.6	1.3	SK	0.4	1.4	1.0

Source: WIOD Release 2016. wiiw calculations.

Table A.4.2: Global value chain-trade (EU-28 = 100), shares and p.p. change

Manufacturing				Advanced manufacturing				Manufacturing and business services			
	2000	2014	PP. Change		2000	2014	PP. Change		2000	2014	PP. Change
AT	2.8	3.5	0.7	AT	2.3	3.5	1.2	AT	2.4	3.0	0.5
BE	4.4	3.6	-0.8	BE	2.4	1.8	-0.6	BE	4.4	4.2	-0.2
BG	0.0	0.3	0.3	BG	0.0	0.2	0.2	BG	0.0	0.3	0.2
CY	0.0	0.0	0.0	CY	0.0	0.0	0.0	CY	0.0	0.1	0.0
CZ	0.8	2.2	1.4	CZ	0.6	2.4	1.8	CZ	0.8	1.7	1.0
DE	27.3	32.1	4.8	DE	30.8	38.1	7.3	DE	25.9	28.3	2.4
DK	1.4	1.4	0.0	DK	1.4	1.4	0.1	DK	1.4	1.4	0.0
EE	0.1	0.2	0.1	EE	0.0	0.1	0.1	EE	0.0	0.2	0.1
ES	4.2	5.1	0.9	ES	2.7	3.4	0.8	ES	4.3	4.6	0.3
FI	2.5	1.9	-0.7	FI	1.9	1.4	-0.4	FI	2.1	1.7	-0.4
FR	12.4	9.5	-2.9	FR	12.7	8.9	-3.8	FR	13.5	10.6	-3.0
GB	17.0	9.8	-7.2	GB	20.8	10.9	-9.9	GB	17.9	12.8	-5.2
GR	0.3	0.6	0.3	GR	0.1	0.1	0.0	GR	0.3	0.5	0.2
HR	0.2	0.2	0.0	HR	0.1	0.1	0.0	HR	0.2	0.2	0.1
HU	0.5	1.2	0.6	HU	0.6	1.5	0.9	HU	0.5	1.1	0.6
IE	2.8	2.5	-0.3	IE	4.9	3.8	-1.0	IE	2.6	2.9	0.3
IT	10.3	10.1	-0.2	IT	8.9	9.9	1.0	IT	10.3	8.8	-1.5
LT	0.1	0.4	0.3	LT	0.1	0.1	0.0	LT	0.1	0.3	0.2
LU	0.3	0.2	-0.1	LU	0.1	0.1	0.0	LU	0.4	0.4	0.0
LV	0.1	0.1	0.1	LV	0.0	0.1	0.0	LV	0.1	0.1	0.1
MT	0.1	0.0	0.0	MT	0.1	0.0	-0.1	MT	0.1	0.1	0.0
NL	4.9	4.9	0.1	NL	3.1	3.5	0.4	NL	5.8	7.3	1.5
PL	1.2	3.1	1.8	PL	0.8	2.3	1.5	PL	1.2	2.7	1.5
PT	0.5	0.9	0.3	PT	0.3	0.4	0.1	PT	0.5	0.8	0.3
RO	0.4	1.1	0.7	RO	0.2	0.9	0.7	RO	0.3	1.0	0.7
SE	4.8	3.9	-0.9	SE	4.8	3.8	-1.0	SE	4.5	4.0	-0.5
SI	0.2	0.5	0.2	SI	0.1	0.3	0.2	SI	0.2	0.4	0.2
SK	0.2	0.8	0.6	SK	0.1	0.7	0.6	SK	0.2	0.7	0.5

Source: WIOD Release 2016. wiiw calculations.

4.8.5.Appendix 5: Additional regression results

Table A5.1: Structural models, advanced manufacturing, EU-28 sample

Aggregate: **Advanced manufacturing**
Sample: **EU-28**
Dependent Variable: **Δvalue added share of advanced manufacturing**

	Model SPEC							
	(1) VC intensity		(2) RVC intensity		(3) GVC intensity		(4) RVC+GVC intensity	
	linear	non-linear	linear	non-linear	linear	non-linear	linear	non-linear
VC intensity	0.0111	0.0090						
	(0.0161)	(0.0161)						
VC intensity x CEMC		0.0202						
		(0.0463)						
RVC intensity			0.0136	0.0251			0.0126	0.0301
			(0.0206)	(0.0227)			(0.0205)	(0.0235)
RVC intensity x CEMC				-0.0844				-0.0878
				(0.0698)				(0.0772)
GVC intensity					0.0110	-0.0080	0.0091	-0.0169
					(0.0269)	(0.0279)	(0.0268)	(0.0272)
GVC intensity x CEMC						0.1336*		0.1427*
						(0.0735)		(0.0738)
share advanced mf	-0.1841***	-0.1858***	-0.1849***	-0.1896***	-0.1835***	-0.2028***	-0.1843***	-0.2105***
	(0.0413)	(0.0407)	(0.0417)	(0.0423)	(0.0402)	(0.0368)	(0.0407)	(0.0379)
Δreal FX (ULC based)	0.0015	0.0016	0.0015	0.0008	0.0017	0.0015	0.0014	0.0004
	(0.0042)	(0.0043)	(0.0042)	(0.0043)	(0.0041)	(0.0040)	(0.0042)	(0.0042)
sdvanced labour share	-0.0172	-0.0166	-0.0177	-0.0183	-0.0180	-0.0158	-0.0172	-0.0153
	(0.0136)	(0.0136)	(0.0140)	(0.0144)	(0.0143)	(0.0152)	(0.0135)	(0.0143)
R&D intensity	0.0804	0.0697	0.0822	0.1068	0.0739	0.0391	0.0814	0.0734
	(0.1293)	(0.1291)	(0.1275)	(0.1279)	(0.1252)	(0.1334)	(0.1259)	(0.1367)
ln GDP per capita	-0.0011	-0.0012	-0.0014	-0.0023	-0.0011	-0.0032	-0.0012	-0.0045
	(0.0040)	(0.0042)	(0.0042)	(0.0039)	(0.0042)	(0.0044)	(0.0043)	(0.0039)
ln population	-0.0162	-0.0162	-0.0155	-0.0171	-0.0153	-0.0176	-0.0161	-0.0202
	(0.0143)	(0.0144)	(0.0135)	(0.0135)	(0.0139)	(0.0142)	(0.0144)	(0.0145)
constant	0.2798	0.2815	0.2725	0.3085	0.2669	0.3243	0.2797	0.3795
	(0.2600)	(0.2615)	(0.2519)	(0.2501)	(0.2521)	(0.2562)	(0.2601)	(0.2576)
Observations	363	363	363	363	363	363	363	363
R-squared	0.3105	0.3108	0.3103	0.3131	0.3100	0.3161	0.3105	0.3199
R-sq. dj.	0.210	0.208	0.210	0.211	0.210	0.214	0.208	0.213
F-test	38.54	55.47	32.92	36.21	37.44	26.06	36.72	29.69

Note: All specifications include country and time fixed effects. *, ** and *** indicate statistical significance at the 1%, 5% and 10% level respectively. Within-group robust standard errors in parentheses. All explanatory variables are lagged by one period. Specifications with interaction terms use centred values of the variables forming the interaction term.

Table A5.2: Structural models, manufacturing and business services, EU-28 sample

Aggregate:	**Manufacturing and business services**							
Sample:	**EU-28**							
Dependent Variable:	**Δvalue added share of manufacturing and business services**							
	Model SPEC							
	(1)		(2)		(3)		(4)	
	VC intensity		RVC intensity		GVC intensity		RVC+GVC intensity	
	linear	non-linear	linear	non-linear	linear	non-linear	linear	non-linear
VC intensity	0.0777***	0.0750***						
	(0.0237)	(0.0223)						
VC intensity x CEMC		0.1016**						
		(0.0428)						
RVC intensity			0.0836**	0.0787**			0.0800**	0.0850**
			(0.0347)	(0.0340)			(0.0384)	(0.0410)
RVC intensity x CEMC				0.1395				0.0337
				(0.0936)				(0.1070)
GVC intensity					0.0875	0.0768	0.0694	0.0542
					(0.0864)	(0.0887)	(0.0919)	(0.0945)
GVC intensity x CEMC						0.1571**		0.1681*
						(0.0695)		(0.0892)
share mf & bs	-0.3258***	-0.3442***	-0.3305***	-0.3423***	-0.3037***	-0.3187***	-0.3268***	-0.3475***
	(0.0649)	(0.0667)	(0.0614)	(0.0645)	(0.0592)	(0.0575)	(0.0621)	(0.0632)
Δreal FX (ULC based)	-0.0206**	-0.0208**	-0.0201**	-0.0199**	-0.0209**	-0.0214**	-0.0206**	-0.0210**
	(0.0092)	(0.0089)	(0.0093)	(0.0091)	(0.0094)	(0.0092)	(0.0094)	(0.0091)
advanced labour share	0.0166	0.0210	0.0192	0.0200	0.0097	0.0158	0.0170	0.0243
	(0.0191)	(0.0207)	(0.0190)	(0.0190)	(0.0176)	(0.0200)	(0.0185)	(0.0210)
R&D intensity	0.2738	0.2232	0.2869	0.2673	0.2712	0.2161	0.2752	0.2122
	(0.2161)	(0.2198)	(0.2140)	(0.2132)	(0.2208)	(0.2266)	(0.2115)	(0.2234)
ln GDP per capita	0.0046	0.0039	0.0017	0.0022	0.0082	0.0063	0.0042	0.0020
	(0.0075)	(0.0078)	(0.0077)	(0.0077)	(0.0079)	(0.0087)	(0.0088)	(0.0097)
ln population	-0.0602**	-0.0639**	-0.0627**	-0.0637**	-0.0453*	-0.0499*	-0.0608**	-0.0671**
	(0.0261)	(0.0270)	(0.0275)	(0.0279)	(0.0237)	(0.0252)	(0.0284)	(0.0306)
constant	0.9698**	1.0350**	1.0490**	1.0580**	0.7034	0.7948*	0.9837*	1.1074*
	(0.4477)	(0.4606)	(0.4781)	(0.4826)	(0.4160)	(0.4452)	(0.5066)	(0.5471)
Observations	363	363	363	363	363	363	363	363
R-squared	0.4566	0.4612	0.4551	0.4578	0.4478	0.4517	0.4566	0.4620
R-sq. dj.	0.378	0.381	0.376	0.377	0.367	0.370	0.376	0.378
F-test	49.97	60.19	48.38	61.02	119.4	72.30	88.43	86.98

Note: All specifications include country and time fixed effects. *, ** and *** indicate statistical significance at the 1%, 5% and 10% level respectively. Within-group robust standard errors in parentheses. All explanatory variables are lagged by one period. Specifications with interaction terms use centred values of the variables forming the interaction term.

4.8.6. Appendix 6: Calculation of value added exports

The concept of value added exports (VAX) was initially suggested by Johnson and Noguera (2012), though the expositions here follow more closely the discussion in Stehrer (2012) and Stehrer (2013).

Three components are required to calculate the value added exports. For any reporting country *r*, these components are the (industry-specific) value added requirements per unit of gross output, v_i^r, where *i* denotes the industry dimension (with $i \in I$); the Leontief inverse of the global input-output matrix, $\boldsymbol{L}$; and the global final demand vector, f_i^C, where the subscript C indicates that the vector comprises the final demand of all countries $c \in C$.

Country *r*'s (industry-specific) value added coefficients are defined as $v_i^r = \frac{value\ added_i^r}{gross\ output_i^r}$. The value added coefficients are arranged in a diagonal matrix of dimension *C·I* x *C·I*[41]. This matrix contains the value added coefficients of reporting country *r* for all industries along the diagonals. The remaining entries of the matrix are zero.

The second element is the Leontief inverse of the global input-output matrix, $\boldsymbol{L} = (\boldsymbol{I} - \boldsymbol{A})^{-\mathbf{1}}$ where $\boldsymbol{A}$ denotes the matrix of coefficients containing the typical element $a_{i,j}^{r,c}$ – the technical coefficients – which indicates the value of the sales of country *r*'s industry *i* to country *c*'s industry *j* per unit of production of c's industry *j*. The technical coefficients describing the domestic production process in country *r* are found along the diagonal elements while the off-diagonal elements constitute country *r's* imports (from a column perspective). The dimension of the matrix of coefficients and the Leontief matrix is also *C·I* x *C·I*.

The final building block is the (industry-specific) global final demand vector f_i^C, which has the dimension *C·I* × 1. This final demand is split into separate blocks indicating the origin of the demand for the final goods. This split of final demand by demanding country, however, appears *within* the elements in the column vector. As usual, each row is associated with the source of the production that is the subject of the final demand.

In the 3-country-2-sector case, which includes the reporting country *r* and partner countries 2 and 3 and assumes a manufacturing sector (*m*) and a services sector (*s*), the full final demand vector, f_i^C, has the form

$$f_i^C = \begin{pmatrix} f_m^{r,r} + f_m^{r,2} + f_m^{r,3} \\ f_s^{r,r} + f_s^{r,2} + f_s^{r,3} \\ f_m^{2,r} + f_m^{2,2} + f_m^{2,3} \\ f_s^{2,r} + f_s^{2,2} + f_s^{2,3} \\ f_m^{3,r} + f_m^{3,2} + f_m^{3,3} \\ f_s^{3,r} + f_s^{3,2} + f_s^{3,3} \end{pmatrix}.$$

where the subscript C indicates that the vector comprises the final demand of all countries $c \in C$. The typical element of this vector contains the final demand from all possible sources. For example, the element $f_s^{r,3}$ captures the value of final goods that country 3 demands from the services sector in country *r*. The value added exports comprise only value added that is created in one country but absorbed in another. Therefore the final demand from reporting country *r* itself needs to be eliminated for the calculation of country *r*'s VAX. This is done by

[41] In the WIOD 2016 Release there are 44 countries and 56 industries so that the dimension of the matrix is 2464 x 2464.

setting the demand from country *r* to zero, yielding an adjusted final demand vector, $f_i^{c \neq r}$. This vector has the form:

$$f_i^{c \neq r} = \begin{pmatrix} 0 + f_m^{r,2} + f_m^{r,3} \\ 0 + f_s^{r,2} + f_s^{r,3} \\ 0 + f_m^{2,2} + f_m^{2,3} \\ 0 + f_s^{2,2} + f_s^{2,3} \\ 0 + f_m^{3,2} + f_m^{3,3} \\ 0 + f_s^{3,2} + f_s^{3,3} \end{pmatrix}.$$

Reporting country *r*'s value added exports can then be calculated as

(A1) $VAX_i^{r,*} = \boldsymbol{v_i^r} \cdot \boldsymbol{L} \cdot f_i^{c \neq r}$

where $VAX_i^{r,*}$ is a row vector of dimension $C \cdot I \times 1$ which contains the sector-specific value added exports of country *r* to all partner countries.

To further illustrate the calculation, the matrices in equation (A1) are shown in detail for the three countries (reporting country *r* and partner countries 2 and 3) – two sectors case (sectors *m* and *s*):

$$\begin{pmatrix} VAX_{m,*}^{r,*} \\ VAX_{s,*}^{r,*} \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix} = \begin{pmatrix} v_m^r & 0 & 0 & 0 & 0 & 0 \\ 0 & v_s^r & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix} \cdot \begin{pmatrix} l_{m,m}^{r,r} & l_{m,s}^{r,r} & l_{m,m}^{r,2} & l_{m,s}^{r,2} & l_{m,m}^{r,3} & l_{m,s}^{r,3} \\ l_{s,m}^{r,r} & l_{s,s}^{r,r} & l_{s,m}^{r,2} & l_{s,s}^{r,2} & l_{s,m}^{r,3} & l_{s,s}^{r,3} \\ l_{m,m}^{2,r} & l_{m,s}^{2,r} & l_{m,m}^{2,2} & l_{m,s}^{2,2} & l_{m,m}^{2,3} & l_{m,s}^{2,3} \\ l_{s,m}^{2,r} & l_{s,s}^{2,r} & l_{s,m}^{2,2} & l_{s,s}^{2,2} & l_{s,m}^{2,3} & l_{s,s}^{2,3} \\ l_{m,m}^{3,r} & l_{m,s}^{3,r} & l_{m,m}^{3,2} & l_{m,s}^{3,2} & l_{m,m}^{3,3} & l_{m,s}^{3,3} \\ l_{s,m}^{3,r} & l_{s,s}^{3,r} & l_{s,m}^{3,2} & l_{s,s}^{3,2} & l_{s,m}^{3,3} & l_{s,s}^{r,3} \end{pmatrix} \cdot \begin{pmatrix} 0 + f_m^{r,2} + f_m^{r,3} \\ 0 + f_s^{r,2} + f_s^{r,3} \\ 0 + f_m^{2,2} + f_m^{2,3} \\ 0 + f_s^{2,2} + f_s^{2,3} \\ 0 + f_m^{3,2} + f_m^{3,3} \\ 0 + f_s^{3,2} + f_s^{3,3} \end{pmatrix}$$

The coefficients in the Leontief matrix represent the total direct and indirect input requirements of any country for producing one dollar worth of output for final demand. For example, the coefficient $l_{m,s}^{r,r}$ indicates the total input requirement of country *r*'s services sector from country *r*'s manufacturing sector for producing one unit of output of sector *s*. Likewise, the coefficient $l_{m,m}^{r,3}$ indicates the input requirement of the manufacturing sector in country 3 per unit of its output that is supplied by country *r*'s manufacturing sector.

The resulting elements, $VAX_{m,*}^{r,*}$ and $VAX_{s,*}^{r,*}$, are the total value added exports of country *r*'s manufacturing and services sector to all other sectors (indicated by the asterisk in the subscript) of all partner countries (indicated by the asterisk in the superscript).

4.8.7. Appendix 7: Calculation of re-exported domestic value added

The starting point for the calculation of the re-exported domestic value added (*DVAre*) is the decomposition of gross exports following the approach in Wang et al. (2013). The DVAre measure is a sub-component of the better-known value added exports (VAX) plus the domestic value added exported but returning home which is not part of VAX. The components which define DVAre are all contained in the key equation (equation (37) on p. 30) in Wang et al. (2013). These elements are characterised by the fact that the value added crosses borders at least twice. They comprise:

(a) The intermediate exports of reporting economy *r* to a partner country which are ultimately shipped to the destination country in the form of final goods.

(b) The intermediate exports of reporting economy *r* to a partner country which are ultimately shipped to the destination country in the form of intermediate goods.

(c) The intermediate exports of reporting economy *r* to a partner country which are consequently re-imported by country *r* in the form of either final goods or intermediate goods.

Note that all these export flows are exports of intermediates in the first export, while the ultimate export may take the form of a final goods or an intermediate goods export.

While not done explicitly in Wang et al. (2013), the decomposition allows for the identification of four 'roles' that a country can take in trade flows that form part of DVAre. These roles are:

(i) *reporting economy, **r,** which is the source country of the value added exported*

(ii) *immediate production partner, **ipp**, which is the recipient country of the first export by the source country r. The immediate production partner necessarily ships the value added (originating from country r) to another country.*

(iii) *ultimate production partner, **upp**, which is the last country in the production chain, responsible for the last production step and sale. This last sale can be an export or a domestic sale.*

(iv) *destination country, **dest**, which is the country of final demand, i.e. the country of absorption.*

In this categorisation the first three roles are all 'producers' because they are involved in the production process. In contrast, the role 'destination' is not part of the producers since it is the country of absorption. Certainly, for a particular trade flow, a particular country can take several roles. A simple example is a re-import, in which case the reporting country is identical to the country of absorption.

In technical terms, there are three terms of interest in the decomposition by Wang et al. (2013). In all these terms the notation is slightly adjusted to fit the description of the roles above. In particular, the index r denotes the reporting country and so on. So for any export flow ϕ, the indication $\phi^{r,ipp}$ means an export from the reporting country to the immediate production partner. Wang et al. (2013) indicate their decomposition at the bilateral level between reporting economy *r* and the immediate production partner, *ipp*:

(a) *Exports of intermediates with the ultimate export being an intermediate goods export, which are labelled* $DVAreex_{inter}^{r,ipp}$

$$DVAreex_{inter}^{r,ipp} = (V^r L^{rr})^T \ \# \ (A^{r,ipp} \sum_{upp \neq r,ipp}^{C} L^{ipp,upp} \cdot F^{upp,upp})$$

where '#' denotes an elementwise multiplication, V^r is the value added coefficient and L^{rr} the domestic Leontief inverse. Furthermore, $A^{r,ipp}$ is the sub-matrix of the global direct input coefficient matrix containing the elements representing inter-industry sales from reporting economy *r* to the immediate production partner, *ipp*. $L^{ipp,upp}$ is the global Leontief matrix with the elements representing direct and indirect inter-industry sales from the immediate production partner to the ultimate production partner, *upp*. Finally, is $F^{upp,upp}$ is the final demand involving purchases by the ultimate production partner – which here is equal to the country of destination so that $F^{upp,upp} = F^{dest,dest}$ – from itself. Hence, in this case the final sale is a domestic transaction and not an export. In other words, the country where the last production step is undertaken and the country of absorption are identical.

(b) *Exports of intermediates with the ultimate export being a final goods export, which are labelled $DVAreex^{r,ipp}_{final}$*

There are two types of re-exports of intermediates. In the first cases the immediate production partner, *ipp*, sells on the final good directly to the destination country, *dest*:

$$DVAreex^{r,ipp}_{final(1)} = (V^r L^{rr})^T \# (A^{r,ipp} \cdot L^{ipp,ipp} \sum_{dest \neq r,ipp}^{C} F^{ipp,dest})$$

In the second case the immediate production partner, *ipp*, sells on an intermediate good to another production partner, *upp*, which ultimately sells the final good to the destination country, *dest:*

$$DVAreex^{r,ipp}_{final(2)} = (V^r L^{rr})^T \# (A^{r,ipp} \sum_{upp \neq r,ipp}^{C} L^{ipp,upp} \sum_{dest \neq r,upp}^{C} F^{upp,dest})$$

In this second case, there are (at least)[42] three border crossings.

(c) *Exports of intermediates which return home to the reporting economy*

$$DVAreimp^{r,ipp}_{total} = (V^r L^{rr})^T \#(A^{r,ipp} \cdot L^{ipp,ipp} \cdot F^{ipp,r} + A^{r,ipp} \sum_{upp \neq r,ipp}^{C} L^{ipp,upp} \cdot F^{upp,r} + A^{r,ipp} \cdot L^{ipp,r} \cdot F^{r,r})$$

Note that within the re-imports there are actually also these three sub-types of imports, i.e. the value added that returns home to the reporting economy directly in the form of final goods, value added that returns home to the reporting economy via a first (*ipp*) and a second production partner (*upp*), and value added that is re-imported in the form of intermediate goods.

In contrast to the focus in Wang et al. (2013) on the bilateral flows between the reporting country and the immediate production partner, the approach in Chapter 4 of this report requires all 'roles' described above. Also, with regards to bilateral exports, the view is that the main interest should be with flows between the reporting economy and the destination

[42] There are 'at least' three border crossings as potentially there may be additional countries that the value added passes on its way from the reporting economy to the destination country. This may happen 'within' the $B^{ipp,upp}$ shipment which cannot be further tracked with this approach.

country, i.e. $\phi^{r,dest}$ as usual in trade analysis even if this flow is indirect via other countries. Hence, the geographic split of exports will be according to destination countries. The information on the immediate and the ultimate production partner will be used to identify the regional versus global VC trade. Hence, in essence the same bilateral *DVAre* flows are used but they are aggregated differently.

The way the calculations are performed ensures that the *DVAre* originating from all source countries is covered and that all 'roles' remain identifiable. This poses some problems of dimensionality so that the usual matrix algebra used to calculate, for example, VAX needs to be adjusted.

The general approach is to calculate all possible combinations of trade flows between the quadruples (*r-ipp-upp-dest*) using matrix algebra and then single out the combinations necessary to single out the three types of *DVAre*.

Hence the matrix calculations will yield a 'magnified' DVAre measure, $\widehat{\boldsymbol{DVAre}}$, which contains all possible combinations of quadruples, some of which need to be dropped later on because they actually do not form part of *DVAre*.

The general approach to calculate these 'magnified DVAre', $\widehat{DVAre}$, is the following:

$$\widehat{\boldsymbol{DVAre}} = \boldsymbol{v^r} \cdot \boldsymbol{L^{rr}} \# (\boldsymbol{A^r} \cdot \boldsymbol{B} \cdot \boldsymbol{F^{dest}})$$

where '#' denotes again an elementwise multiplication. $\boldsymbol{L^{rr}}$ is the (blockdiagonal) domestic Leontief inverse. Post-multiplication of the value added coefficient matrix $\boldsymbol{v^r}$ with the domestic Leontief inverse ensures that only value added embodied in intermediate exports is considered. The result of $v^r \cdot \boldsymbol{L^{rr}}$ constitutes the first part in the calculation of *DVAre*.

The second part of the calculation entails the sub-matrix of the global direct input coefficient matrix ($\boldsymbol{A^r}$) for the reporter *r*, the global Leontief inverse, $\boldsymbol{B}$, and the final demand coming from each of the potential destination countries, represented by the final demand matrix $\boldsymbol{Y^{dest}}$. In the $A^{r,}$ matrix, the reporting country *r* is selling to the immediate production partner (*ipp*). In the case of the Leontief inverse the ultimate production partner (upp) is selling to the final destination country (*dest*). Y^{dest} is the (destination-specific) final demand matrix, which is also a block-diagonal matrix.

As for the first part of the calculation, $\boldsymbol{v^r} \cdot \boldsymbol{L^{rr}}$, the actual calculation is performed using the value added coefficient matrices with the full country industry dimension (*C* x *I*) and containing the value added coefficient of all reporters (i.e. no values are set to zero). Because of the issue of dimensionality, the value added coefficient matrix for each reporting economy *r* is transformed into a row vector. These country-specific row vectors are combined to yield – for the 3-country-2-sector case, assuming a manufacturing sector (*m*) and a services sector (*s*) – a value added coefficient matrix of the form

$$\begin{pmatrix} v_m^r & v_s^r & 0 & 0 & 0 & 0 \\ 0 & 0 & v_m^2 & v_s^2 & 0 & 0 \\ 0 & 0 & 0 & 0 & v_m^3 & v_s^3 \end{pmatrix}$$

Also, the domestic Leontief inverses are inserted as the diagonal blocks into a diagonal matrix of dimension C x *I* to yield the $\boldsymbol{L^{rr}}$ matrix. This matrix has the following form:

$$\begin{pmatrix} l_{m,m}^{r,r} & l_{m,s}^{r,r} & 0 & 0 & 0 & 0 \\ l_{s,m}^{r,r} & l_{s,s}^{r,r} & 0 & 0 & 0 & 0 \\ 0 & 0 & l_{m,m}^{2,2} & l_{m,s}^{2,2} & 0 & 0 \\ 0 & 0 & l_{s,m}^{2,2} & l_{s,s}^{2,2} & 0 & 0 \\ 0 & 0 & 0 & 0 & l_{m,m}^{3,3} & l_{m,s}^{3,3} \\ 0 & 0 & 0 & 0 & l_{s,m}^{3,3} & l_{s,s}^{r,3} \end{pmatrix}$$

The above-described value added coefficient matrix $\boldsymbol{v_i^r}$ is multiplied with the block-diagonal domestic Leontief inverse.

$$[\boldsymbol{v_i} \ \cdot \boldsymbol{L^{rr}}]$$

In the 3-country-2-sector example the following result is obtained:

$$\boldsymbol{vL^{rr}} = \begin{pmatrix} v_m^r & v_s^r & 0 & 0 & 0 & 0 \\ 0 & 0 & v_m^2 & v_s^2 & 0 & 0 \\ 0 & 0 & 0 & 0 & v_m^3 & v_s^3 \end{pmatrix} \cdot \begin{pmatrix} l_{m,m}^{r,r} & l_{m,s}^{r,r} & 0 & 0 & 0 & 0 \\ l_{s,m}^{r,r} & l_{s,s}^{r,r} & 0 & 0 & 0 & 0 \\ 0 & 0 & l_{m,m}^{2,2} & l_{m,s}^{2,2} & 0 & 0 \\ 0 & 0 & l_{s,m}^{2,2} & l_{s,s}^{2,2} & 0 & 0 \\ 0 & 0 & 0 & 0 & l_{m,m}^{3,3} & l_{m,s}^{3,3} \\ 0 & 0 & 0 & 0 & l_{s,m}^{3,3} & l_{s,s}^{r,3} \end{pmatrix}$$

$$= \begin{pmatrix} v_m^r\, l_{m,m}^{r,r} + v_s^r\, l_{s,m}^{r,r} & v_m^r\, l_{m,s}^{r,r} + v_s^r\, l_{s,s}^{r,r} & 0 & 0 & 0 & 0 \\ 0 & 0 & v_m^2\, l_{m,m}^{2,2} + v_s^2\, l_{s,m}^{2,2} & v_m^2\, l_{m,s}^{2,2} + v_s^2\, l_{s,s}^{2,2} & 0 & 0 \\ 0 & 0 & 0 & 0 & v_m^3\, l_{m,m}^{3,3} + v_s^3\, l_{s,m}^{3,3} & v_m^3\, l_{m,s}^{3,3} + v_s^3 l_{s,s}^{3,3} \end{pmatrix}$$

The resulting matrix, $\boldsymbol{L^{rr}}$, is transposed blockwise and post-multiplied with a *C I x1* vector of ones to yield a *1 x C I* column vector of the form.

$$vL^{rr} = \begin{pmatrix} v_m^r\, l_{m,m}^{r,r} + v_s^r\, l_{s,m}^{r,r} \\ v_m^r\, l_{m,s}^{r,r} + v_s^r\, l_{s,s}^{r,r} \\ v_m^2\, l_{m,m}^{2,2} + v_s^2\, l_{s,m}^{2,2} \\ v_m^2\, l_{m,s}^{2,2} + v_s^2\, l_{s,s}^{2,2} \\ v_m^3\, l_{m,m}^{3,3} + v_s^3\, l_{s,m}^{3,3} \\ v_m^3\, l_{m,s}^{3,3} + v_s^3\, l_{s,s}^{3,3} \end{pmatrix}$$

The column vector v^{rr} is the first part of the operation.

The second part requires the matrix multiplication of $\boldsymbol{A^r}$ with the global Leontief inverse $\boldsymbol{L}$ and then with the appropriate (reporter-specific) block-diagonal final demand matrix,· $\boldsymbol{F^{dest}}$.

Using the roles as defined above for each reporting economy *r*, the reporting-country-specific rows of the direct input coefficient A are used to define $\boldsymbol{A^r}$ which has dimension *C·I x C·I*. In the 3-country-2-sector case this matrix has the form

$$\boldsymbol{A^r} = \begin{pmatrix} a_{m,m}^{r,r} & a_{m,s}^{r,r} & a_{m,m}^{r,2} & a_{m,s}^{r,2} & a_{m,m}^{r,3} & a_{m,s}^{r,3} \\ a_{s,m}^{r,r} & a_{s,s}^{r,r} & a_{s,m}^{r,2} & a_{s,s}^{r,2} & a_{s,m}^{r,3} & a_{s,s}^{r,3} \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix}$$

The blockwise diagonalisation of this $\boldsymbol{A^r}$ matrix yields

$$\boldsymbol{diag}(\boldsymbol{A^r}) = \begin{pmatrix} a^{r,r}_{m,m} & a^{r,r}_{m,s} & 0 & 0 & 0 & 0 \\ a^{r,r}_{s,m} & a^{r,r}_{s,s} & 0 & 0 & 0 & 0 \\ 0 & 0 & a^{r,2}_{m,m} & a^{r,2}_{m,s} & 0 & 0 \\ 0 & 0 & a^{r,2}_{s,m} & a^{r,2}_{s,s} & 0 & 0 \\ 0 & 0 & 0 & 0 & a^{r,3}_{m,m} & a^{r,3}_{m,s} \\ 0 & 0 & 0 & 0 & a^{r,3}_{s,m} & a^{r,3}_{s,s} \end{pmatrix}$$

This matrix is post-multiplied with the global Leontief matrix L to yield:

$$diag(\ \boldsymbol{A^r}\ ) \cdot \boldsymbol{L}\ \ )$$

The details of these matrices are as follows:

$$diag(A^r) \times L = \begin{pmatrix} a^{r,r}_{m,m} & a^{r,r}_{m,s} & 0 & 0 & 0 & 0 \\ a^{r,r}_{s,m} & a^{r,r}_{s,s} & 0 & 0 & 0 & 0 \\ 0 & 0 & a^{r,2}_{m,m} & a^{r,2}_{m,s} & 0 & 0 \\ 0 & 0 & a^{r,2}_{s,m} & a^{r,2}_{s,s} & 0 & 0 \\ 0 & 0 & 0 & 0 & a^{r,3}_{m,m} & a^{r,3}_{m,s} \\ 0 & 0 & 0 & 0 & a^{r,3}_{s,m} & a^{r,3}_{s,s} \end{pmatrix} \begin{pmatrix} l^{r,r}_{m,m} & l^{r,r}_{m,s} & l^{r,2}_{m,m} & l^{r,2}_{m,s} & l^{r,3}_{m,m} & l^{r,3}_{m,s} \\ l^{r,r}_{s,m} & l^{r,r}_{s,s} & l^{r,2}_{s,m} & l^{r,2}_{s,s} & l^{r,3}_{s,m} & l^{r,3}_{s,s} \\ l^{2,r}_{m,m} & l^{2,r}_{m,s} & l^{2,2}_{m,m} & l^{2,2}_{m,s} & l^{2,3}_{m,m} & l^{2,3}_{m,s} \\ l^{2,r}_{s,m} & l^{2,r}_{s,s} & l^{2,2}_{s,m} & l^{2,2}_{s,s} & l^{2,3}_{s,m} & l^{2,3}_{s,s} \\ l^{3,r}_{m,m} & l^{3,r}_{m,s} & l^{3,2}_{m,m} & l^{3,2}_{m,s} & l^{3,3}_{m,m} & l^{3,3}_{m,s} \\ l^{3,r}_{s,m} & l^{3,r}_{s,s} & l^{3,2}_{s,m} & l^{3,2}_{s,s} & l^{3,3}_{s,m} & l^{3,3}_{s,s} \end{pmatrix}$$

$$= \begin{pmatrix} a^{r,r}_{m,m} \cdot l^{r,r}_{m,m} + a^{r,r}_{m,s} \cdot l^{r,r}_{s,m} & a^{r,r}_{m,m} \cdot l^{r,r}_{m,s} + a^{r,r}_{m,s} \cdot l^{r,r}_{s,s} & a^{r,r}_{m,m} \cdot l^{r,2}_{m,m} + a^{r,r}_{m,s} \cdot l^{r,2}_{s,m} & a^{r,r}_{m,m} \cdot l^{r,2}_{m,s} + a^{r,r}_{m,s} \cdot l^{r,2}_{s,s} & a^{r,r}_{m,m} \cdot l^{r,3}_{m,m} + a^{r,r}_{m,s} \cdot l^{r,3}_{s,m} & a^{r,r}_{m,m} \cdot l^{r,3}_{m,s} + a^{r,r}_{m,s} \cdot l^{r,3}_{s,s} \\ a^{r,r}_{s,m} \cdot l^{r,r}_{m,m} + a^{r,r}_{s,s} \cdot l^{r,r}_{s,m} & a^{r,r}_{s,m} \cdot l^{r,r}_{m,s} + a^{r,r}_{s,s} \cdot l^{r,r}_{s,s} & a^{r,r}_{s,m} \cdot l^{r,2}_{m,m} + a^{r,r}_{s,s} \cdot l^{r,2}_{s,m} & a^{r,r}_{s,m} \cdot l^{r,2}_{m,s} + a^{r,r}_{s,s} \cdot l^{r,2}_{s,s} & a^{r,r}_{s,m} \cdot l^{r,3}_{m,m} + a^{r,r}_{s,s} \cdot l^{r,3}_{s,m} & a^{r,r}_{s,m} \cdot l^{r,3}_{m,s} + a^{r,r}_{s,s} \cdot l^{r,3}_{s,s} \\ a^{r,2}_{m,m} \cdot l^{2,r}_{m,m} + a^{r,2}_{m,s} \cdot l^{2,r}_{s,m} & a^{r,2}_{m,m} \cdot l^{r,r}_{m,s} + a^{r,2}_{m,s} \cdot l^{r,r}_{s,s} & a^{r,2}_{m,m} \cdot l^{2,2}_{m,m} + a^{r,2}_{m,s} \cdot l^{2,2}_{s,m} & a^{r,2}_{m,m} \cdot l^{r,r}_{m,s} + a^{r,2}_{m,s} \cdot l^{2,2}_{s,s} & a^{r,2}_{m,m} \cdot l^{2,3}_{m,m} + a^{r,2}_{m,s} \cdot l^{2,3}_{s,m} & a^{r,2}_{m,m} \cdot l^{2,3}_{m,s} + a^{r,2}_{m,s} \cdot l^{r2,3}_{s,s} \\ a^{r,2}_{s,m} \cdot l^{2,r}_{m,m} + a^{r,2}_{s,s} \cdot l^{2,r}_{s,m} & a^{r,2}_{s,m} \cdot l^{r,r}_{m,s} + a^{r,2}_{s,s} \cdot l^{r,r}_{s,s} & a^{r,2}_{s,m} \cdot l^{2,2}_{m,m} + a^{r,2}_{s,s} \cdot l^{2,2}_{s,m} & a^{r,2}_{s,m} \cdot l^{r,r}_{m,s} + a^{r,2}_{s,s} \cdot l^{2,2}_{s,s} & a^{r,2}_{s,m} \cdot l^{2,3}_{m,m} + a^{r,2}_{s,s} \cdot l^{2,3}_{s,m} & a^{r,2}_{s,m} \cdot l^{2,3}_{m,s} + a^{r,2}_{s,s} \cdot l^{2,3}_{s,s} \\ a^{r,3}_{m,m} \cdot l^{3,r}_{m,m} + a^{r,3}_{m,s} \cdot l^{3,r}_{s,m} & a^{r,3}_{m,m} \cdot l^{3,r}_{m,s} + a^{r,3}_{m,s} \cdot l^{3,r}_{s,s} & a^{r,3}_{m,m} \cdot l^{3,2}_{m,m} + a^{r,3}_{m,s} \cdot l^{3,2}_{s,m} & a^{r,3}_{m,m} \cdot l^{3,2}_{m,s} + a^{r,3}_{m,s} \cdot l^{3,2}_{s,s} & a^{r,3}_{m,m} \cdot l^{3,3}_{m,m} + a^{r,3}_{m,s} \cdot l^{r3,3}_{s,m} & a^{r,3}_{m,m} \cdot l^{3,3}_{m,s} + a^{r,3}_{m,s} \cdot l^{3,3}_{s,s} \\ a^{r,3}_{s,m} \cdot l^{3,r}_{m,m} + a^{r,3}_{s,s} \cdot l^{3,r}_{s,m} & a^{r,3}_{s,m} \cdot l^{3,r}_{m,s} + a^{r,3}_{s,s} \cdot l^{3,r}_{s,s} & a^{r,3}_{s,m} \cdot l^{3,2}_{m,m} + a^{r,3}_{s,s} \cdot l^{3,2}_{s,m} & a^{r,3}_{s,m} \cdot l^{3,2}_{m,s} + a^{r,3}_{s,s} \cdot l^{3,2}_{s,s} & a^{r,3}_{s,m} \cdot l^{3,3}_{m,m} + a^{r,3}_{s,s} \cdot l^{3,3}_{s,m} & a^{r,3}_{s,m} \cdot l^{3,3}_{m,s} + a^{r,3}_{s,s} \cdot l^{3,3}_{s,s} \end{pmatrix}$$

Define this matrix as AL^r

$$\boldsymbol{AL^r} = \begin{pmatrix} AL^{r,r}_{m,m} & AL^{r,r}_{m,s} & AL^{r,2}_{m,m} & AL^{r,2}_{m,s} & AL^{r,3}_{m,m} & AL^{r,3}_{m,s} \\ AL^{r,r}_{s,m} & AL^{r,r}_{s,s} & AL^{r,2}_{s,m} & AL^{r,2}_{s,s} & AL^{r,3}_{s,m} & AL^{r,3}_{s,s} \\ AL^{2,r}_{m,m} & AL^{2,r}_{m,s} & AL^{2,2}_{m,m} & AL^{2,2}_{m,s} & AL^{2,3}_{m,m} & AL^{2,3}_{m,s} \\ AL^{2,r}_{s,m} & AL^{2,r}_{s,s} & AL^{2,2}_{s,m} & AL^{2,2}_{s,s} & AL^{2,3}_{s,m} & AL^{2,3}_{s,s} \\ AL^{3,r}_{m,m} & AL^{3,r}_{m,s} & AL^{3,2}_{m,m} & AL^{3,2}_{m,s} & AL^{3,3}_{m,m} & AL^{3,3}_{m,s} \\ AL^{3,r}_{s,m} & AL^{3,r}_{s,s} & AL^{3,2}_{s,m} & AL^{3,2}_{s,s} & AL^{3,3}_{s,m} & AL^{3,3}_{s,s} \end{pmatrix}$$

This is a *CI* x *CI* matrix, of which there are *C* such matrices, one for each reporter. Note that in this matrix the indices of the elements are to be interpreted as follows: first index indicates the immediate production partner (*ipp*) and the index indicates the last country in the value chain, i.e. the ultimate production partner (*upp*).

In the next step this AL^r matrix is post-multiplied with the global final demand matrix for each of the countries.

The (industry-specific) global final demand vector f has the dimension $C{\cdot}I \times 1$. In the 3-country-2-sector case, it takes the form:

$$f = \begin{pmatrix} f^{r,r}_m + f^{r,2}_m + f^{r,3}_m \\ f^{r,r}_s + f^{r,2}_s + f^{r,3}_s \\ f^{2,r}_m + f^{2,2}_m + f^{2,3}_m \\ f^{2,r}_s + f^{2,2}_s + f^{2,3}_s \\ f^{3,r}_m + f^{3,2}_m + f^{3,3}_m \\ f^{3,r}_s + f^{3,2}_s + f^{3,3}_s \end{pmatrix}$$

This final demand is split into separate blocks indicating the origin of the demand for the final goods. From the WIOD data the information in this vector can also be used to form a *CI* x *CI* final demand matrix, F. For the 3-country-2-sector case:

$$\boldsymbol{F} = \begin{pmatrix} f_m^{r,r} & f_m^{r,2} & f_m^{r,3} \\ f_s^{r,r} & f_s^{r,2} & f_s^{r,3} \\ f_m^{2,r} & f_m^{2,2} & f_m^{2,3} \\ f_s^{2,r} & f_s^{2,2} & f_s^{2,3} \\ f_m^{3,r} & f_m^{3,2} & f_m^{3,3} \\ f_s^{3,r} & f_s^{3,2} & f_s^{3,3} \end{pmatrix}$$

As usual, each row is associated with the source of the production that is the subject of the final demand. For example, the element $f_s^{r,3}$ captures the value of final goods that country 3 demands from the services sector in country *r*.

This matrix is now split into column vectors for each individual country, f^r. This vector indicates the value added from all sources needed to satisfy final demand of a destination country *dest* and has dimension *CI* x *1*:

$$f^{dest} = \begin{pmatrix} f_m^{r,dest} \\ f_s^{r,dest} \\ f_m^{2,dest} \\ f_s^{2,dest} \\ f_m^{3,dest} \\ f_s^{3,dest} \end{pmatrix}$$

Each of the destination-specific column vectors (there are *C* such vectors) are diagonalised and pre-multiplied with each of the AL^r matrices calculated above. Note that there is not only F but there are C such f^{dest} diagonal matrices. In this context f^{dest} is used to avoid confusion with country *r* as the source of the value added (although they can be identical, i.e. in the case of re-imports).

$$\boldsymbol{ALf^{r \to dest}} = \boldsymbol{AL^r} \cdot f^{dest}$$

This operation is done not only for the *AL* matrix of country *r* but for all of the *C* countries. The arrow in the superscript of the $\boldsymbol{ALf^{r \to dest}}$ matrix should indicate that the value added will travel from *r* to *dest* via other countries.

For country *r*, and defining country 3 as the destination country (*dest*), the 3-country-2-sector case can be written as follows:

$$AL^r f^{dest}$$
$$= \begin{pmatrix} AL_{m,m}^{r,r} & AL_{m,s}^{r,r} & AL_{m,m}^{r,2} & AL_{m,s}^{r,2} & AL_{m,m}^{r,dest} & AL_{m,s}^{r,dest} \\ AL_{s,m}^{r,r} & AL_{s,s}^{r,r} & AL_{s,m}^{r,2} & AL_{s,s}^{r,2} & AL_{s,m}^{r,dest} & AL_{s,s}^{r,dest} \\ AL_{m,m}^{2,r} & AL_{m,s}^{2,r} & AL_{m,m}^{2,2} & AL_{m,s}^{2,2} & AL_{m,m}^{2,dest} & AL_{m,s}^{2,dest} \\ AL_{s,m}^{2,r} & AL_{s,s}^{2,r} & AL_{s,m}^{2,2} & AL_{s,s}^{2,2} & AL_{s,m}^{2,dest} & AL_{s,s}^{2,dest} \\ AL_{m,m}^{dest,r} & AL_{m,s}^{dest,r} & AL_{m,m}^{dest,2} & AL_{m,s}^{dest,2} & AL_{m,m}^{dest,dest} & AL_{m,s}^{dest,dest} \\ AL_{s,m}^{dest,r} & AL_{s,s}^{dest,r} & AL_{s,m}^{dest,2} & AL_{s,s}^{dest,2} & AL_{s,m}^{dest,3} & AL_{s,s}^{dest,dest} \end{pmatrix} \cdot \begin{pmatrix} f_m^{r,dest} & 0 & 0 & 0 & 0 & 0 \\ 0 & f_s^{r,dest} & 0 & 0 & 0 & 0 \\ 0 & 0 & f_m^{2,dest} & 0 & 0 & 0 \\ 0 & 0 & 0 & f_s^{2,dest} & 0 & 0 \\ 0 & 0 & 0 & 0 & f_m^{dest,dest} & 0 \\ 0 & 0 & 0 & 0 & 0 & f_s^{dest,dest} \end{pmatrix}$$
$$= \begin{pmatrix} AL_{m,m}^{r,r} \cdot f_m^{r,dest} & AL_{m,s}^{r,r} \cdot f_s^{r,dest} & AL_{m,m}^{r,2} \cdot f_m^{2,dest} & AL_{m,s}^{r,2} \cdot f_s^{2,dest} & AL_{m,m}^{r,dest} \cdot f_m^{dest,dest} & AL_{m,s}^{r,dest} \cdot f_s^{dest,dest} \\ AL_{s,m}^{r,r} \cdot f_m^{r,dest} & AL_{s,s}^{r,r} \cdot f_s^{r,dest} & AL_{s,m}^{r,2} \cdot f_m^{2,dest} & AL_{s,s}^{r,2} \cdot f_m^{2,dest} & AL_{s,m}^{r,dest} \cdot f_m^{dest,dest} & AL_{s,s}^{r,dest} \cdot f_m^{dest,dest} \\ AL_{m,m}^{2,r} \cdot f_m^{r,dest} & AL_{m,s}^{2,r} \cdot f_s^{r,dest} & AL_{m,m}^{2,2} \cdot f_m^{2,dest} & AL_{m,s}^{2,2} \cdot f_m^{2,dest} & AL_{m,m}^{2,dest} \cdot f_m^{dest,dest} & AL_{m,s}^{2,dest} \cdot f_m^{dest,dest} \\ AL_{s,m}^{2,r} \cdot f_m^{r,dest} & AL_{s,s}^{2,r} \cdot f_s^{r,dest} & AL_{s,m}^{2,2} \cdot f_m^{2,dest} & AL_{s,s}^{2,2} \cdot f_m^{2,dest} & AL_{s,m}^{2,dest} \cdot f_m^{dest,dest} & AL_{s,s}^{2,dest} \cdot f_m^{dest,dest} \\ AL_{m,m}^{dest,r} \cdot f_m^{r,dest} & AL_{m,s}^{dest,r} \cdot f_s^{r,dest} & AL_{m,m}^{dest,2} \cdot f_m^{2,dest} & AL_{m,s}^{dest,2} \cdot f_m^{2,dest} & AL_{m,m}^{dest,dest} \cdot f_m^{dest,dest} & AL_{m,s}^{dest,dest} \cdot f_m^{dest,dest} \\ AL_{s,m}^{dest,r} \cdot f_m^{r,dest} & AL_{s,s}^{dest,r} \cdot f_s^{r,dest} & AL_{s,m}^{dest,2} \cdot f_m^{2,dest} & AL_{s,s}^{dest,2} \cdot f_m^{2,dest} & AL_{s,m}^{dest,dest} \cdot f_m^{dest,dest} & AL_{s,s}^{dest,dest} \cdot f_m^{dest,dest} \end{pmatrix}$$

There are C x C such matrixes for each reporter-destination combinations. The 'route' along which the value added travelled from the reporter to the destination can be read directly from the indices of the global Leontief matrix. Therefore, from this $AL^r f^{dest}$ matrix all three relevant items for the calculation of the *DVAre* can be identified. In the above example, all elements in the matrix have country *r* as reporter and country *dest* as the destination country. The element $AL^{2,dest}_{s,s} \cdot f^{dest,dest}_m$ then is value added originating from country *r* that is exported in the form of intermediates to country 2, which takes the role of the immediate production partner. Country 2 is processing and re-exporting the value added in the form of intermediates to the final destination country in the form of intermediates. The destination country (dest) is responsible for the final production step, so it also has the role of the ultimate production partner.

The final step is to multiply elementwise the first part, $\boldsymbol{vL^{rr}}$, with the second part:

$$\boldsymbol{vL^{rr}}\#\boldsymbol{AL^r} \cdot f^{dest}$$

This yields the magnified *DVAre*. To obtain the *DVAre* as defined above the required elements of the universe of combinations $\boldsymbol{vL^{rr}}\#\boldsymbol{AL^r} \cdot f^{dest}$ need to be singled out. More precisely, the components of *DVAre* defined above are obtained as follows

(a) *Exports of intermediates with the ultimate export being an intermediate goods export, which are labelled* $DVAreex^{r,ipp}_{inter}$

Contains all elements where $r \neq ipp \cap r \neq dest \cap [ipp \neq upp \cap upp = dest]$.

(b) *Exports of intermediates with the ultimate export being a final goods export (*$DVAreex^{r,ipp}_{final}$*)*

$DVAreex^{r,ipp}_{final(1)}$

Contains all elements where $r \neq ipp \cap r \neq dest \cap [ipp = upp \cap upp \neq dest]$.

$DVAreex^{r,ipp}_{final(2)}$

Contains all elements where $r \neq ipp \cap r \neq dest \cap [ipp \neq upp \cap upp \neq dest]$.

(c) *Exports of intermediates which return home to the reporting economy (*$DVAreimp^{r,ipp}_{total}$*)*

Contains all elements where $r = dest \cap r \neq ipp$.

5. Intra-EU Production and Trade Linkages: Firm-level Analysis

5.1. Introduction

Over the past two decades there has been an increased fragmentation and integration of production and innovation within and across national borders, driven by technological change and trade liberalisation (Antràs and Chor 2013; Siedschlag and Murphy 2015). Furthermore, over the same period, there has been an increased integration of services and manufacturing activities via vertical integration and outsourcing (Pilat and Wölfl 2005; Francois and Wörz 2008). It has been theoretically and empirically established that trade and FDI patterns are jointly determined with organisational structures such as sourcing and integration strategies. Recent reviews of this evidence include Helpman (2006), and Antràs and Chor (2013). There is also growing evidence showing that international production and innovation networks have heightened the transmission of macroeconomic shocks across countries (Kohler 2004; Costinot, Vogel and Wang 2013).

Recent evidence on the Single Market integration and competitiveness in the EU and its Member States (European Commission 2015) indicates that reforms at both the EU and Member State levels could improve productivity and competitiveness. Specifically, it is highlighted that removing regulatory barriers to competitiveness and integration would allow a more efficient allocation of resources across firms and sectors in the Single Market. In this context, one of the identified sources of productivity growth is the geographic reallocation of resources within the Single Market and the more efficient integration of EU firms in international value chains. This reallocation of resources would also lead to a better exploitation of backward and forward linkages in global value chains by strengthening the integration of business services in key manufacturing sectors.

In this context, understanding what determines intra-EU production and trade linkages at firm level across EU countries is key to designing policies aimed at competitiveness and growth at the firm, country and European levels. This chapter examines the sourcing strategies of firms established in the EU and identifies institutional and regulatory factors that could foster further integration across EU countries, particularly with respect to the integration of services inputs by manufacturing firms.

The remainder of this chapter is structured as follows. Section 5.2 reviews the theoretical and empirical evidence and provides a conceptual framework for the analysis. Section 5.3 describes the data and empirical methodology used. Next, Section 5.4 compares productivity differentials linked to the integration of manufacturing and services inputs across EU countries. Section 5.5 discusses the results of the empirical analysis of determinants of intra-EU production and trade linkages. A special focus of the analysis is on institutional and regulatory factors in the EU countries which are relevant in the context of strengthening the Single Market. On the basis of the results of the empirical analysis, Section 5.7 examines the performance of EU countries with respect to the identified indicators on the quality of institutions and regulations. Finally, Section 5.7 summarizes the key findings of the empirical analysis and on that basis discusses policy implications for strengthening the Single Market.

5.2. Theoretical and Empirical Background

Within-industry firm heterogeneity is at the centre of the most recent theoretical models explaining the increased fragmentation and integration of production and innovation and linkages between manufacturing and services (Grossman and Helpman 2002; Antràs 2003; Antràs and Helpman 2004, 2008). However, most existing empirical evidence related to intra-EU linkages is based on the analysis of industry and country data (see e.g. Stehrer et al. 2012; Foster-McGregor et al. 2013; Stöllinger et al. 2015; Leitner and Stehrer, 2014). To uncover the extent and intensity of intra-EU linkages, cross-country analysis using comparable firm-level datasets is needed.

This section provides an overview of the relevant theoretical and empirical literature on firms' sourcing and integration strategies, with the aim to guide the proposed empirical analysis on determinants of intra-EU production and trade linkages across Member States. The key features of this literature are an incomplete-contracting environment and firm heterogeneity with respect to productivity. These features are crucial in shaping firms' internationalisation and organizational choices.

Grossman and Helpman (2002) were among the pioneers of this new strand of the international trade literature. They examine the firms' choice between outsourcing and vertical integration. In determining their organisational mode, firms that are assumed to be equally productive are faced with the trade-off between the costs of running a large and less specialised organisation versus the search and monitoring costs of an input supplier. The authors show that outsourcing is likely to be more prevalent in some industries than in others. Outsourcing is more likely to be viable in large firms and in large economies. Also, in competitive markets outsourcing requires a high per unit cost advantage for specialised input producers relative to integrated firms, while in markets with less competition, outsourcing depends on the comparison of the fixed costs between specialised producers and integrated firms.

Following on the questions raised by Grossman and Helpman (2002), Antràs (2003) focused on incomplete contracts to explain why some firms source inputs abroad within their boundary via foreign direct investment (FDI), while others source them at arm's length, via outsourcing. Combined with productivity differences across firms within industries, this approach predicts the relative prevalence of alternative forms of the international organization of production as a function of sectoral characteristics and differences in features of the trading partners. Further, Antràs and Helpman (2004) theoretically formalise the decision of firms to engage in international markets either through foreign outsourcing or FDI. Their model predicts that in a vertically integrated industry, the most productive firms source their intermediates from an owned affiliate while less productive firms outsource them from arm's length suppliers.

Helpman (2006) reviews the theoretical and empirical literature on international trade, FDI and organizational choices of firms. He highlights that productivity differences are linked to different choices for the organizational choices of production and distribution. In this context, international trade and FDI patterns are jointly determined with organizational structures such as sourcing and integration strategies. The theoretical models in international trade and investment focus on individual firms' choices of engagement in activities across national borders linked to firm and industry characteristics and the returns from foreign trade and investment. Organisational choices such as outsourcing and integration strategies are important in this context (Spencer 2005). Firms engaged in international activities such as exporting and FDI differ systematically from firms serving only home markets. Only a small fraction of firms export, and these are larger and more productive than non-exporters. Another established empirical fact is that a large number of firms export to larger markets (Eaton, Kortum and Kramarz 2004). A small fraction of firms engage in FDI, and these are larger and more productive than exporters. The distribution of firms by size and productivity varies across industries. The classification of FDI into horizontal and vertical has become meaningless as multinationals invest in low-cost countries to create export platforms from which they serve other countries across the world, and the large flows of FDI across developed countries cannot be classified as horizontal FDI. The evidence also indicates that multinational firms have more complex integration strategies than firms serving only the domestic market (Feinberg and Keane 2006; Yeaple 2003; Grossman, Helpman, and Szeidl 2005).

Antràs and Chor (2013) develop a property–rights-theoretical model of multinational firm boundary choices along the value chains. They show that the relative position (upstream or downstream) at which suppliers enter the production chain is a key determinant of the integration choice. Furthermore, the final-good producer's elasticity of demand is crucially important in shaping the nature of the relationship between integration and the degree of "downstreamness". The novelty of this model compared to previous property-rights models of multinational firm boundaries (Antràs 2003, 2005; Antràs and Helpman 2004) consists in the introduction of a natural (or technological) sequencing of production stages, which implies that production at a stage can start only after the delivery of inputs from all upstream stages. In an incomplete-contracting environment, property rights are a source of bargaining power and an incentive for firms' integration along the value chain. Antràs (2015) highlights that, while advances in ICT and falling trade barriers have fostered fragmenting production across firms and countries, contractual frictions remain a significant obstacle to the globalization of value chains due to a low level of enforcement of contract clauses and legal remedies.

Alfaro et al. (2016) build on and expand the model developed by Antràs and Chor (2013) and demonstrate that contractual frictions play an important role in shaping the integration choices of firms. By combining data on production activities of public and private firms operating in over 100 countries with information from Input-Output tables, they construct measures of firms' relative positions along the value chains, the "upstreamness/downstreamness" of integrated and non-integrated inputs. Using these novel measures, they find that a firm's propensity to integrate a given stage of the value chain is shaped by the relative contractibility of the stages located upstream versus downstream from that stage, as well as by the firm's productivity. Furthermore, this evidence highlights that organizational decisions have spillovers along the value chain, in that relationship-specific investments made by upstream suppliers affect the incentives of suppliers in downstream stages.

Existing empirical evidence suggests that firms with international activities tend to engage in multiple internationalisation modes (such as exporting, international outsourcing, foreign direct investment) to make the most of global opportunities in order to reduce costs, expand outputs, and maximize returns (Yeaple 2003; Grossman et al. 2005). The decision to engage in internationalisation activities and the optimal choice of outward international activities differs across heterogeneous firms and industries.

Helpman, Melitz and Yeaple (2004) demonstrate, theoretically, that when foreign direct investment is motivated by market access, the least productive firms exit, the next more productive firms serve only the home market, the next more productive firms enter foreign markets through exporting and the most productive firms become multinationals and enter foreign markets through foreign direct investment.

Empirical evidence for this sorting of firms into international activities is provided for Ireland by Girma, Görg, and Strobl (2004), and for the United Kingdom by Girma, Kneller and Pisu (2005). Using firm-level data from Japan, Head and Reis (2003) show that when firms invest abroad for efficiency-related reasons (factor prices), the least productive firms locate abroad in small countries, while the more productive produce locate at home. Using data for the US companies, Yeaple (2003) examined firms engaged simultaneously in vertical and horizontal FDI. Siedschlag and Murphy (2015) examined the extent and determinants of firms' engagement in outward international activities associated with European and global value chains. The empirical evidence indicates that, in the group of firms with outward international activities, a large number are only exporters, while a small number of firms only engage in international sourcing or only in foreign direct investment. Firms engaged simultaneously in more than one type of outward international activity are few. These firms are more mature, larger, more productive, and have higher product innovation rates than those engaged in single international activities.

Nunn and Trefler (2013) construct measures of industry characteristics from disaggregated US import data and find that an industry's skill, capital and R&D intensity predict intra-firm trade shares, as expected. Furthermore, they show that the type of capital intensity matters: industries with capital which is not firm-specific do not have high levels of intra-industry trade.

Industry R&D and capital intensity better explain the share of international trade conducted within multinationals rather than outsourcing (Bernard, Jensen, Redding and Schott 2012). Tomiura (2007) uses micro data from Japan and provides evidence on the role of productivity in conditioning the sorting of firms into exporting FDI and international activities. He finds that firms engaged in FDI are more productive than exporters and firms engaged in foreign outsourcing. Furthermore, he finds that firms engaged in international outsourcing are less capital-intensive than other firms with international activities.

In summary, the review of existing theoretical and empirical on global sourcing of production inputs provides useful insights and suggests the following predictions, which guide the empirical analysis in this chapter:

- Input sourcing choices are determined by characteristics of firms and industries as well as institutional and regulatory characteristics of home and host countries;
- More productive firms are more likely to source inputs via foreign direct investment rather than at arm's length;
- Contractual frictions increase the likelihood of input sourcing via foreign direct investment rather than at arms' length;
- Firms in industries which are more intensive in R&D and tangible capital are more likely to source inputs via foreign direct investment;
- Relationship-specific investments made by upstream suppliers affect the incentives of suppliers in downstream stages of the value chain.

This survey of existing literature also suggests questions to be examined in the empirical analysis:

- What is the extent and intensity of intra-EU production and trade linkages in the manufacturing and services sectors at the industry and firm levels?

- What firm, industry and country characteristics determine the patterns of intra-EU production and trade linkages? What role do regulatory barriers play in explaining these patterns?
- What determines the sourcing choices of manufacturing firms in the EU? What role do regulatory barriers play in firms' input sourcing strategies?

In particular, the evidence provided by this study contributes to better understanding determinants of firms' inputs sourcing strategies across EU countries and how these factors relate to the Single Market in goods and services. This new evidence improves the knowledge base for structural reforms at the EU and Member States level, aimed at removing regulatory barriers to competitiveness and integration as well as more efficient allocation of resources across firms and sectors in the Single Market of goods and services.

5.3. Data and Descriptive Analysis

For the purpose of this analysis, information on the ownership structure and company accounts from the *Orbis* data set is combined with input-output (I-O) data from the WIOT data set.[42]

Using the most recent information on ownership (information on company deals updated to April 2017) combined with company accounts from the *Orbis* data set (information on financial variables for 2014), parent companies established in the 28 EU countries are identified. Using the NACE codes for primary activities, 7,012 parent companies in manufacturing are identified, and 26,946 parent companies in services for which financial variables are available. Using the ownership structure of the identified parent companies allows uncovering their affiliates located in the 28 EU countries. The 7,012 parent manufacturing firms are linked to 19,997 affiliates of which 7,230 are in manufacturing, 10,777 in services and 1,990 in other sectors. Further, the 26,946 parent services firms are linked to 95,202 affiliates, of which 10,572 are manufacturing firms, 69,087 are services firms and 15,543 are firms in other sectors. Sectors other than manufacturing and services include: Agriculture, forestry, fishing; Mining and quarrying; Utilities; and Construction.

5.3.1 Firms' input sourcing choices: integration vs. outsourcing

For each parent company (global ultimate owner, *g*), integrated and outsourced inputs are identified following the methodology used by Alfaro et al. (2016)[43] by combining information on firms' ownership structure from the *Orbis* data set[44] with Input-Output (I-O) tables for the EU countries.

For each *g*, the primary NACE 2digit code as its output industry *j is* identified. Given that the WIOT data allow to identify input-output linkages across countries, for each output industry *j* in each home country *c* a set of production inputs $I_{j,c}^{i,h} = \{i : a_{ihjc} > 0\}$. a_{ihjc} is identified as the value of input *i* in host country *h* required to produce one unit (1€) of production in industry *j* in home country *c*. The world input – output tables include information on 56 industries in each of the 28 EU countries, which result in 1568 country-industry input-output linkages.

For each parent company *g*, integrated and outsourced inputs are identified as follows. The set of integrated inputs $I_{j,c}^{i,h}$ comprises the affiliates in country *h* whose primary (NACE 2digit)

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[42] See Timmer et al. (2015) for a description of the WIOT data set.

[43] Alfaro et al. (2016) draw on Fan and Lang (2000).

[44] The most recent data available in the *Orbis* data set provided by the Bureau van Dijk is extracted.

activity corresponds to a production input *i* for output *j* in country *c*, as identified in the input-output tables. The remainder of $I_{j,c}^{i,h}$ inputs is designated to those for which no affiliate is detected as *possible* outsourced inputs[45].

By linking the ownership information with the input-output data for the 28 EU countries, 10,492,482 possible input-output production linkages are identified for the parent companies in manufacturing, of which 14,245 are integrated links between parent and affiliated firms. In the case of the parent companies in services, 40,254,339 input-output production linkages, of which 54,854 are intra-firm production linkages, are identified.

It is worth noting that the number of affiliates in the data is larger than the number of identified integrated input linkages (for manufacturing there are 19,997 affiliates and 14,245 integrated links), which implies that some parent companies source the same input from multiple affiliates in the same country. In the descriptive analysis of this section, these multiple affiliates are disregarded, focusing only on ownership links that, for each parent, identify input-output links uniquely. This avoids inflating the descriptive figures with multiple counting of inputs. However, in the empirical estimations all ownership links will be exploited.

Table 5.1 to Table 5.6 below describe patterns of input sourcing by manufacturing and services parent companies established in the EU countries.

Table 5.1 shows that, on average, manufacturing parent firms source 2.04 inputs intra-firm; by construction, the average number of possible outsourced inputs is much larger at 1,566. The maximum number of integrated inputs by one parent company is 109, while the lowest number possible outsourced inputs is 1,459.

In the case of services parent firms, the pattern is broadly similar, with the exception of the maximum number of integrated inputs, which is larger.

Table 5.1: Input sourcing by manufacturing and services companies established in EU countries

	Mean	Median	Min	Max
Manufacturing				
Integrated inputs	2.04	1	1	109
Possible outsourced inputs	1566	1567	1459	1567
Services				
Integrated inputs	2.04	1	1	121
Possible outsourced inputs	1566	1567	1447	1567

Source: ESRI calculations based on the linked data from *Orbis* and WIOT data sets.

Table 5.2 disaggregates the information on integrated inputs by the sector of the affiliate. Among the 7,012 parent firms in manufacturing, 2,689 firms source service inputs only, 2,191 source manufacturing only, 1,596 source both manufacturing and service inputs, and 536 parent companies source inputs other than manufacturing and/or services. The highest average number of integrated inputs, 5.08, is found for parent firms that source both manufacturing and services inputs.

[45] Having only information on the set of inputs (i.e. sector-host country combinations in the I-O table with positive requirement coefficient) that correspond to an affiliate, one is left to label the set of sector-country combination inputs with no corresponding ownership link as outsourced input. However, each firm will only decide to source a fraction the latter inputs, hence the notation which refers to possible outsourced inputs.

Table 5.2: Patterns of integrated inputs by manufacturing firms established in EU countries

Linkage type	Number of parent companies	Mean Integrated inputs	Min	Max
Manufacturing – Services	2,689	1.21	1	23
Manufacturing – Manufacturing	2,191	1.09	1	6
Manufacturing – Manufacturing and Services	1,596	5.08	2	109
Manufacturing – neither Manufacturing nor Services	536	1.02	1	3
Total	7,012	2.04	1	109

Source: ESRI calculations based on the linked data from *Orbis* and WIOT data sets.

Table 5.3 shows a similar breakdown for integrated inputs by services companies. Among the 26,946 services parent firms, 17,752 firms integrate services inputs only, 1,602 manufacturing inputs only, 5,276 services and manufacturing inputs, and 2,316 integrate neither manufacturing nor services. The average number of integrated inputs is largest at 5.02 in the case of parent companies which integrate both services and manufacturing inputs.

Table 5.3: Patterns of integrated inputs by services companies established in EU countries

Linkage type	Number of parent companies	Mean integrated inputs	Min	Max
Services - Services	17,752	1.37	1	22
Services – Manufacturing	1,602	1.13	1	7
Services – manufacturing and Services	5,276	5.02	2	121
Services – Neither Manufacturing nor Services	2,316	1.05	1	3
Total	26,946	2.04	1	121

Source: ESRI calculations based on the linked data from *Orbis* and WIOT data sets.

Table 5.4 and Table 5.5 show summary statistics of the characteristics of parent firms broken down by the type of input they integrate.

Among all manufacturing parent firms, firms integrating both manufacturing and services inputs are the largest, and have the highest productivity, capital (both tangible and intangible) and skills intensities. Relative to manufacturing firms which integrate manufacturing inputs only, manufacturing firms that integrate services inputs only are larger, less productive, and less intensive in capital and skills.

Table 5.4: Summary statistics for manufacturing firms with integrated inputs established in EU countries

Linkage type	Value-Added per Employee	Tangible capital Intensity	Intangible capital Intensity	Skills Intensity	Employees
Manufacturing – Services	142.51	158.03	12.54	48.6	104.99
Manufacturing – Manufacturing	156.8	216.69	13.95	50.08	84.36
Manufacturing – Manufacturing and Services	262.83	379.64	22.67	75.15	1176.07
Manufacturing – neither Manufacturing nor Services	218.41	316.09	12.27	56.6	56.76
Total	180.21	239.02	15.29	55.73	338.64

Source: ESRI calculations based on the linked data from *Orbis* and WIOT data sets.

Table 5.5 presents summary statistics for services parent firms. Services firms which integrate both manufacturing and services inputs are by far the largest, with the highest productivity and most intensive capital and skills.

Table 5.5: Summary statistics for services firms with integrated inputs established in EU countries

Linkage type	Value-Added per Employee	Capital Intensity	Intangible capital Intensity	Skills Intensity	Employees
Services - Services	206.51	626.07	22.31	55.48	80.03
Services – Manufacturing	273.04	632.49	30.88	76.46	65.57
Services – manufacturing and services	896.14	2413.78	103.35	217.33	1055.07
Services – neither manufacturing nor Services	178.21	1223.15	21.08	46.64	39.56
Total	343.82	1029.87	38.92	87.85	266.6

Source: ESRI calculations based on linked data from *Orbis* and WIOT data sets.

Table 5.6 shows the distribution of parent firms and the intensity of integrated inputs across EU countries. Ireland, the Netherlands and the United Kingdom have the highest intensity of integrated inputs by manufacturing companies. The United Kingdom and the Netherlands also have the highest average integrated inputs by services firms.[46]

[46] The distribution of parent companies (GUOs), in both manufacturing and services, is driven by the sample of firms available in *Orbis*. In particular, the availability of firms' financials determines the number of firms in each country. Since data on the population of parent firms in EU countries is not available, all regressions in the empirical analysis include home country-input-output industry fixed effects.

Table 5.6: The distribution of parent companies and the intensity of integrated inputs across EU countries

Country of parent company – GUO	Number of GUOs – Manufacturing	Mean number of integrated inputs by manufacturing GUOs	Number of GUOs – Services	Mean number of integrated inputs by services GUOs
Austria	23	6.91	63	2.95
Belgium	147	2.72	707	3.5
Bulgaria	4	2	8	1.25
Czech Republic	398	1.48	1,446	1.71
Germany	612	4.01	1,345	5.29
Denmark	5	15	2	3.5
Estonia	34	1.15	220	1.39
Spain	1,151	1.53	5,379	1.78
Finland	336	2.79	1,396	2.04
France	375	2.7	1,872	2.34
United Kingdom	30	17.1	15	16.47
Greece			2	2
Croatia	21	1.48	56	1.18
Hungary	40	1.45	102	1.55
Ireland	2	26		
Italy	2,275	1.61	5,832	1.91
Lithuania			1	3
Luxembourg	5	1.8	28	6.57
Latvia	3	1	3	1.67
Netherlands	9	25.22	9	10.33
Poland	45	2.53	99	2.12
Portugal	320	1.36	853	1.31
Romania	8	1.13	13	1.08
Sweden	959	1.47	6,248	1.69
Slovenia	94	1.61	526	1.36
Slovakia	116	1.53	721	1.65
Total	7,012	2.04	26,946	2.04

Source: ESRI calculations based on linked data from *Orbis* and WIOT data sets.

Table 5.7 below shows the distribution of the number of parent firms and integrated inputs by industry. The largest number of parent firms can be found in two industries: Food, beverages and tobacco and Fabricated metal products. Manufacture of coke and refined petroleum products has the lowest number of parent firms and the largest average number of integrated inputs. The lowest average number of integrated inputs is in Wood and wood products and Repair and installation of machinery and equipment.

Table 5.7: The distribution of parent companies and the intensity of integrated inputs - manufacturing firms

WIOT sector of parent company (GUO)	**Number of GUOs**	**Mean number of integrated inputs**
Manufacture of food products, beverages and tobacco products	1104	1.97
Manufacture of textiles, wearing apparel and leather products	483	1.61
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	264	1.39
Manufacture of paper and paper products	132	3.28
Printing and reproduction of recorded media	242	1.82
Manufacture of coke and refined petroleum products	26	4.92
Manufacture of chemicals and chemical products	310	2.34
Manufacture of basic pharmaceutical products and pharmaceutical preparations	82	2.78
Manufacture of rubber and plastic products	360	2.02
Manufacture of other non-metallic mineral products	386	2.02
Manufacture of basic metals	176	2.94
Manufacture of fabricated metal products, except machinery and equipment	1104	1.55
Manufacture of computer, electronic and optical products	312	2.52
Manufacture of electrical equipment	260	2.23
Manufacture of machinery and equipment n.e.c.	870	2.52
Manufacture of motor vehicles, trailers and semi-trailers	145	2.54
Manufacture of other transport equipment	90	3.63
Manufacture of furniture; other manufacturing	411	1.65
Repair and installation of machinery and equipment	255	1.39
Total	7012	2.04

Source: ESRI calculations based on linked data from Orbis and WIOT data sets.

Table 5.8 shows the distribution of the number of parent firms and average integrated inputs for services firms. The highest number of parent firms can be found in Wholesale trade and the lowest in Insurance, reinsurance and pension funding. Postal and courier activities appear with the largest average number of integrated inputs, while retail trade has the lowest.

Table 5.8: The distribution of parent companies and the intensity of integrated inputs - services firms

WIOT sector of parent company (GUO)	Number of GUOs	Mean number of integrated inputs
Wholesale and retail trade and repair of motor vehicles and motorcycles	1075	1.34
Wholesale trade, except of motor vehicles and motorcycles	5366	1.62
Retail trade, except of motor vehicles and motorcycles	2173	1.32
Land transport and transport via pipelines	887	1.47
Water transport	67	3.13
Air transport	18	6.39
Warehousing and support activities for transportation	550	1.92
Postal and courier activities	21	7.52
Accommodation and food service activities	1571	1.33
Publishing activities	316	2.78
Motion picture, video and television programme production, sound recording and music publishing activities; programming and broadcasting activities	200	1.64
Telecommunications	158	2.54
Computer programming, consultancy and related activities; information service activities	1476	1.7
Financial service activities, except insurance and pension funding	2094	3.72
Insurance, reinsurance and pension funding, except compulsory social security	3	1.67
Activities auxiliary to financial services and insurance activities	381	3
Real estate activities	2793	1.89
Legal and accounting activities; activities of head offices; management consultancy activities	3795	3
Architectural and engineering activities; technical testing and analysis	1049	1.72
Scientific research and development	207	1.55
Advertising and market research	469	1.55
Other professional, scientific and technical activities; veterinary activities	612	2.27
Administrative and support service activities	1665	1.91
Total	26946	2.04

Source: ESRI calculations based on linked data from *Orbis* and WIOT data sets.

5.3.2. The intensity of intra-EU production linkages

The ownership information about integrated inputs can also be analysed with respect to the relevance of production inputs, i.e. exploiting the information about the magnitude of the input-output coefficient a_{ihjc} (the value of input *i* in host country *h* required to produce one unit (1€) of production in industry *j* in home country *c*).

Table 5.9 reports the average a_{ihjc} coefficient across various sub-samples. First, it is evident that the average importance in the production of integrated inputs is by far larger than that of possible outsourced inputs; in other words, both manufacturing and services headquarters decide to integrate inputs corresponding to a larger value of their output.

Restricting the focus of the analysis on integrated inputs only, the importance of inputs in production is largest for manufacturing inputs sourced by manufacturing headquarters, followed by service inputs sourced by service headquarters. The remaining subgroup of linkages, across services and manufacturing, shows a lower average input-output coefficient.

Table 5.9 also shows the results of a sensitivity analysis. The average input intensity is computed on various cuts of the a_{ihjc} distribution, with similar findings. The most noticeable difference across columns is the sharp reduction in the number of possible outsourced inputs: concentrating on the top quartile of the a_{ihjc} distribution significantly reduces the number of possible outsourcing links identified by the input-output tables. Most of the integrated inputs instead correspond to the top quartile of the distribution, as expected from the finding that headquarters tend to integrate affiliates in sectors which contribute substantially to the final output.

Table 5.9: Intensity of integrated inputs

	I-O requirement coefficients >0		**Top 3 quartiles of I-O requirement coefficients**		**Top quartile of I-O requirement coefficients**	
	No. of inputs*	**Avg. I-O coefficient**	**No. of inputs***	**Avg. I-O coefficient**	**No. of inputs***	**Avg. I-O coefficient**
Manufacturing headquarters						
Integrated inputs	14,245	0.0476	14,174	0.0478	13,291	0.0510
Possible outsourced inputs	10,478,237	0.0006	7,784,459	0.0008	2,573,177	0.0024
Among integrated links:						
Manufacturing – Services	3,244	0.0262	3,235	0.0262	3,132	0.0271
Manufacturing – Manufacturing	2,390	0.1237	2,389	0.1237	2,361	0.1252
Manufacturing – both	8,068	0.0340	8,008	0.0343	7,269	0.0378
Manufacturing – neither	543	0.0425	542	0.0426	529	0.0436
Total	14,245	0.0476	14,174	0.0478	13,291	0.0510
Services Headquarters						
Integrated inputs	54,854	0.0495	50,803	0.0534	50,803	0.0534
Possible outsourced inputs	40,199,485	0.0006	29,432,917	0.0008	8,234,245	0.0029
Among integrated links:						
Services – Services	24,295	0.0682	24,261	0.0683	23,617	0.0701
Services – Manufacturing	1,798	0.0106	1,798	0.0106	1,719	0.0111
Services – both	26,330	0.0365	26,085	0.0368	23,108	0.0416
Services – neither	2,431	0.0330	2,426	0.0331	2,359	0.0340
Total	**54854**		**54570**		**50803**	

Note: the I-O requirement coefficient is computed exploiting the full dimension of the WIOT table over the 28 EU countries. In this way, each sector in each country is considered as an input for the output of a certain sector in a certain country. This implies that the I-O requirement coefficients are smaller than if only the national I-O table was used.
*These are "unique inputs": since large GUOs tend to have more than one affiliate in the same industry, to avoid double counting the I-O coefficient and inflate the figures towards integration decision of large GUOs, this table only considers a certain input once for each GUO.

In the empirical analysis, the intensity of integrated inputs will be exploited as an outcome variable additionally to the binary sourcing choice. Country level determinants of integration or outsourcing can, in fact, also affect the choice of which input to integrate. For this purpose, a measure of average integration specific to each parent firm *g* in each host country *h* is constructed as follows:

(Eq.5-1) $$Intensity_{gjch} = \frac{1}{I}\sum_{i=1}^{I} a_{ihjc}$$

5.4. Integration of manufacturing and services inputs and productivity

To motivate the empirical analysis, the productivity differentials of parent companies which source manufacturing and services inputs via foreign direct investment within firms' boundaries are further explored.

Sourcing patterns could result in productivity differentials, over and above observable firm, industry and country characteristics. The decision to integrate a manufacturing or services affiliate could, in fact, result in a varying degree of complexity of the group structure, which can in turn affect the productivity performance of the parent company. A rigorous test of this rationale would require variation in sourcing strategies within the firm, which would allow to test the impact of, say, the addition of a service affiliate to a manufacturing group, or vice versa. Unfortunately, the available data only allow us to observe a fixed group structure, which forces us to perform a simpler, descriptive exercise. Parent firms are separated into mutually exclusive groups depending on, first, whether their primary activity is in manufacturing or services, and second, whether they integrate manufacturing affiliates, services affiliates or both. Next, the mean difference in productivity across these mutually exclusive categories are tested, controlling for as many determinants of firm productivity as possible at the firm, sector and country level. While this remains a descriptive analysis, it can still be informative about systematic productivity differentials across multinational groups with heterogeneous sourcing strategies about manufacturing and service inputs.

To perform this exercise, parent firms are separated into the following six mutually exclusive categories:

- manufacturing parents integrating manufacturing inputs (*Man. – Man.)*
- manufacturing parents integrating services inputs (*Man. – Serv.*)
- manufacturing parents integrating both manufacturing and services inputs (*Man. – Serv. Man.*)
- services parents integrating services inputs (*Serv. – Serv.*)
- services parents integrating manufacturing inputs (*Serv. – Man.*)
- services parents integrating both manufacturing and services inputs (*Serv. – Man. – Serv.*)

The test is performed estimating the following model:

(Eq.5-2) $$\ln(VA/EMP)_{gjcih} = \alpha + \beta CAT_{gjcih} + \sum_{r}\delta_r \ln(X)_{gjcih} + \mu_{cji} + \varepsilon_{igjcih}$$

The dependent variable is value added per employee, computed as the value of operating turnover net of material cost divided by the number of employees. CAT_{gjcih} is a binary indicator which is equal to 1 if the parent company *g* in sector *j* in country *c* integrates an affiliate in industry *i* in host country *h* and belongs to one of the above mentioned six categories, and 0 otherwise. X_{gjcih} denotes a vector of firm-level controls which are known to affect firm productivity (capital intensity, skill intensity, number of employees, intensity of investment in intangible capital). μ_{cji} denotes a set of fixed effects at the country-output-input level: these fixed effects pick up any unobservable feature specific to each NACE 2-digit output-input pair in each country of residence of the parent related to firm productivity.

Table 5.10 shows the results. Columns 1-6 present the results of the same regression, each time with a different excluded category, in order to allow a full comparison across the six firm groups.

The most productive parent companies are in services: the coefficients on the three services categories in the first three columns are large, positive and, with a few exceptions, statistically significant. This implies that with respect to all manufacturing group structures, service parents have higher productivity.

Very interestingly, there seems to be a premium for specialization, both within the service and the manufacturing parent groups. Within the service groups, the most productive parent firms are those which integrate service affiliates only: the gap relative to service firms integrating both types of affiliates is large and significant, whereas the gap with respect to service firms integrating manufacturing firms only is positive, but not statistically significant. Notice that service firms integrating both types of affiliates are the least productive ones among the service parent companies. Within the manufacturing groups, a similar tendency is found, although it is statistically less well identified. Manufacturing parent companies integrating both services and manufacturing affiliates are the least productive among manufacturing groups, although the difference is only statistically significant with respect to manufacturing parents integrating service affiliates.

Table 5.10: Productivity differences across parent groups

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable			Ln(Va/Empl)			
Man.-Man.	0	0.00649	0.0604	-0.189***	-0.164*	-0.0527
	(.)	(0.0621)	(0.0596)	(0.0701)	(0.0958)	(0.0622)
Man.-Serv.	-0.00649	0	0.0539'	-0.195***	-0.171*	-0.0592
	(0.0621)	(.)	(0.0355)	(0.0546)	(0.0894)	(0.0421)
Man.-Serv.-Man.	-0.0604	-0.0539'	0	-0.249***	-0.224**	-0.113***
	(0.0596)	(0.0355)	(.)	(0.0496)	(0.0892)	(0.0393)
Serv.-Serv.	0.189***	0.195***	0.249***	0	0.0247	0.136***
	(0.0701)	(0.0546)	(0.0496)	(.)	(0.0882)	(0.0479)
Serv.-Man.	0.164*	0.171*	0.224**	-0.0247	0	0.111'
	(0.0958)	(0.0894)	(0.0892)	(0.0882)	(.)	(0.0759)
Serv.-Man.-Serv.	0.0527	0.0592	0.113***	-0.136***	-0.111'	0
	(0.0622)	(0.0421)	(0.0393)	(0.0479)	(0.0759)	(.)
Ln(Capital Intensity)	0.159***	0.159***	0.159***	0.159***	0.159***	0.159***
	(0.0332)	(0.0332)	(0.0332)	(0.0332)	(0.0332)	(0.0332)
Ln(Skill Intensity)	0.764***	0.764***	0.764***	0.764***	0.764***	0.764***
	(0.0482)	(0.0482)	(0.0482)	(0.0482)	(0.0482)	(0.0482)
Ln(Intangibles Intensity)	0.0347'	0.0347'	0.0347'	0.0347'	0.0347'	0.0347'
	(0.0223)	(0.0223)	(0.0223)	(0.0223)	(0.0223)	(0.0223)
Country-output-input FE	yes	yes	yes	yes	yes	yes
Observations	18,682	18,682	18,682	18,682	18,682	18,682

Source: ESRI estimates based on linked data from *Orbis* and WIOT data sets.
Note: Robust standard errors clustered at the country-output industry of the parent company in parentheses. ' p<0.15, * p<0.10, ** p<0.05, *** p<0.01

5.5 Determinants of intra-EU production and trade linkages

The focus of this analysis is on the sourcing strategies of EU manufacturing companies. Specifically, determinants of integration versus outsourcing choices of manufacturing companies located in the EU countries are examined. Integrated manufacturing and services inputs are considered, also focusing on integrated inputs across EU countries. For the purpose of this analysis, information on ownership from the *Orbis* data set is combined with data from I-O tables for EU countries (WIOT).

The empirical analysis is based on estimates obtained with the following linear probability model:

(Eq.5-3) $$\Pr(Integrated_{gjcih} = 1) = \alpha + \sum_r \beta_r X_{gjcih} + \sum_t \delta_t C_h + \sum_q \gamma_q P_{ih} + \eta_{cji} + \varepsilon_{gjcih}$$

The dependent variable is a binary indicator taking value 1 if parent firm *g* in sector *j* in home country *c* owns an affiliate in sector *i* in host country *h*, and 0 otherwise. X_{gjcih} is a vector of firm characteristics including productivity, tangible and intangible capital intensities, skills intensity and size. C_h is a vector of host country characteristics, including tangible, intangible and human capital intensities, production costs (proxied by GDP per capita) and size (GDP).

P_{ih} is a vector of policy variables specific to the host country *h*: these include institutional characteristics such as the quality of contracts' enforcement (Rule of Law), employment protection legislation, financial development, contractual frictions (efficiency of procedures for solving insolvency), as well as restrictions to FDI and entrepreneurship (sectoral restrictions to FDI, the impact of services regulations, and barriers to entrepreneurship).[47]

η_{cji} denotes a set of home country output-input industry fixed effects. These fixed effects pick up any unobservable feature specific to each NACE 2digit output-input pair in each country of residence of the parent firm which affect the propensity of firms to choose to source inputs from within the boundaries of the firms rather than non-related suppliers. ε_{gjcih} is a white noise model residual. Detailed descriptions of the variables and data sources are given in Table 5.14 in the Appendix.

As mentioned in section 5.3, besides the decision to integrate or outsource inputs, the intensity of integrated inputs in production is also considered as an additional outcome variable. For this purpose, the following model is estimated:

(Eq. 5-4) $$Intensity_{gjch} = \alpha + \sum_r \beta_r X_{gjcih} + \sum_t \delta_t C_h + \sum_q \gamma_q P_{ih} + \eta_{cji} + \varepsilon_{gjcih}$$

where the dependent variable corresponds to the average I-O share of integrated inputs for each parent firm g in each host country h.

Box 5.1: Econometric issues

A concern in relation to specifications 5.3 and 5.4 is that causality might run from sourcing choices and the intensity of vertical integration to firm performance (productivity, size, capital and skill intensities). Unfortunately, with the available data, it is not possible to find instrumental variables that could isolate the causal link between firm characteristics and integration decisions. Furthermore, while ownership varies over time, the information available in the Orbis data set corresponds to the most recent ownership information for 2017 and changes over time are not recorded. In order to mitigate reverse causality concerns, this study therefore resorted to a "within-parent firm" estimation, exploiting cross-country variation within parent firms, in order to net out any time-constant unobservable parent company characteristic which could be correlated with both the likelihood (and the intensity) of integration and the other regressors in the models. While this procedure does not allow to estimate the firm-level parameters (β_r), it reassures that the model is correctly specified and free of reverse causality. These results are reported in Tables 5.16-5.18 in the Appendix and show that the main findings concerning the country characteristics leading to the decision to integrate or outsource inputs are upheld.

5.5.1. Sourcing choices of manufacturing firms: intra-EU production linkages

Table 5.11 shows estimated determinants of the propensity of manufacturing firms to integrate manufacturing and service inputs from industries other than the industry of the parent company based on the model specification described above. The estimates are marginal effects obtained with linear probability estimators. All regressions include parent country input-output industry fixed effects. Standard errors are clustered at parent country –

[47] All the policy variable are host country specific, with the exception of the restrictions to FDI and the impact of services restrictions, which vary over sectors within the host country).

output industry. The identification in the empirical strategy is based on exogenous variation across host countries within the group of parent country input-output links. As explained in Box 5.1 above, to alleviate concerns about reverse causality, the firm specific variation (with parent firm fixed effects) is also removed.[48] The results hold, indicating the meaningful variation is indeed where it matters for the scope of this analysis, i.e. across destination countries for foreign affiliates.

Column 1 shows the estimates for all manufacturing parent firms, while Columns 2-4 consider the exclusively defined manufacturing parent groups depending on the type of integrated inputs: manufacturing only, services only, and manufacturing and services.[49]

Manufacturing firms that integrate inputs via foreign direct investment across EU countries are larger, more productive, more intensive in tangible and intangible capital and less intensive in skills than manufacturing firms that outsource inputs.

Affiliates of manufacturing parent firms are likely to be located in large countries, countries with lower production costs, and countries with lower intensity of production factors (tangible, intangible, and human capital). The probability of sourcing inputs from affiliates across EU countries is higher in countries with strong legal systems, more flexible labour markets (less stringent employment protection legislation for regular contracts), lower corporate tax rates and less-developed financial markets. The estimates also indicate that manufacturing firms tend to locate in countries with high corporate tax rates and more developed financial systems. This result suggests that multinationals tend to borrow in countries with developed financial systems with high corporate tax rates where they can benefit from debt-related tax allowances. Furthermore, manufacturing firms tend to source their inputs via foreign direct investment rather than via arm's length transactions in countries where contractual frictions are high (less efficient insolvency procedures). Sectoral restrictions to FDI decrease the probability of sourcing inputs via FDI while service regulations with a high impact on downstream industries increases the propensity of manufacturing firms to source inputs via FDI. Finally, barriers to entrepreneurship in host countries do not seem to matter for the sourcing choice of manufacturing firms.

The estimates across columns 2-4 highlight different sourcing behaviours of manufacturing parent firms depending on the type of sourced inputs. With respect to firm characteristics, it appears that the average effects obtained for all manufacturing firms are driven by manufacturing firms which integrate both manufacturing and services inputs. Larger firms are more likely to source inputs intra-firm rather than at arms' length, regardless of the type of input category. Apart from parents' size, production factor intensities and productivity do not matter for the sourcing choices of manufacturing firms integrating manufacturing inputs only. In contrast, manufacturing firms which source services inputs intra-firm are likely to be more productive and more intensive in intangible capital than manufacturing firms which source inputs via outsourcing, while tangible capital and skills intensities do not seem to matter.

Host countries' factor intensities have similar effects on the sourcing choices of the different groups of manufacturing parent firms in terms of direction with weaker effects again in the case of manufacturing firms with integrated manufacturing inputs only. With respect to institutional and regulatory characteristics, similarities include the positive link between the

[48] These estimates are reported in Tables 5.16-5.18 in the Appendix.

[49] The observations in column 1 of Table 5.11 (as well as in Tables 5.12 and 5.13 below) are larger than the sum of the observations in columns 2, 3 and 4. This is because in column 1 also parent companies with affiliates in sectors other than manufacturing and services are included (i.e. primary sectors and construction).

propensity to source inputs via FDI and the strength of legal systems, less stringent employment protection regulations for regular contracts, less-developed domestic financial markets, higher contractual frictions (less efficient insolvency procedures), and a high impact of service regulations on downstream industries. There are a number of dissimilarities across the three manufacturing parent firms' categories. While more flexible regulations for the use of temporary contracts increase the propensity to source inputs via FDI in the case of manufacturing firms which integrate both manufacturing and services, the effect is opposite for manufacturing firms which integrate services only and manufacturing only. This result could be linked to the fact that across the EU countries for which data are available the correlation between EPL for regular contracts and EPL for temporary contracts is low, at 0. 3664. This low correlation implies that the strictness of regulations for regular and temporary contracts may be opposite to each other. For example, countries with more restrictive EPL for regular contracts and less restrictive EPL for the use of temporary contracts include the Czech Republic, Germany, the Netherlands and Sweden. At the other side of the spectrum, countries with less stringent EPL regulations for regular contracts and more restrictive EPL regulations for the use of temporary contracts include Estonia, Spain, Greece, Slovakia and Poland. The estimates in columns 2 and 3 suggest that manufacturing firms which integrate manufacturing inputs only and services inputs only are more likely to source them via affiliates with less stringent EPL regulations for permanent contracts and more stringent EPL for the use of the temporary contracts. These results suggest that sourcing inputs via affiliates would be less dependent on temporary contracts. However, it appears that adjustment to shocks in the case of sourcing inputs intra-firm would be expected via flexibility of labour markets with respect to permanent employment contracts.

While barriers to domestic entrepreneurship increase the propensity of manufacturing firms with integrated services to source inputs via FDI, they do not matter for the other two groups of manufacturing parent firms. Low corporate tax rates and less-developed domestic financial markets increase the integration probability of manufacturing firms with services affiliates only and of manufacturing firms with both manufacturing and services affiliates.

Table 5.11: Determinants of sourcing choices for manufacturing firms, intra-EU vertical production linkages

	(1)	(2)	(3)	(4)
	All Manufacturing HQ	Man HQ – Serv. Affiliates	Man HQ – Man. Affiliates	Man HQ – Man & Serv. Affiliates
Parent firm characteristics				
Productivity	0.000369***	0.0000868***	0.00000463	0.00109**
	(0.000120)	(0.0000241)	(0.00000790)	(0.000430)
Tangible capital intensity	0.000263***	0.00000305	0.00000668	0.00128***
	(0.0000860)	(0.0000163)	(0.00000502)	(0.000434)
Intangible capital intensity	0.000394***	0.0000641**	0.00000973	0.000612*
	(0.000147)	(0.0000263)	(0.00000622)	(0.000331)
Skills intensity	-0.000940***	-0.0000650	-0.0000200	-0.00153**
	(0.000287)	(0.0000477)	(0.0000134)	(0.000754)
Size	0.00119***	0.000183***	0.0000409***	0.00276***
	(0.000226)	(0.0000300)	(0.0000119)	(0.000515)
Host country characteristics				
Tangible capital intensity	-0.00118*	-0.000391**	-0.0000810	-0.00458**
	(0.000600)	(0.000174)	(0.0000673)	(0.00214)
Human capital	-0.000808*	-0.00131***	-0.000227***	-0.00161
	(0.000427)	(0.000173)	(0.0000623)	(0.00175)
R&D intensity	-0.000419*	0.0000391	-0.00000118	-0.00158*
	(0.000221)	(0.000110)	(0.0000387)	(0.000859)
GDP per capita	-0.000439***	-0.0000615	-0.0000278	-0.00156***
	(0.000100)	(0.0000472)	(0.0000219)	(0.000298)
GDP	0.000530***	0.000205***	0.0000433***	0.00184***
	(0.0000722)	(0.0000346)	(0.0000112)	(0.000232)
Rule of law	0.00311***	0.00133***	0.000276***	0.0109***
	(0.000661)	(0.000202)	(0.0000858)	(0.00227)
EPL for regular contracts	-0.00183**	-0.00107***	-0.000213***	-0.00521**
	(0.000732)	(0.000191)	(0.0000747)	(0.00233)
EPL for temporary contracts	-0.000587	0.000568***	0.0000951**	-0.00314**
	(0.000383)	(0.000146)	(0.0000459)	(0.00134)
Corporate tax rate	-0.0186***	-0.00528***	-0.000558	-0.0676***
	(0.00342)	(0.00139)	(0.000448)	(0.0111)
Financial development	-0.0155***	-0.00413***	-0.000452	-0.0568***
	(0.00289)	(0.00106)	(0.000357)	(0.00957)
Corporate tax rate * Financial development	0.00460***	0.00123***	0.000119	0.0168***
	(0.000857)	(0.000323)	(0.000109)	(0.00279)
Time to resolve insolvency	0.000575***	0.000234***	0.0000879***	0.00208***
	(0.000210)	(0.0000839)	(0.0000326)	(0.000786)
Sectoral restrictions to FDI	-0.00561***	-0.0000298	-0.000500**	-0.0217***
	(0.00137)	(0.000467)	(0.000197)	(0.00451)
Impact of service regulations	0.00657**	0.00164***	0.000335***	0.0217**
	(0.00271)	(0.000414)	(0.0000968)	(0.00949)
Barriers to entrepreneurship	-0.0000220	0.000677***	-0.00000376	-0.000390
	(0.000438)	(0.000230)	(0.0000800)	(0.00178)
Constant	0.0603***	0.0192***	0.00247	0.213***
	(0.0120)	(0.00458)	(0.00157)	(0.0391)
Observations	7,118,505	2,708,351	2,228,720	1,641,837

Source: ESRI estimates based on linked data from *Orbis* and WIOT data sets.
Note: Estimates are obtained with linear probability estimators. The dependent variable is equal to 1 if the parent company integrates inputs intra-firm via foreign direct investment and 0 otherwise. All continuous explanatory variables are in natural logarithms. All regressions include parent country input-output industry fixed effects. Standard errors in parentheses clustered at parent country-output industry level.' p<0.15, * p<0.10, ** p<0.05, *** p<0.01.

5.5.2. Determinants of the intensity of integrated inputs: intra-EU production linkages

Table 5.12 shows the estimates for determinants of the intensity of integrated inputs by manufacturing parent firms across EU countries. Column 1 shows the estimates for all manufacturing parent firms, while columns 2-4 present the results for the three exclusively defined manufacturing parent firms groups discussed above. The dependent variable is the average intensity of integrated inputs defined in Section 5.3. The estimates are obtained with OLS with fixed effects. The identification empirical strategy is based on variation across host countries within each parent country input-output combination.

In comparison to the estimates for the sourcing choice discussed above, firm characteristics are less important for the intensity of integrated inputs by manufacturing firms. The only significant effect, albeit only marginally significant, is for skills intensity. The average intensity of integrated inputs is negatively linked to parent firms' skills intensity. With respect to host country characteristics, the average intensity of intra-EU integrated inputs is higher in large countries, in countries with higher R&D intensity and higher GDP per capita and lower in countries more intensive in tangible capital.

Similarly to the sourcing choices for manufacturing firms, the intensity of integrated inputs is higher in countries with stronger legal systems, low corporate tax rates, less developed domestic financial markets and in countries with higher contractual frictions (less efficient procedures to resolve insolvency). Barriers to FDI, the impact of services regulations on downstream industries, and barriers to entrepreneurship in the host countries do not significantly affect the intensity of integration inputs.

Looking across columns 2-4 at the three categories of manufacturing parent firms, with the exception of tangible capital and skills intensities, the intensity of integrated inputs does not seem to be sensitive to firm characteristics. Tangible capital intensity is negatively linked with the intensity of integrated inputs in the case of manufacturing firms with integrated manufacturing inputs only, while the intensity of skills is negatively linked with the intensity of integrated services inputs by manufacturing parent firms.

Table 5.12: Determinants of the intensity of integrated inputs by manufacturing firms, intra-EU vertical production linkages

Intensity of integrated inputs

	(1)	(2)	(3)	(4)
	All Manufacturing HQ	Man HQ – Serv. Affiliates	Man HQ – Man. Affiliates	Man HQ – Man & Serv. Affiliates
Parent firm characteristics				
Productivity	0.000212	0.000330	0.00322	0.00000786
	(0.000244)	(0.000232)	(0.00319)	(0.0000323)
Tangible capital intensity	0.0000724	-0.0000479	-0.000322**	0.0000540
	(0.000106)	(0.0000573)	(0.000156)	(0.000188)
Intangible capital intensity	0.0000706	0.0000665	-0.00130'	0.0000985
	(0.0000647)	(0.0000782)	(0.000837)	(0.0000844)
Skills intensity	-0.000705*	-0.00124***	-0.00116	-0.000567
	(0.000403)	(0.000475)	(0.00292)	(0.000518)
Size	-0.0000137	0.000000224	0.00120'	-0.0000440
	(0.0000649)	(0.0000797)	(0.000747)	(0.0000853)
Host country characteristics				
Tangible capital intensity	-0.00395***	-0.00178	-0.0915**	-0.00466***
	(0.00143)	(0.00239)	(0.0344)	(0.00171)
Human capital	-0.00108	0.000472	-0.00506***	-0.00153
	(0.00124)	(0.00156)	(0.00190)	(0.00138)
R&D intensity	0.00104*	0.00177*	-0.0164	0.00105'
	(0.000593)	(0.00102)	(0.0128)	(0.000721)
GDP per capita	0.000584*	0.00108*	0.0295**	0.000434
	(0.000326)	(0.000588)	(0.0134)	(0.000408)
GDP	0.000621***	0.000839***	-0.00663*	0.000570***
	(0.000105)	(0.000163)	(0.00343)	(0.000123)
Rule of law	0.00415***	0.00186	0.0496**	0.00456***
	(0.00112)	(0.00203)	(0.0203)	(0.00127)
EPL for regular contracts	0.0000276	-0.000342	-0.0117***	0.0000765
	(0.000923)	(0.00141)	(0.00369)	(0.00104)
EPL for temporary contracts	-0.000486	0.000932	0.00916**	-0.000851
	(0.000679)	(0.000880)	(0.00360)	(0.000752)
Corporate tax rate	-0.0199***	0.0000281	-0.196***	-0.0216**
	(0.00711)	(0.0159)	(0.0673)	(0.00830)
Financial development	-0.0186***	-0.000379	-0.172***	-0.0204***
	(0.00590)	(0.0129)	(0.0614)	(0.00682)
Corporate tax rate * Financial development	0.00508***	-0.000252	0.0447***	0.00561***
	(0.00175)	(0.00386)	(0.0154)	(0.00201)
Time to resolve insolvency	0.00156***	0.00202***	0.0400**	0.00137***
	(0.000398)	(0.000724)	(0.0164)	(0.000436)
Sectoral restrictions to FDI	-0.00323	-0.00306	0.0601'	-0.00179
	(0.00298)	(0.00522)	(0.0369)	(0.00322)
Impact of service regulations	-0.00324	-0.00764	-0.518**	-0.00171
	(0.00309)	(0.0186)	(0.255)	(0.00323)
Barriers to entrepreneurship	0.00191	0.00147	0.107**	0.00261
	(0.00182)	(0.00165)	(0.0473)	(0.00204)
Constant	0.0752***	-0.00825	0.884***	0.0857***
	(0.0264)	(0.0610)	(0.304)	(0.0311)
Observations	5,273	785	143	4,309

Source: ESRI estimates based on linked data from *Orbis* and WIOT data sets.
Note: Estimates are obtained with OLS estimators. The dependent variable and all continuous explanatory variables are in natural logarithms. All regressions include parent country input-output industry fixed effects. Standard errors in parentheses clustered at parent country-output industry level.' p<0.15, * p<0.10, ** p<0.05, *** p<0.01.

The intensity of integrated inputs by manufacturing firms appears to be most sensitive to host country characteristics in the case of manufacturing firms which integrate manufacturing inputs only. There are both similarities and differences across the three categories of manufacturing firms. GDP per capita is positively linked to the intensity of integrated inputs for manufacturing firms integrating manufacturing only and services only and it does not matter for the intensity of integrated manufacturing and services. The intensity of integrated inputs is higher in larger countries in the case of manufacturing firms with services affiliates only and manufacturing firms with both services and manufacturing affiliates. In contrast, the intensity of integrated inputs for manufacturing firms with manufacturing affiliates only is higher in smaller countries. While the R&D intensity of host countries increases, the intensity of integrated inputs in the case of manufacturing firms with services affiliates only, it does not matter in the case of the other manufacturing parent groups. Tangible capital intensity is negatively linked to the intensity of integrated inputs in the case of manufacturing firms with manufacturing affiliates only and manufacturing firms with both manufacturing and services affiliates. The intensity of integrated inputs in the case of manufacturing firms with manufacturing affiliates only is higher in the countries with less educated work forces.

Looking further at the sensitivity of the intensity of integrated inputs by manufacturing firms to institutional and regulatory characteristics in host countries, this again appears to be higher in the case of manufacturing firms with manufacturing affiliates only.

The strength of the legal systems is positively linked with the intensity of integrated inputs in the case of manufacturing firms with manufacturing affiliates only and in the case of manufacturing firms with both manufacturing and services affiliates. It does not seem to matter for manufacturing firms with service affiliates only. Less stringent employment protection regulations for regular contracts and more stringent regulations for the use of temporary contracts increase the intensity of integrated inputs for manufacturing firms with manufacturing affiliates only. Labour market regulations do not seem to matter for the intensity of integrated inputs in the case of the other two manufacturing parent categories. The intensity of integrated inputs is larger in countries with lower corporate tax rates and less-developed financial systems in the case of manufacturing firms with manufacturing affiliates only and manufacturing firms with both manufacturing and services affiliates. Consistent with the results for the sourcing choices, the intensity of integrated inputs is higher in countries with higher corporate tax rates and higher financial development. The estimate is positive and significant again for manufacturing firms with manufacturing affiliates only and for manufacturing firms with both manufacturing and services affiliates. The intensity of integrated inputs is larger in countries with higher contractual frictions (less efficient procedures to resolve insolvency). This result holds for all three manufacturing parent categories and it is consistent with the theoretical models predicting that contractual frictions increase the likelihood of intra-firm integration. While barriers to FDI do not seem to matter for the intensity of integrated inputs, the impact of service regulations in downstream industries reduces the intensity of integrated inputs in the case of manufacturing firms with manufacturing affiliates only. Barriers to entrepreneurship in the host country increase the intensity of integrated inputs in the case of manufacturing firms with manufacturing affiliates only. This result is consistent with the prediction that the size of multinational activity is likely to be higher in countries with less domestic competition.

Table 5.13 shows the results for determinants of the intensity of integrated inputs for services parent firms. Column 1 presents the estimates for all parent services firms while columns 2-4 show the estimates for three categories of services parent firms depending on the integrated inputs.

Looking first at column 1, the intensity of integrated inputs by services firms does not seem to be linked to parent firms' characteristics. Only a few economic and institutional conditions in the host countries appear to affect the intensity of integrated inputs by services firms. The intensity of integrated inputs by services firms increases with economic size and the strength of legal systems. It is larger in less developed countries and in countries with more flexibility of regulations for the use of temporary contracts. This latter result is, however, only marginally significant.

Table 5.13: Determinants of the intensity of integrated inputs by services firms, intra-EU vertical production linkages

	(1)	(2)	(3)	(4)
	All Services HQ	Serv. HQ – Serv. Affiliates	Serv. HQ – Man. Affiliates	Serv. HQ – Man. & Serv. Affiliates
Parent firm characteristics				
Productivity	0.00000937	0.00000621	-0.000179*	0.00000290
	(0.0000290)	(0.0000716)	(0.000102)	(0.0000204)
Tangible capital intensity	0.00000860	0.0000190	-0.0000206	-0.00000244
	(0.0000102)	(0.0000370)	(0.0000331)	(0.00000936)
Intangible capital intensity	0.00000201	-0.0000323	0.00000259	0.0000111'
	(0.0000144)	(0.0000399)	(0.0000563)	(0.00000745)
Skills intensity	0.00000740	0.0000203	0.000121**	0.0000224
	(0.0000186)	(0.0000458)	(0.0000480)	(0.0000207)
Size	-0.00000191	-0.00000683	-0.0000298	0.00000739
	(0.00000690)	(0.0000380)	(0.0000310)	(0.00000515)
Host country characteristics				
Tangible capital intensity	-0.000341	-0.00145	0	-0.000316
	(0.000367)	(0.00107)	(.)	(0.000379)
Human capital	0.000529	-0.000206	0.00159	0.000641
	(0.000526)	(0.00125)	(0.00156)	(0.000595)
R&D intensity	-0.0000853	0.000959'	0.000335	-0.0000956
	(0.000217)	(0.000619)	(0.000578)	(0.000230)
GDP per capita	-0.000163*	-0.000403*	-0.000200	-0.000121
	(0.0000967)	(0.000235)	(0.000804)	(0.000103)
GDP	0.0000649***	0.0000699	-0.0000623	0.0000679**
	(0.0000232)	(0.0000604)	(0.0000931)	(0.0000267)
Rule of law	0.000736**	0.000848	-0.000954	0.000700**
	(0.000318)	(0.000636)	(0.00176)	(0.000333)
EPL for regular contracts	0.000413	-0.00118	0.000579	0.000608
	(0.000576)	(0.00123)	(0.00129)	(0.000640)
EPL for temporary contracts	-0.000354*	-0.000502	-0.000752	-0.000233
	(0.000185)	(0.000634)	(0.000926)	(0.000217)
Corporate tax rate	-0.00150	0.00296	0.00738	-0.00181
	(0.00195)	(0.00714)	(0.0234)	(0.00222)
Financial development	-0.00189	0.00128	0.00322	-0.00208
	(0.00162)	(0.00588)	(0.0173)	(0.00183)
Corporate tax rate * Financial development	0.000494	-0.000428	-0.00118	0.000539
	(0.000485)	(0.00178)	(0.00561)	(0.000548)
Time to solve insolvency	0.000134	0.000915**	0.000471	0.000106
	(0.000162)	(0.000420)	(0.000667)	(0.000182)
Sectoral restrictions to FDI	-0.00118	-0.00267	0	-0.000974
	(0.000946)	(0.00267)	(.)	(0.00101)
Impact of service regulations	-0.00177'	0.000691	-0.0126	-0.00267**
	(0.00120)	(0.00281)	(0.0150)	(0.00132)
Barriers to entrepreneurship	-0.000599	0.00106	-0.000132	-0.000736
	(0.000793)	(0.00185)	(0.00151)	(0.000869)
Constant	0.00520	-0.00471	-0.0237	0.00556
	(0.00632)	(0.0218)	(0.0782)	(0.00702)
Observations	12,644	1,843	148	10,689

Source: ESRI estimates based on linked data from *Orbis* and WIOT data sets.
Note: Estimates are obtained with OLS estimators. The dependent variable and all continuous explanatory variables are in natural logarithms. All regressions include parent country input-output industry fixed effects. Standard errors in parentheses clustered at parent country-output industry level.' p<0.15, * p<0.10, ** p<0.05, *** p<0.01.

Looking across columns 2-4, the intensity of integrated inputs by services parent firms does not seem to be sensitive to firm characteristics with the exception of productivity and skills intensity which are negatively and positively linked in the case of services firms with manufacturing affiliates.

There are also only a few host country characteristics that significantly affect the intensity of integrated inputs by services parent companies. The intensity of integrated inputs in the case of services firms with services affiliates only is larger in less developed countries, while the intensity of integrated inputs in the case of services parent firms with affiliates in both manufacturing and services is larger in larger countries. Less efficient procedures for resolving insolvency are positively linked to the intensity of integrated inputs by services firms with services affiliates only. Finally, the intensity of integrated inputs in the case of services firms with both manufacturing and service affiliates is lower in countries where the impact of services regulations on downstream industries is larger.

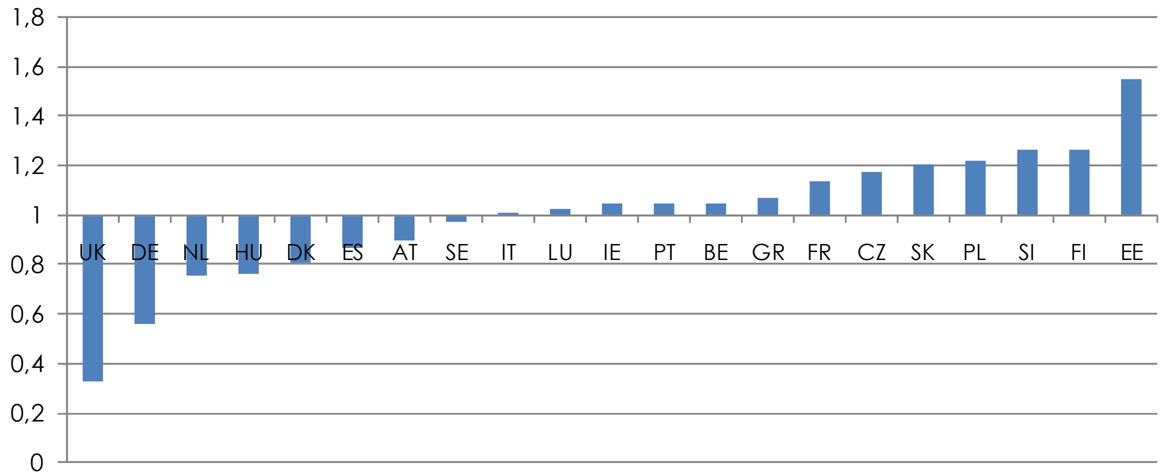
5.6. EU Countries' Institutional and Regulatory Performance

Taken together, the empirical results discussed in Section 5.5 suggest that lowering barriers to FDI and relaxing the restrictiveness of services regulations can increase the propensity of manufacturing firms to integrate manufacturing and services inputs across EU countries.

Table 5.15 in the Appendix summarises the institutional and regulatory performance of EU countries relative to the EU average. This performance is discussed below, focusing on the following: services regulations; restrictions to FDI; the quality of legal systems; the efficiency of insolvency procedures; and barriers to entrepreneurship.

Figure 5.1 shows the EU countries performance with respect to the impact of regulations in services on downstream industries. As shown in Fig. 1 below, countries which perform well in this respect include the UK, Germany, the Netherlands, Hungary, Denmark, Spain, Austria and Sweden. The impact of services regulations on manufacturing activities is particularly high in Estonia, Finland, Slovenia, Poland, Slovakia, the Czech Republic, France, and Greece. The impact of services regulations on manufacturing activities is close to the EU average in Italy, Luxembourg, Ireland, Portugal and Belgium.

Figure 5.1: The impact of services regulations: EU countries' performance relative to the EU average, 2013

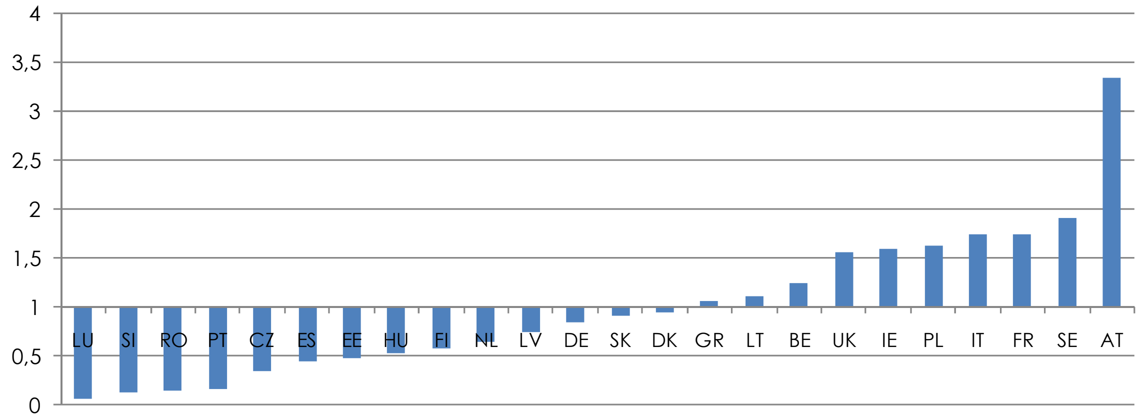


Source: OECD data, ESRI calculations.
Note: Data is not available for the following EU countries: Bulgaria, Croatia, Cyprus, Latvia, Lithuania, Malta, Romania.

Figure 5.2 shows the performance of EU countries with respect to an indicator capturing sectoral restrictions to FDI (an average of the scores for restrictions to FDI in the secondary and tertiary sectors).

Countries with a better performance than the EU average include Luxembourg, Slovenia, Romania, Portugal, Spain, Estonia, Hungary, Finland, the Netherlands, Latvia, Germany, Slovakia, and Denmark. Sectoral restrictions to FDI are particularly high in Austria, Sweden, France, Italy, Poland, Ireland, the UK and close to the EU average in Greece, Lithuania and Belgium.

Figure 5.2: Sectoral restrictions to FDI: EU countries' performance relative to the EU average, 2014

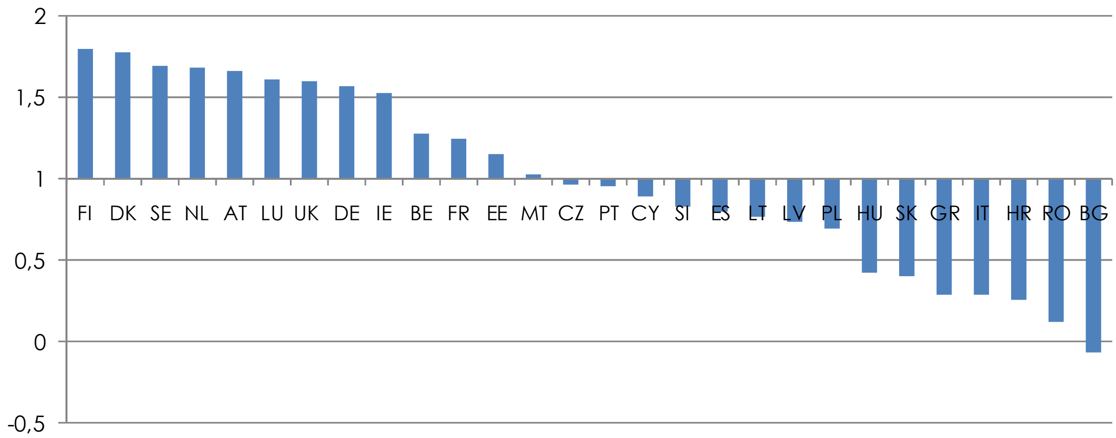


Source: OECD data, ESRI calculations.
Note: Data are not available for Bulgaria, Croatia, Cyrus and Malta.

The empirical results also indicate that the quality of contract enforcement (Rule of Law) and the efficiency of insolvency procedures increase the location probability of manufacturing affiliates.

Figure 5.3 shows the performance of EU countries with respect to the quality of contract enforcement measured.

Figure 5.3: The quality of contract enforcement (Rule of Law): EU countries' performance relative to the EU average, 2014



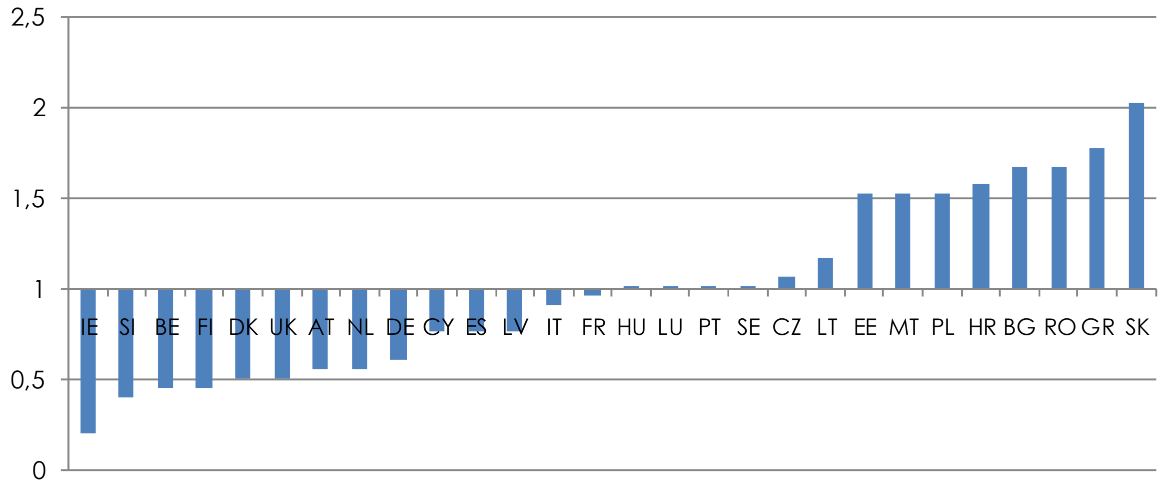
Source: World Bank data, ESRI calculations.

Countries performing very well (above the EU average) include Finland, Denmark, Sweden, the Netherlands, Austria, Luxembourg, the UK, Germany, Ireland, Belgium, France and Estonia. The quality of contract enforcement is perceived to be particularly low and it is way below the EU average in Bulgaria, Romania, Croatia, Italy, Greece, Slovakia, Hungary, Poland, Latvia, Lithuania, Spain, Slovenia, and Cyprus and close to the EU average in Malta, the Czech Republic and Portugal.

Figure 5.4 shows the performance of EU countries with respect to the efficiency of insolvency procedures measured as the time in days to solve insolvency.

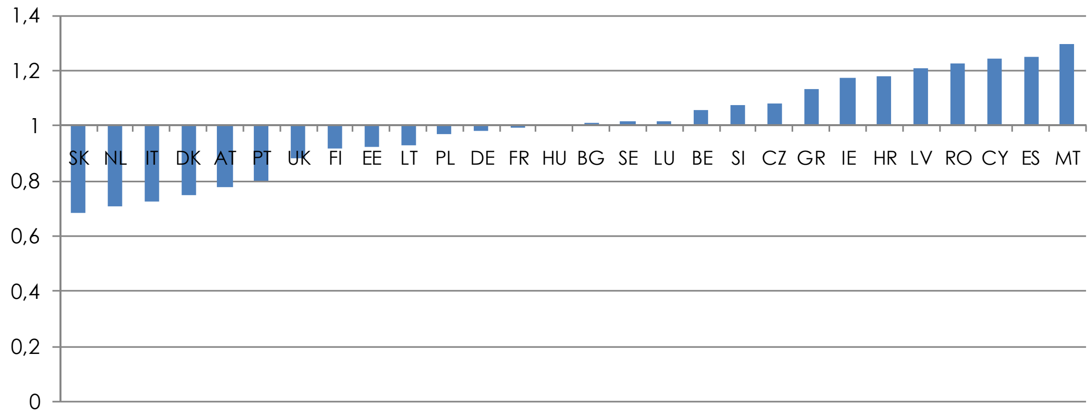
Countries performing very well in this respect include Ireland, Slovenia, Belgium, Finland, Denmark, the UK, Austria, the Netherlands, Germany, Cyprus, Spain and Latvia. At the other end of the spectrum, countries with a longer time to solve insolvency include Slovakia, Greece, Romania, Bulgaria, Croatia, Poland, Malta, Estonia and Lithuania. The rest of the EU countries are in the middle, close to the EU average: Italy, France, Hungary, Luxembourg, Portugal, Sweden and the Czech Republic.

Figure 5.4: The efficiency of insolvency procedures: EU countries' performance relative to the EU average, 2014



Source: World Bank data, ESRI calculations.

Figure 5.5: Regulatory barriers to entrepreneurship: EU countries' performance relative to the EU average, 2013



Source: OECD data, ESRI calculations.

Figure 5.5 shows the performance of EU countries with respect to freedom from barriers to entrepreneurship. Countries with the best performance include Slovakia, the Netherlands, Italy, Denmark, Austria, Portugal, the UK, Finland, Estonia and Lithuania with scores better than the EU average. Germany, France, Hungary, Bulgaria, Sweden and Luxembourg perform close to the EU average. At the other end of the spectrum, countries with scores worse than the EU average include Malta, Spain, Cyprus, Romania, Latvia, Croatia, Ireland, Greece, the Czech Republic, Slovenia and Belgium.

5.7. Key Findings and Policy Implications

This chapter examines the extent and determinants of intra-EU production and trade linkages using firm-level data. The key findings and their policy implications are discussed below.

The descriptive analysis on productivity differentials across parent groups with different structures reveals systematic productivity differences between manufacturing and services parent firms integrating manufacturing and services inputs, in favour of the latter. In terms of the group structure, i.e. separating parent companies depending on whether they integrate manufacturing inputs, service inputs or both, a *premium for specialisation* emerges: both manufacturing and service parent firms, with affiliates in both manufacturing and services have lower productivity, relative to the parents having affiliates either in manufacturing or in services.

Manufacturing firms that source inputs intra-firm via foreign direct investment (FDI) across EU countries are larger, more productive, more intensive in tangible and intangible capital and less intensive in skills than manufacturing firms that source inputs at arm's length.

Affiliates of manufacturing firms are likely to be located in large countries, in countries with lower production costs, and with lower intensity of production factors (tangible, intangible, and human capital).

The probability of integrating inputs by manufacturing firms across EU countries is positively linked with the strength of legal systems, flexibility of labour markets (less stringent employment protection legislation for regular contracts), and negatively linked to corporate tax rates and financial development in host countries. The estimates also indicate that manufacturing firms tend to locate in countries with high corporate tax rates and more developed financial systems. This result is consistent with the prediction of the literature on multinational activity and imperfect capital markets (Desai et al. 2004; Antràs et al. 2009) that affiliates are more likely to borrow in countries with high corporate tax rates where they can benefit from debt-related tax allowances. Less efficient insolvency procedures are associated with a higher probability of sourcing inputs via foreign direct investment relative to arm's length sourcing. This result is consistent with the theoretical prediction that contractual frictions incentivises firms to source inputs intra-firm.

The probability of sourcing inputs via FDI is negatively linked to sectoral restrictions to FDI and positively linked to the impact of services regulations on downstream industries. Finally, barriers to entrepreneurship in host countries do not seem to matter for the sourcing choice of manufacturing firms.

These results seem to be driven by manufacturing firms with more complex integration strategies – integrating both manufacturing and services inputs. Furthermore, this analysis highlights both similarities and differences in the integration behaviour across the three categories of manufacturing parent firms, depending on the type of integrated inputs. In terms of institutional and regulatory factors, the similarities include the positive links between the propensity to source inputs via FDI and the strength of legal systems, less stringent employment protection legislation for regular contracts, less developed financial markets, higher contractual frictions, and a higher impact of services regulations on downstream industries.

A number of other institutional factors have different impacts on the propensity of manufacturing firms to source different inputs. Manufacturing firms with both manufacturing and services affiliates are more likely to source inputs via FDI from countries with more flexible regulations for the use of temporary contracts. In contrast, manufacturing firms with manufacturing affiliates only and services affiliates only are more likely to source inputs from countries with stricter regulations for the use of temporary contracts. Manufacturing firms which source services only are more likely to source them via affiliates in countries with higher barriers to entrepreneurship. In contrast, barriers to entrepreneurship do not matter for the sourcing choices of manufacturing parent firms with manufacturing inputs only and with both manufacturing and services inputs. Low corporate tax rates and less-developed financial markets increase the propensity to source inputs via FDI in the case of manufacturing firms with services inputs only and manufacturing firms with both manufacturing and services inputs, while these factors do not matter for the sourcing choices of manufacturing firms with manufacturing inputs only.

In comparison to the estimates for the sourcing choice discussed above, firm characteristics are less important for the intensity of integrated inputs by manufacturing firms.

The average intensity of intra-EU integrated inputs by manufacturing firms is higher in large countries and in countries with higher R&D intensity and higher GDP per capita. It is lower in countries more intensive in tangible capital.

Similarly to the sourcing choices for manufacturing firms, the intensity of integrated inputs is higher from sourcing countries with stronger legal systems, low corporate tax rates, less-developed domestic financial markets and in countries with less efficient procedures to resolve insolvency. Barriers to FDI, the impact of services regulations on downstream industries, and barriers to entrepreneurship in the host countries do not significantly affect the intensity of integration inputs by manufacturing firms.

The intensity of integrated inputs by manufacturing firms appears to be most sensitive to host country characteristics including institutional and regulatory characteristics in the case of manufacturing firms which integrate manufacturing inputs only. The intensity of integrated inputs in the case of manufacturing parent firms with affiliates in manufacturing only is higher in countries with stronger legal systems, less stringent EPL for regular contracts, more stringent EPL for temporary contracts, lower corporate tax rates, less developed financial markets, higher contractual frictions, lower barriers entrepreneurship, and a lower impact of service regulations on downstream industries. Over and above these effects, the intensity of integrated inputs by manufacturing firms with manufacturing affiliates only is higher in countries with higher corporate tax rates and more developed financial markets. In the case of manufacturing parent firms with services affiliates only, the intensity of integrated inputs is higher in countries with higher contractual frictions and it is not sensitive to other institutional and regulatory characteristics. In the case of manufacturing firms with both manufacturing and services affiliates, the intensity of integrated inputs is positively associated with the strength of legal systems, contractual frictions, low corporate tax rates, and less-developed financial markets. Over and above these effects, the intensity of integrated inputs by manufacturing firms with both manufacturing and services affiliates is higher in countries with higher corporate tax rates and more-developed financial markets. The intensity of integrated inputs by services firms does not seem to be linked to parent firms' characteristics. The intensity of integrated inputs by services firms increases with economic size and the strength of legal systems. It is larger in less-developed countries and in countries with less flexibility of regulations for the use of temporary contracts. This latter result is however only marginally significant.

The intensity of integrated inputs by service parent companies is less sensitive to economic and institutional characteristics in host countries. Less efficient procedures for resolving insolvency are positively linked to the intensity of integrated inputs by services firms with services affiliates only. Finally, the intensity of integrated inputs in the case of services firms with both manufacturing and service affiliates is lower in countries where the impact of services regulations on downstream industries is larger.

Taken together, the results of this analysis suggest that strengthening the quality of legal systems, lowering barriers to FDI and increasing the flexibility of labour markets could enable and intensify the integration of production inputs across EU countries.

Improving financial development and the efficiency of procedures for resolving insolvencies is likely to increase the likelihood of sourcing inputs at arms' length. Lowering barriers to entrepreneurship in host countries could also foster the sourcing of production inputs at arm's length.

Lowering service regulations across EU countries is likely to foster the sourcing of inputs from downstream industries.

Given the heterogeneity of institutional and regulatory characteristics of EU countries, such policy measures need to be tailored to country-specific conditions. The European Commission could play an important role in benchmarking and facilitating the adoption of best practices among EU Member States.

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5.9. Appendix to Chapter 5

Table 5.14: Description of variables and data sources

Variable	Description	Data source
Firm-level variables		
Productivity	Value added per employee	Orbis
Tangible capital stock	Total fixed assets per employee	Orbis
Intangible capital stock	Total intangible fixed assets per employee	Orbis
Human capital	Total labour cost per employee	Orbis
Size	Total number of employees	Orbis
Country factors		
Capital intensity	Gross fixed capital formation, % of GDP	World Bank
Human capital	Share of labour force with tertiary education	World Bank
R&D intensity	Private and public R&D expenditures (current and capital expenditures), % of GDP	World Bank
GDP per capita	GDP per inhabitant	World Bank
GDP	GDP	World Bank
Policy variables		
Rule of law	Synthetic indicator capturing agents' confidence in the quality of contract enforcement, property rights, the police and the court, the likelihood of crime and violence	World Bank
EPL for regular contracts	Synthetic indicator measuring the strictness of regulations on dismissals for regular contracts	OECD
EPL for temporary contracts	Synthetic indicator measuring the strictness of regulations on the use of temporary contracts	OECD
Financial development	Domestic bank credit to the private sector, % of GDP	World Bank
Efficiency of insolvency	Number of days to solve insolvency	World Bank
Sectoral restrictions to FDI	Index for the regulations' restrictiveness to FDI – average across secondary and tertiary sectors	OECD
Impact of service regulations	Synthetic indicator measuring the potential costs of anti-competitive regulations in services on sectors that use the output of services as intermediate inputs in the production process	OECD; Égert and Wanner (2016)
Barriers to entrepreneurship	Index for regulations' restrictiveness to entrepreneurship	OECD

Table 5.15: Institutional and regulatory performance of EU countries relative to the EU

Countries	EPL regular contracts home	EPL temporary contracts home	Impact of service regulations	Sectoral restrictions to FDI	Barriers to entrepreneurship	PMR total home	Rule of Law	Labor Market Regulations	Domestic Bank Credits to Private Sector	Time to resolve Insolvency	Education	GDP home	GDP capita home
AT	1.061	0.735	0.894	3.347	0.777	0.827	1.661	0.834	0.973	0.558	0.982	0.652	1.469
BE	0.848	1.330	1.048	1.240	1.056	0.961	1.283	1.055	0.642	0.457	1.290	0.801	1.374
BG	n/a	n/a	n/a	n/a	1.008	1.092	-0.066	1.079	0.657	1.674	0.920	0.084	0.225
CY	n/a	n/a	n/a	n/a	1.240	1.144	0.899	1.139	2.762	0.761	1.343	0.037	0.831
CZ	1.310	0.805	1.173	0.345	1.079	0.975	0.964	1.182	0.549	1.065	0.690	0.343	0.627
DE	1.200	0.630	0.558	0.848	0.981	0.891	1.572	0.872	0.875	0.609	0.839	5.816	1.383
DK	0.985	0.770	0.809	0.942	0.747	0.839	1.777	1.102	1.948	0.507	1.004	0.537	1.832
EE	0.811	1.680	1.552	0.476	0.925	0.896	1.158	0.881	0.752	1.522	1.234	0.037	0.535
ES	0.917	1.435	0.869	0.457	1.248	1.000	0.795	0.814	1.427	0.761	1.156	2.194	0.909
FI	0.971	0.875	1.261	0.587	0.917	0.897	1.800	0.814	1.032	0.457	1.259	0.395	1.394
FR	1.068	2.030	1.140	1.753	0.999	1.018	1.245	0.838	1.042	0.964	1.134	4.385	1.274
UK	0.491	0.210	0.328	1.557	0.881	0.752	1.602	1.192	1.526	0.507	1.243	4.200	1.252
GR	0.949	1.260	1.072	1.063	1.135	1.207	0.293	0.664	1.286	1.775	0.957	0.392	0.693
HR	n/a	n/a	n/a	n/a	1.178	1.439	0.264	0.999	0.764	1.572	0.752	0.092	0.417
HU	0.711	0.700	0.762	0.531	1.004	0.921	0.422	0.969	0.476	1.014	0.786	0.222	0.433
IE	0.626	0.350	1.047	1.604	1.173	1.009	1.529	1.071	0.897	0.203	1.308	0.384	1.601
IT	1.200	1.120	1.010	1.744	0.726	0.894	0.286	0.977	0.981	0.913	0.600	3.270	1.036
LT	n/a	n/a	n/a	1.110	0.931	1.051	0.769	1.161	0.452	1.167	1.228	0.070	0.460
LU	1.006	2.100	1.021	0.065	1.017	1.011	1.609	0.884	1.010	1.014	1.485	0.094	3.261
LV	n/a	n/a	n/a	0.755	1.207	1.115	0.734	1.133	0.566	0.761	0.998	0.044	0.426
MT	n/a	n/a	n/a	n/a	1.296	1.087	1.024	1.138	1.158	1.522	0.749	0.016	0.713
NL	1.264	0.525	0.756	0.653	0.708	0.635	1.682	1.086	1.278	0.558	1.044	1.363	1.556
PL	0.999	0.980	1.221	1.632	0.971	1.143	0.694	1.141	0.576	1.522	0.963	0.857	0.434
PT	1.426	1.015	1.047	0.168	0.801	0.898	0.959	0.902	1.427	1.014	0.718	0.358	0.663
RO	n/a	n/a	n/a	0.149	1.225	1.170	0.127	1.070	0.343	1.674	0.569	0.292	0.282
SE	1.168	0.455	0.971	1.921	1.015	1.054	1.691	0.989	1.446	1.014	1.144	0.831	1.650
SI	1.166	1.015	1.261	0.140	1.073	1.180	0.828	0.922	0.606	0.406	0.957	0.077	0.717
SK	0.825	0.980	1.201	0.914	0.682	0.893	0.401	1.093	0.550	2.029	0.650	0.156	0.554
EU	1	1	1	1	1	1	1	1	1	1	1	1	1

Table 5.16: Determinants of sourcing choices for manufacturing firms, intra-EU vertical production linkages. Estimates with parent firm fixed effects.

	(1)	(2)	(3)	(4)
	All Manufacturing HQ	Man HQ – Serv. Affiliates	Man HQ – Man Affiliates	Man HQ – Man **&** Serv. Affiliates
Host country characteristics				
Tangible capital intensity	-0.00139**	-0.000472***	0.00000649	-0.00623***
	(0.000550)	(0.000174)	(0.0000660)	(0.00238)
Human capital	-0.000937**	-0.00141***	-0.000134**	-0.00228
	(0.000417)	(0.000173)	(0.0000595)	(0.00183)
R&D intensity	-0.000422*	-0.0000293	0.0000422	-0.00167*
	(0.000229)	(0.000106)	(0.0000369)	(0.000937)
GDP per capita	-0.000470***	-0.0000892*	-0.0000200	-0.00186***
	(0.000104)	(0.0000480)	(0.0000212)	(0.000410)
GDP	0.000519***	0.000184***	0.0000547***	0.00191***
	(0.0000701)	(0.0000332)	(0.0000118)	(0.000258)
Rule of law	0.00335***	0.00147***	0.000157**	0.0129***
	(0.000635)	(0.000200)	(0.0000760)	(0.00271)
EPL for regular contracts	-0.00147**	-0.000967***	-0.000179**	-0.00497*
	(0.000636)	(0.000176)	(0.0000719)	(0.00274)
EPL for temporary contracts	-0.0000876 (0.000308)	0.000729*** (0.000147)	0.000120*** (0.0000439)	-0.00178 (0.00128)
Corporate tax rate	-0.0164***	-0.00482***	0.00000731	-0.0645***
	(0.00296)	(0.00129)	(0.000414)	(0.0112)
Financial development	-0.0135***	-0.00370***	0.0000278	-0.0542***
	(0.00247)	(0.000973)	(0.000328)	(0.00962)
Corporate tax rate x Financial development	0.00398*** (0.000731)	0.00110*** (0.000296)	-0.0000316 (0.000100)	0.0159*** (0.00281)
Time to solve insolvency	0.000579***	0.000183**	0.000119***	0.00226***
	(0.000203)	(0.0000825)	(0.0000337)	(0.000845)
Sectoral restrictions to FDI	-0.000139	0.00327***	-0.00161***	-0.00398'
	(0.000594)	(0.000461)	(0.000260)	(0.00247)
Impact of service regulations	-0.00313*** (0.000403)	-0.00123*** (0.000152)	-0.000277*** (0.0000418)	-0.0112*** (0.00152)
Barriers to entrepreneurship	0.000324 (0.000418)	0.000957*** (0.000240)	-0.000153* (0.0000781)	0.000729 (0.00184)
Constant	0.0579***	0.0189***	0.000199	0.230***
	(0.0105)	(0.00427)	(0.00144)	(0.0421)
Observations	7310487	2803345	2282961	1665815

Source: ESRI estimates based on linked data from *Orbis* and WIOT data sets.
Notes: Estimates are obtained with linear probability estimators. All continuous explanatory variables are in natural logarithms. All regressions include parent companies fixed effects and parent country input-output industry fixed effects. Standard errors in parentheses clustered at parent country-output industry level. * p<0.10, ** p<0.05, *** p<0.01.

Table 5.17: Determinants of the intensity of integrated inputs by manufacturing firms, intra-EU vertical production linkages. Estimates with parent firm fixed effects.

	(1)	(2)	(3)	(4)
	All Manufacturing HQ	Man HQ – Serv. Affiliates	Man HQ – Man Affiliates	Man HQ – Man **&** Serv. Affiliates
Host country characteristics				
Tangible capital intensity	-0.00493***	-0.00621*	-0.00492	-0.00505***
	(0.00167)	(0.00318)	(0.00344)	(0.00181)
Human capital	-0.00105	0.00119	-0.00781***	-0.00120
	(0.00138)	(0.00195)	(0.00154)	(0.00144)
R&D intensity	0.00125*	0.00222'	0	0.00121'
	(0.000710)	(0.00147)	(.)	(0.000771)
GDP per capita	0.00115**	0.00195'	-0.000891	0.00117**
	(0.000446)	(0.00123)	(0.00136)	(0.000480)
GDP	0.000666***	0.000799***	0.00165***	0.000650***
	(0.000113)	(0.000238)	(0.0000792)	(0.000121)
Rule of law	0.00401***	0.00188	0	0.00413***
	(0.00131)	(0.00232)	(.)	(0.00137)
EPL for regular contracts	0.000504	0.0000565	-0.00118	0.000531
	(0.00111)	(0.00163)	(0.000861)	(0.00117)
EPL for temporary contracts	-0.00132*	0.000945	0.00383**	-0.00151*
	(0.000757)	(0.000981)	(0.00165)	(0.000799)
Corporate tax rate	-0.0301**	-0.00308	0	-0.0316**
	(0.0127)	(0.0178)	(.)	(0.0138)
Financial development	-0.0268***	-0.00312	-0.000795	-0.0283**
	(0.0101)	(0.0143)	(0.000736)	(0.0109)
Corporate tax rate x Financial development	0.00747**	0.000384	-0.000881***	0.00788**
	(0.00300)	(0.00425)	(0.000260)	(0.00324)
Time to solve insolvency	0.00153***	0.00309**	-0.00429***	0.00147**
	(0.000539)	(0.00145)	(0.000945)	(0.000566)
Sectoral restrictions to FDI	0.000232	-0.000951	0.00416	0.000368
	(0.00216)	(0.00584)	(0.00576)	(0.00222)
Impact of service regulations	0.00123	-0.00192	-0.0417	0.00148
	(0.00144)	(0.00427)	(0.0493)	(0.00150)
Barriers to entrepreneurship	0.00287'	0.00354	0	0.00300'
	(0.00194)	(0.00259)	(.)	(0.00203)
Constant	0.108**	0.00592	0.0446**	0.115**
	(0.0437)	(0.0646)	(0.0177)	(0.0472)
Observations	5300	800	147	4316

Source: ESRI estimates based on linked data from *Orbis* and WIOT data sets.
Notes: Estimates are obtained with OLS estimators. The dependent variable and all continuous explanatory variables are in natural logarithms. All regressions include parent company fixed effects, as well as country input-output industry fixed effects. Standard errors in parentheses clustered at parent country-output industry level.' p<0.15, * p<0.10, ** p<0.05, *** p<0.01.

Table 5.18: Determinants of the intensity of integrated inputs by services firms, intra-EU vertical production linkages. Estimates with parent firm fixed effects.

	(1)	(2)	(3)	(4)
	All Services HQ	Serv. HQ – Serv. Affiliates	Serv. HQ – Man. Affiliates	Serv. HQ – Man. **&** Serv. Affiliates
Host country characteristics				
Tangible capital intensity	-0.000603*	-0.00121	-0.0000327	-0.000588'
	(0.000360)	(0.00165)	(0.000622)	(0.000366)
Human capital	0.000405	0.000625	-0.000495	0.000413
	(0.000512)	(0.00165)	(0.000697)	(0.000534)
R&D intensity	-0.000230	0.00101	0	-0.000281
	(0.000293)	(0.000963)	(.)	(0.000297)
GDP per capita	-0.0000825	-0.000601**	-0.0000276	-0.0000607
	(0.000122)	(0.000292)	(0.000428)	(0.000128)
GDP	0.0000737**	0.000146**	0.0000163	0.0000654**
	(0.0000309)	(0.0000733)	(0.000120)	(0.0000305)
Rule of law	0.00110***	0.000864	0.000490	0.00110***
	(0.000389)	(0.000870)	(0.000364)	(0.000393)
EPL for regular contracts	0.000391	-0.000193	0.0000111	0.000421
	(0.000610)	(0.00188)	(0.000983)	(0.000624)
EPL for temporary contracts	-0.000285	-0.000735	0.000378'	-0.000265
	(0.000231)	(0.000661)	(0.000253)	(0.000226)
Corporate tax rate	-0.00407'	-0.00111	0	-0.00440'
	(0.00264)	(0.00852)	(.)	(0.00291)
Financial development	-0.00386*	-0.00204	0	-0.00412*
	(0.00218)	(0.00684)	(.)	(0.00238)
Corporate tax rate x Financial development	0.00108*	0.000589	-0.0000270	0.00116'
	(0.000651)	(0.00205)	(0.000144)	(0.000712)
Time to solve insolvency	0.000123	0.000740	-0.000408	0.0000989
	(0.000237)	(0.000550)	(0.000323)	(0.000246)
Sectoral restrictions to FDI	-0.0000524	-0.00186	0	-0.0000355
	(0.000598)	(0.00308)	(.)	(0.000587)
Impact of service Regulations	-0.000486	0.00128*	-0.00453	-0.000615'
	(0.000387)	(0.000735)	(0.0139)	(0.000418)
Barriers to entrepreneurship	-0.000446	-0.0000413	0	-0.000501
	(0.000812)	(0.00237)	(.)	(0.000850)
Constant	0.0143'	0.00494	0.00213	0.0155'
	(0.00883)	(0.0258)	(0.00158)	(0.00967)
Observations	12747	1881	154	10749

Source: ESRI estimates based on linked data from *Orbis* and WIOT data sets.
Notes: Estimates are obtained with OLS estimators. The dependent variable and all continuous explanatory variables are in natural logarithms. All regressions include parent company fixed effects, as well as country input-output industry fixed effects. Standard errors in parentheses clustered at parent country-output industry level.' p<0.15, * p<0.10, ** p<0.05, *** p<0.01.

6. Summary and policy implications

This report offers an extensive analysis of the effects of the Single Market of the European Union. The analysis has shed light on four interrelated aspects. It first revealed asymmetric economic performance, which mirrors structural differences across Member States. These differences in economic outcomes were confronted with measures of the Single Market, economic institutions, changes in demand patterns and producer price developments. Next, the changes in value chains were tracked over time, and also put into a global perspective. Eventually, firm level evidence complemented these findings. These results are highly relevant for policies at the Member State and EU levels.

The economic analyses of the Single Market and the performance of its Member States are motivated by a structuralist perspective. The starting point of the performance diagnostics is the tradable-nontradable framework, which splits the economy by the degree of tradability of sector output. Tradability is perceived as an industrial property. Not all tradable goods and services are effectively traded. For instance, it is conceivable that goods classified as highly tradable (e.g., machinery and equipment) are traded by more competitive countries, whereas they are not traded at all by firms in economies suffering from poor trade competitiveness. From a purely structural perspective, a larger share of tradable goods is associated not only with greater export potential, but also with more competitiveness. A shift from a current account deficit to a current account surplus involves a shift in the composition of domestic production.

A higher share of industries providing goods and services which are rather tradable can be interpreted as an indicator of external competitiveness. The share of nontradable goods production increased significantly in the peripheral countries of the EU prior to the financial crisis. Against this background, the output composition of the "South" countries was rather distinct to the one of "Core" and "CEE" EU countries, where it remained more or less flat or even declined on average. The "South" countries in turn were those which faced the severest recessions, especially with regard to their duration, and to a lesser extent with respect to the amplitude of the economic downswing. This characterises the increasingly unstable output composition in the "South" countries prior to the crisis. These supply side imbalances were mirrored by the ever higher current account deficits, which identified the corresponding imbalance on the demand side. The supply side rebalancing has started in several "South" countries (e.g., Spain or Greece), bringing the output composition back to a more sustainable trajectory. An increasing share of tradables also mirrors improving overall competitiveness, greater opportunities to benefit from global upswings, and economic structures that render adjustments due to contractions in output less painful.

The sector of tradable goods and services contributes more to aggregate productivity than nontradables. Hence, the sector structure is a determinant of aggregate productivity. The data show great performance variance across countries and industries. Even if economies perform poorly at the aggregate level they may exhibit highly productive sectors. However, as countries grow in aggregate performance their inter-sectoral productivity differences decrease. Tradable sectors were found to be a substantial determinant of aggregate labour productivity, much more so than nontradables. This is also supported by a TFP analysis that finds that the contributions of multifactor productivity growth of tradables to aggregate labour productivity growth are much larger than the contributions of nontradables.

The sector structures differ across Member States. Hence, there is different productivity growth potential from a hypothetical structural adjustment. The different elasticity of tradables and nontradables on aggregate performance implies that sector composition is a determinant of aggregate productivity. Hence, there is potential for productivity growth from hypothetical structural adjustments. The scenario analysis shows that the labour productivity of Greece, Romania, Croatia, Ireland, Cyprus Bulgaria, Portugal, Slovenia and Italy in particular would grow in aggregate productivity if they were able to implement the sector structures of the most labour-productive countries in the sample (Belgium, Denmark and the Netherlands). The UK and Luxemburg would lose from an adjustment of industrial structures, which can be explained by their peculiar industrial structures that are dominated by financial sectors with high apparent labour productivity.

Productivity growth was highest in the bulk of the Core countries of the EU. In the pre-crisis period, Sweden, Finland and Austria exhibited the highest labour productivity growth rates. The productivity growth rates in the Core countries prior to the crisis were largely driven by within-sector productivity increases. The lowest productivity growth was found in Italy, Spain and Bulgaria. In the post-crisis period, the aggregate annual labour productivity growth dropped. The three best performing countries were Denmark, Ireland and Sweden, and the lowest productivity increases after 2008 were observable in Greece, Bulgaria and the United Kingdom.

The productivity growth contributions mirror the macroeconomic development. In countries that weathered the crisis well, the largest growth contribution came from within-sector productivity gains from tradables. The countries that later suffered severely from imbalances exhibited the largest contributions to productivity gains from structural shifts towards nontradables. A shift-share analysis decomposed productivity growth before and after the crisis into a within-sector effect and a structural change effect, defined as the sum of the between-sector effect and the interaction effect. The economies that later suffered from structural imbalances showed productivity growth which was largely driven by structural change, i.e. by the sum of the between-sector effect and the interaction effect. Corresponding with the macroeconomic findings, there was a shift in the relevance for productivity growth towards nontradable sectors. This was observable across the EU. For instance, these accounted for more than half of the productivity growth in Cyprus, Greece, Spain and Italy, whereas they contributed less than a quarter in three countries with the highest growth rates. In the post-crisis period, productivity growth from structural change nearly came to a halt across all EU economies. Productivity increases almost exclusively occurred within sectors, which suggest re-balancing mechanisms that are captured by productivity statistics. In addition, the role of nontradable sectors in productivity growth dropped throughout the EU, with the notable exception of Greece, where post-crisis growth of labour productivity continues to hinge on nontradables. These results are worrying from a catching-up perspective. Less productive economies should exhibit higher productivity growth rates than more productive ones.

Consumption trends point at an increasing importance of nontradables with increasing aggregate productivity. This puts the structural, supply side interpretation into perspective. The tradable-nontradable framework is – by and large – a supply side, structuralist approach that tends to focus on external competitiveness. Only implicitly does it consider demand side aspects. Consumption studies offer an alternative explanation. It seems that (at least certain) nontradable goods and services are increasingly consumed as countries grow in their wealth. In the first half of the 2000s, there were substantial changes in the commodity structure across all EU Member States. The consumption of nontradables grew rapidly at the expense of domestically produced tradables. This development was equally borne by intermediate demand and private consumption. In later years, nontradables lost some of their shares to imported tradables from both within and outside the common market. However, there are substantial country differences. The economies in the South witnessed a massive boom in the consumption of nontradables, which came at the expense of tradables from all three sources (domestic, intra-EU and extra-EU). In the aftermath of the crisis, these countries returned to a consumption pattern which corresponds with the demand pattern of other countries.

The tradable-nontradable approach has implications for macroeconomic imbalances. The observed structural shifts seem to be an indicator of weakening external competitiveness, which has implications for the trade and current account deficit. A large share of nontradables restricts an economy's ability to balance its current account. Hence, there is a structural implication of the tradable-nontradable approach. Reducing net debt levels by moving from a borrowing to a repayment position implies a shift in the composition of the output produced – less nontradable goods production relative to tradable goods production. Certainly, this is difficult to achieve, since sector structures are the outcome of institutional factors, factor endowments and idiosyncratic comparative advantages. Nevertheless, the mechanisms observed in the tradable-nontradable approach suggest that Member States should seek to avoid macroeconomic imbalances by implementing structural policies which favour tradables over nontradables. Also, the nontradable sector has been found to be less relevant for aggregate productivity. However, it is unclear if this finding is axiomatic, or if the functioning of the sector can be changed by economic policies to make nontradables more dynamic.

The tradability approach serves as a link between economic structures and trade competitiveness. Tradability as a characteristic of goods and services motivates the analysis of the Single Market, but is not an integration indicator in itself. The macroeconomic TNT framework serves as a link between economic structures and trade competitiveness. It links trade competitiveness to economic structures and performance on a macroeconomic level. The more competitive an economy becomes, the higher the share of sectors providing tradable goods and services is. To study this mechanism, a straightforward dichotomy of tradables and nontradables is used in the performance diagnostics chapter which motivates the study. Tradability is a mere industrial property, and not a market integration indicator *per se*. The subsequent chapters disaggregate this macroeconomic approach, and use the sector level information, thereby considering interactions at both the macro- and microeconomic level. A series of additional integration indicators are used, and a steady index of tradability which is based on value chain trade serves as a control variable for an industrial property. Eventually, the TNT approach is relinquished altogether when value chains and firm-level sourcing decisions are studied. Both rely on the modern trade framework in which all goods and services are regarded as tradable.

International trade increased, while demand from both the Single Market and from extra-EU economies grew in importance. Overall, the consumption of domestically produced goods has decreased, and both imports and exports have increased more than proportionally. In Europe as a whole, extra-EU imports grew more quickly than intra-EU imports. Furthermore, extra-EU exports grew more quickly than their intra-EU exports, mirroring the growing importance of an extra-EU destination. This trend is mainly driven by the Core countries, which were able to expand their net export surplus vis-a-vis extra-EU countries. The countries of the CEE and South regions were able to diminish their trade deficits, integrating themselves into the Single Market rather than seeking extra-EU trading partners.

Integration into the Single Market can take various forms. Two types of indicators are chiefly applied: EU Membership status and intra-EU trade linkages. There is an ongoing discussion about the adequate measurement of the Single Market and European integration. The present report makes use of two broad aspects. The first dimension analysed reflects the effect of EU membership. This is an important aspect, since joining the European Union requires an accession country to reform its institutions and harmonise its legislation. The channel through which this occurs is the implementation of the Community Acquis, the accumulated legislation, legal acts, and court decisions which constitute the body of European Union law. The second dimension explored is the participation in the Single Market, which is captured by two trade and value chain related measures. Both indicators are based on WIOD data, and consider an upstream (backward linkage) integration measure, and a downstream (forward linkage) measure. The indicators are defined as a 'surplus', i.e. the difference between EU and non-EU linkages. The indicator can also be interpreted as the degree of regional (EU) contribution as opposed to global contribution to value added trade. These indicators were linked to employment and labour productivity in levels and growth rates, as well as industrial dynamics.

EU accession led to employment and value added gains in accession countries. This suggests a prominent role of the Community Acquis over and above trade and FDI relations with other EU Member States. A status index was defined to capture the effect of accession processes, i.e. the impact of switching from being a candidate country to being a Member State. This status variable was considered as an explanatory factor over and above effective trade related integration measures. The results robustly show that becoming a Member State in particular increases sectoral value added and, to a lesser extent, employment. However, EU accession exerted a negative effect on employment, which especially holds for more tradable industries. This can be explained by the acceleration of the economic and institutional transition process which was a consequence of accession.

EU accession induced more modest producer price dynamics. Accession also lowers producer price inflation. Both indicate a more efficient allocation system. EU membership facilitated an economic catching up process of the New Member States. This is, for instance, mirrored by producer price inflation rates. These were higher in nontradables than in tradables in many CEE countries, which can be interpreted as a currency appreciation in a Balassa-Samuelson framework.

The catching-up process of CEE countries is also reflected by strong industrial turbulence. The catching up process that occurred after joining the EU is also reflected by industrial turbulence indicators. Firm entry, firm exit and the turnover of firms seem to decrease with the relative economic position. These indicators therefore tend to be higher in CEE countries. Only the share of high growth firms seems to decrease with the distance to frontier countries, indicating that firm growth is a different industrial process than firm turbulence. These patterns are robust reflections of structures, although the industrial dynamics themselves are cyclical.

Forward integration in European value chain trade is positively related to employment and value added. Backward integration in European value chains is positively associated with employment, and to a lesser degree with value added. The regression results indicate that there is a positive relation between downstream integration in European value chains and employment. Industries with higher degrees of forward integration also exhibit higher levels of value added. Higher degrees of backward integration in EU value chain trade are positively related to employment levels. Higher degrees of sourcing from other EU countries tend to be slightly positively or insignificantly related to value added. The results for value added are generally weaker than the effects for employment.

Economic institutions moderate the effects of market integration on employment and value added. Trade patterns and value chains are determined by competitive advantages, which are shaped by economic policies. Institutions serve as vehicles of integration through which employment and productivity gains materialise. In other words, policy makers indirectly influence economic outcomes and thereby the dispersion of production and economic integration across Member States. In this interpretation, the often attested "Single Market gap" is an outcome of different institutional performances at the Member State level. To this end, the analysis of the effect of trade integration on labour productivity has been expanded by an exploratory analysis of institutions. It studied the joint effect of trade integration into the Single Market and economic institutions on employment and value added. With respect to institutions, the overall quality of the governance system, use of external finance and labour market flexibility were analysed. The results show that the extent of the positive effect of Single Market integration on employment and value added is strongly driven by the presence of high quality institutions. In other words, the availability of sound institutions and deeper market integration jointly increase employment. These results stress the importance of a high institutional quality at the Member State level, which moderate the effects of integration into the Single Market.

The effects of trade integration on economic outcomes are procyclical and increase in magnitude with the general tradability of a sector's goods and services. The effects of integration on employment and value added levels increase with the general tradability of the goods and services produced by a sector. This implies that the effects of market integration get transmitted into the Member States' economies through sectors with higher tradability. This also implies that the effects of the Single Market are procyclical. The present analysis focuses on structural characteristics, but the economic effects are eventually moderated by the volume of value chain trade, which fluctuates with the business cycle. This notion is also supported by the previous performance diagnostics, which found that the value added share of sectors with high tradability dropped in countries that later suffered from structural imbalances. This resulted in a weakening of the effects of economic integration into the Single Market. Also, the institutional setting contributes to the pro-cyclical nature of trade effects. On the one hand, sound institutions facilitate growth processes in economic upswings. On the other hand, they cannot slow down economic downturns, but potentially shorten their duration. Hence, not only institutional reform itself is an effort which takes time, but also its effects on economic outcomes are rather observable in the long term.

The most important institutional aspects are a sound legal system, government effectiveness and to a lesser degree labour market regulation. Not all analysed domestic institutions were found to be equally relevant. The findings suggest that the rule of law indicator, in particular, and overall government effectiveness are important aspects. These indicators seek to capture the overall quality of the public administration, the availability of modern infrastructure and a sound legal system and the presence of an impartial judiciary. In addition, many countries have taken great strides towards freer and less regulated labour markets. The results for labour market freedom were mixed, however. There was some evidence that intermediate levels of labour market regulations seem to be best for employment and industrial dynamics. Then again, there is also some evidence that freer labour markets tend to attract FDI and facilitate local sourcing; and these effects may be non-linear. The results hint at slightly negative effects of more flexible labour markets on value added. The use of external finance – especially from shareholders – was found to be less important for long-run sectoral productivity growth. However, a significantly positive effect on the level of sectoral employment and value added was found. Certainly, the banking system plays an important role in selecting investment projects via its lending decisions, and is the key player in the transmission of financial shocks. However, the presently analysed, rather developmental issue 'access to finance' seems to be less of an issue in the EU.

Sound institutions favour within-sector productivity growth, which suggests that institutions foster path dependence. An additional analysis used the results of the previous shift-share analysis, and estimated the growth contributions from within-sector productivity growth and structural change. The analysis interacted trade integration with market integration indicators to study their joint effect on productivity growth. The results suggest that sound institutions and well-integrated markets facilitate productivity increases within established sectoral structures. This effect suggests that good institutions favour path dependence. Especially backward integration with other EU Member States is a strong contributor to within-industry productivity growth. Given that most productivity growth stems from within-industry contributions, this is an important finding that corroborates the reform agenda with regard to Rule of Law, public services and infrastructure availability. The contributions to productivity growth from a change in the sector composition are negative in countries with a better legal system and more integrated industries. This should be interpreted against the background of the structural change pattern, where productivity gains from structural change mainly came from the less productive nontradable sector.

The bulk of the differences in the long-run productivity growth rates can be explained by domestic institutions, especially the rule of law and government effectiveness. A scenario analysis indicated that the bulk of the differences in the long-run productivity growth rates can be explained by domestic institutions such as the rule of law or the overall government effectiveness capturing the quality of infrastructure, the public administration and education. In other words, the asymmetries of growth performance can be linked to economic institutions, and a hypothetical policy reform can therefore stimulate growth and catching up. In this analysis, trade based indicators for integration into the Single Market served as vehicles through which productivity effects materialise.

Economic performance asymmetries across Member States are also reflected by the industrial dynamics at the sector level. Forward integration leads to a decrease in the entry rate. Backward integration reduces exit rates. Economic integration into the Single Market affects industrial dynamics. Forward and backward integration into European value chains are negatively associated with firm turnover rates. However, the turnover rate is a composite indicator, which consists of both entry and exit rates. The results for the individual components are more nuanced. Forward integration leads to a decrease in the entry rate, pointing at sunk costs. Backward integration reduces exit rates, suggesting a stabilising function of intra-EU sourcing. Also these analyses support the prominent role of institutions. There are positive interaction effects between backward integration and the rule of law on industry turbulence, while labour market flexibility seems to have a mixed effect on industry turbulence and high growth firms. An intermediate level of labour market flexibility seems to be associated with both higher turnover rates and a higher share of high growth firms.

Given the importance of Single Market Integration for competitiveness, the following explores the dynamics in international value chains. The expansion of international value chains has

indeed come to a halt in the years after 2011. Cross-border production sharing between countries has dramatically altered international trading patterns. In view of the joint cross-border production processes, numerous products would deserve the designation 'Made in the World', as suggested by the WTO initiative of the same name – although in general there is the perception that international value chains are predominantly regional in scope. However, since the Great Recession there have been concerns that the trend towards geographically dispersed production has come to a halt. Indeed, based on a measure of international value chain (VC) trade termed re-exported domestic value added, which refers to exports of intermediates that cross international borders at least twice, accounting for about 17% (2014) of total EU gross exports, it can be shown that VC trade has been stagnating since 2011 at a level of about 26% of value added exports. Hence, there is new evidence confirming the conjecture that the expansion of international value chains has come to a halt in the post-crisis period (2011-2014).

Globally, there is some evidence that certain value chains have disintegrated. This is not observable in the European Union. Some of the potential reasons for the loss of dynamism in VC trade that is observed are, among other factors, the re-shoring of initiatives and protectionist tendencies trying to 'bring manufacturing back' and increase domestic value added contributions to exports. This gives rise to the fear that international value chains may be dismantled. Comparing different types of export flows is informative in this context. In particular, in the post-crisis period – and in contrast to the longer-term trend – the growth of value added exports exceeded that of gross exports. In addition, VC trade was less dynamic than value added exports (except in the case of advanced manufacturing industries) at the global level which could indeed be seen as a worrying trend, signalling that some value chains are on the retreat.

EU Member States capture large domestic value added in export. In the EU28 a slightly different and slightly more favourable pattern emerges. In the EU's VC trade was still generally growing at the same pace as value added exports (VAX) during the post-crisis years (approximately 3.3%-3.4% when the entire economy is considered, and about one percentage point less for manufacturing only). This constellation is compatible with a situation in which EU Member States manage to capture large domestic value added in export transactions *without* dismantling value chains. While this would be a subject for further investigation, the data at hand are in line with the idea that the European Single Market, due to the guaranteed free movement of goods, services and investments and accompanying regulations such as competition rules, acts as a reinsurance mechanism against potential protectionist tendencies. This is not to say that the EU28 are immune to economic nationalism; nevertheless, the idea that the Single Market provides an institutional anchor to also safeguard internationally-organised production is consistent with the patterns of the post-crisis export data. This finding is also confirmed when considering VC trade intensities of the EU, defined as the ratio of VC trade to value added exports. The VC intensity clearly levelled off after 2011 so that the VC trade to VAX ratio of about 26% may be considered a peak in VC trade. Still, no signs of a massive decline in this VC intensity are discernible for the EU28.

There is a decline in the elasticity of exports with regard to both own-country and foreign-country GDP. A related finding is that the changes in attitude towards international value chains contributed to the significant decline in the income elasticity of trade, which is well documented in the literature. Confirming and supplementing existing findings with in-depth gravity estimations for gross exports, value added exports and VC trade flows (i.e. re-exported domestic value added), the decline in the elasticity of exports with regard to both own-country and foreign-country GDP is rather similar across the three types of export flows. If anything, the decline in this elasticity is typically lower for VC trade, which makes it unlikely that disruptions in international value chains had a significant impact on the lowered income elasticity of overall trade. It seems that there are some other structural factors at play which caused the income elasticity of trade to fall – a fact that entails the prospect that the current trade slowdown in the EU28 will be a medium- to long-term phenomenon.

The EU as a whole held its competitive position in the global market, albeit new players such as the BRICS countries entered the market. The trade slowdown, including the reduced dynamic in VC trade, is not a trend specific to the EU. While the EU28 was clearly underperforming in terms of economic growth and much of Member States' trade in intra-EU trade, the EU was relatively successful in defending global export market shares, given that with China and other emerging economies there appeared a number of important new players in the international trade arena. This is equally true for VC trade and becomes blatantly visible when comparing the 1 percentage point loss in the world market share in VC trade of the EU with the corresponding losses of the United States and Japan which amounted to 8 percentage points and 5 percentage points, respectively (2000-2014), when an extended manufacturing sector that also comprises business services is considered.

The intra-EU value chain dynamics led to a reallocation of market shares. Central European economies benefitted. Zooming closer into the EU and at individual Member States reveals VC trade developments that are well-known from overall trade developments. In particular, there was a marked reshuffling of market shares of Member States in EU-wide VC trade from large Member States such as France, Italy and the United Kingdom towards a group of Central European (CE) economies – Germany, Austria, the Czech Republic, Hungary, Poland and Slovakia – which together form the Central European Manufacturing Core. By 2014 this CE Manufacturing Core accounted for 35% of the EU's entire VC trade, which corresponds to an increase of more than 5 percentage points since 2000. Notably, all members of this group contributed to this positive trend which continued into the post-crisis years.

Global value chains at par with regional value chains with a modest shift towards the former. The complexity of VC trade implies that more than one partner country is involved. In addition to the source country, which is the origin of the value added, an immediate production partner and the ultimate production partner, i.e. the last link in the production chain, can be identified, plus – as usual – the destination country where the value added is absorbed. By identifying the production partners that are involved in VC trade as value added from the source is shipped to other countries, processed and further re-exported, such VC trade can be separated into regional value chain (RVC) trade and global value chain (GVC) trade. The former includes all VC trade which involves only partners from within the region of the source country. Defining the EU as the 'European region', European RVCs include VC trade where only EU Member States act as producers ('Factory Europe'). In contrast, all GVC trade is VC trade involving an EU Member State as the source country but also third countries as production partners. This way of defining the regional scope of value chains is arguably more precise than existing approaches in the literature, but also relatively restrictive, and to some extent challenges the stylised fact that cross-border production cooperation is predominantly regional in scope. According to this definition the split between RVC trade and GVC trade for the EU28 is about half-half. The shift between RVC trade and GVC trade in the 2000 to 2014 period was modest, moving slightly towards more GVC trade so that European value chains indeed became more global, but only slightly more so, with the share of GVC trade in total VC trade increasing from 49.4% to 51.1% when all industries in the economy are considered (the numbers are similar for manufacturing).

The organisation of value chains is strongly influenced by the source of final demand. One of the most striking results in the context of RVCs and GVCs is the extent to which demand is shaping the organisation of production. In models of offshoring, the extent of production relocation - and hence cross-border production sharing - is determined by the trade-off between the coordination costs of offshoring and the advantages resulting from the wage differential. The empirical data, however, suggest that demand patterns are strongly influencing decisions on where to locate production. Qualitatively this result is not surprising, but quantitatively it is. Splitting VC trade into not only RVCs and GVCs (both are determined by producers), but also by type of final demand. One can distinguish between extra-EU and intra-EU demand, which is determined by the country of absorption. This analysis reveals that the EU's RVC trade serving intra-EU demand accounts for 33% of total EU VC trade compared to only 16% destined for extra-EU markets. For GVC trade exactly the opposite is true: More than 40% of total VC trade is GVC trade serving extra-EU demand while less than 10% of GVC trade involves value added destined for EU markets. In short, RVCs predominantly produce for the EU market, while GVCs predominantly produce for third countries.

Especially large countries play central roles in regional value chains. Setting the focus on the RVC trade part, which can also be labelled 'Factory Europe', and looking at production linkages between Member States shows the expected picture: Germany emerges as the central hub, which is the key production partner for basically all other Member States. Furthermore, the cross-tables of production linkages within Factory Europe reveal that the other large Member States, France, the United Kingdom and Italy, are key production partners of other EU Member States. The most prominent feature in this context is that for Germany, apart from the larger Member States, the members of the CE Manufacturing Core are also key production partners, once more underlining the tight production integration within this country group.

Joint production largely occurs within the Single Market and between Member States. There are notable exceptions to this pattern. The established patterns regarding production linkages are to a large extent driven by the economic size of the Member States. One way to eliminate the influence of country size is to turn to revealed export preference, which – applied to VC trade – indicates the intensity of joint production with a specific partner relative to how much the world average produces with that partner. The revealed export preferences RXP document a strong tendency of Member States to engage in joint production with other EU Member States, highlighting the role of geographic proximity. The exceptions here are Greece, which is actually less involved in RVC trade than the average country, and Ireland, which also only has a small positive RXP index. But distance is not the whole story as the example of Switzerland exemplifies. Located amidst EU Member States, its RXP index is strongly positive but still much lower than that of all its neighbouring countries such as Austria, Germany, France and Italy. This suggests that the Single Market, in addition to geographic proximity, facilitates cross-border production sharing, possibly due to lower non-tariff barriers within the Single Market.

The EU is the largest trading bloc of the triad. At the same time, 'Factory Europe' is not a closed bloc. The Regional introversion is highest in 'Factory North America', followed by 'Factory Europe' and 'Factory South East Asia'. Putting European RVC trade into perspective by comparing it with 'Factory North America' (comprising the United States, Canada and

Mexico) and ‘Factory South East Asia’ (comprising Japan, Korea, China, Indonesia and Taiwan) shows that in absolute terms ‘Factory Europe’ is by far the largest of the three regional factories. In fact, with a size of EUR 463 billion it is about five times larger than Factory North America. By comparison, the EU’s total RVC trade is only about twice as large as that of NAFTA members. Again, this comparison is biased in the sense that the numbers strongly reflect the size of the respective trading bloc and also the number of members. To remedy this issue, the regional introversion index (RII), which is equal to the RXP index applied to trade within a region, is used. This metric establishes a clear ranking, which has Factory North America at the top with an RII of more than 0.70 when considering the entire economy, followed by Factory Europe with an index hovering around 0.6 over time and, finally, Factory South East Asia where the RII dropped significantly from about 0.5 to below 0.4 between 2000 and 2014. This constellation lends itself to the interpretation that, while being large and globally important, the EU is not a closed bloc by international standards.

The effect of value chain trade resembles the effects of trade. While this close investigation of international value chain trade has established rather clear results regarding recent developments, the relative importance of RVC trade and GVC trade as well as the role of demand in this, the implications of VC trade for structural change and competitiveness are much harder to assess. The question here is to what extent VC trade is indeed qualitatively different from overall trade, which can be answered by looking at the economic impact of the VC trade *intensity*, i.e. the ratio of VC trade over VAX. In this context structural change is measured by changes in the value added share of manufacturing in total GDP, while labour productivity and world market shares in value added exports serve as measures of competitiveness. The key insight is that there seem to be few extra effects from VC trade *in addition* to the effects of overall trade. Clearly, VC trade is conducive to labour productivity growth in Member States, but so is value added trade (i.e. overall trade). Hence, there are no additional productivity gains to be expected from VC trade *relative* to trade in general. With regard to structural change, there is one interesting result which points to the fact that higher VC trade intensity does not foster the manufacturing sector across Member States in general. However, there is a positive effect of VC trade intensity for the members of the CE Manufacturing Core which seems to stem from the GVC part of VC trade. Arguably, there is also a slight positive impact of VC trade suggested for the same country group on world market shares of VAX, but this effect is not robust. The main insight from these outcomes is probably that expectations with respect to international value chains, both regional and global, should be aligned with expectations with respect to trade. Integration in international VCs necessarily facilitates structural upgrading and guarantees a stronger presence in global export markets. Certainly, this may be the case and the CE Manufacture Core demonstrates that there are examples where VC integration makes a difference, but it should not be seen as an automatism. Rather the implications of VC trade and the ‘additionality’ of VC trade in comparison to trade in general are country and context-specific.

Firm-level evidence on sourcing choices by corporate groups sheds further light on the dynamics within value chains. Especially the integration of service inputs is associated with higher productivity of parent companies. Also, specialised firm groups are more productive. Firm-level evidence about the extent and determinants of intra-EU production and trade linkages uncovered productivity differentials across parent groups with different production structures. The analysis revealed systematic productivity differences between manufacturing and service parent firms integrating manufacturing and services inputs, in favour of the latter. In terms of the group structure, (i.e. separating parent companies depending on whether they integrate manufacturing inputs, service inputs or both), a premium for production specialization emerges: for both manufacturing and service parent firms, integrating affiliates in both manufacturing and services is associated with lower productivity, relative to the parent firms that opt to integrate inputs of one kind only, either in manufacturing or in services.

Larger parent firms are the drivers of sourcing inputs via foreign direct investment, suggesting barriers to market entry. Manufacturing firms that source inputs intra-firm via foreign direct investment (FDI) across EU countries are larger, more productive, more intensive in tangible and intangible capital and less intensive in skills than manufacturing firms that source inputs at arm's length. Affiliates of manufacturing firms are likely to be located in large countries and in countries with lower production costs, as well as with lower intensity of production factors (tangible, intangible, and human capital).

The intensity of integrated inputs is explained by country rather than parent firm characteristics. The average intensity of intra-EU integrated inputs by manufacturing firms is higher in large countries, in countries with higher R&D intensity and higher GDP per capita. It is lower in countries more intensive in tangible capital. The intensity of integrated inputs by services firms increases with economic size and the strength of legal systems. It is larger in less developed countries and countries with less flexibility of regulations for the use of temporary contracts. The latter result is, however, only marginally significant.

Sound economic institutions facilitate economic integration across Member States. The probability of integrating inputs by manufacturing firms across EU countries is positively linked with the strength of legal systems, flexibility of labour markets (less stringent employment protection legislation for regular contracts), and negatively linked to corporate tax rates and financial development in host countries. The estimates also indicate that manufacturing firms tend to locate in countries with high corporate tax rates and more developed financial systems. This result is consistent with the prediction of the literature on multinational activity and imperfect capital markets that affiliates are more likely to borrow in countries with high corporate tax rates where they can benefit from debt-related tax allowances. Less efficient insolvency procedures are associated with a higher probability of sourcing inputs via foreign direct investment relative to arm's length sourcing. This result is consistent with the prediction that contractual frictions incentivise firms to source inputs intra-firm. The empirical evidence indicates that the probability of sourcing inputs via FDI is negatively linked to sectoral restrictions to FDI and positively linked to the impact of service regulations on downstream industries. Finally, barriers to entrepreneurship in host countries do not seem to matter for the sourcing choice of manufacturing firms.

The facilitating effect of high institutional quality is stronger for manufacturing than for service parent firms. The intensity of integrated inputs by service parent companies is less sensitive to economic and institutional characteristics in host countries. Less efficient procedures for resolving insolvency are positively linked to the intensity of integrated inputs by services firms with services affiliates only. Finally, the intensity of integrated inputs in the case of services firms with both manufacturing and service affiliates is lower in countries where the impact of services regulations on downstream industries is larger.

The firm-level evidence corroborates the policy agenda which seeks to reduce barriers to trade and FDI. Tradability and market integration have been used widely in this report as channels through which the effects of economic institutions are transmitted. The findings therefore corroborate the policy agenda that seeks to reduce barriers to trade and FDI. For instance, the effects of the sourcing of service inputs from host countries have been found to be associated with the higher productivity of parent companies. Hence, optimising service regulations across EU countries is likely to foster the sourcing of inputs from downstream industries. Given the heterogeneity of the institutional and regulatory characteristics of EU countries, such policy measures need to be tailored to country-specific conditions. In this context, the European Commission could play an important role in benchmarking and facilitating the adoption of best practices among the EU Member States.

The strength of legal systems and flexible local labour markets are linked to integrating inputs by manufacturing firms. The importance of the general institutional quality is re-confirmed. The probability of integrating inputs by manufacturing firms across EU countries is positively linked with the strength of legal systems and flexibility of labour markets (especially less stringent employment protection legislation for regular contracts), and negatively linked to corporate tax rates and financial development in host countries. However, the empirical results indicate that the effect of corporate tax rates on the intra-EU integration of inputs is non-linear, depending on the level of financial development. Thus, the evidence in this report shows that manufacturing firms tend to locate in countries with high corporate tax rates and more developed financial systems. This result is consistent with the prediction of the literature on multinational activity and imperfect capital markets, which finds that affiliates are more likely to borrow in countries with high corporate tax rates where they can benefit from debt-related tax allowances.

More efficient insolvency procedures in host countries facilitate FDI spillovers. There is an intriguing result for insolvency procedures with respect to FDI spillovers. If these are more efficient, they have been found to be associated with a higher probability of sourcing inputs via foreign direct investment relative to arm's length sourcing. There seems to be a 'vintage effect' of the stock of firms, where low transaction costs in business closures leads to a more efficient renewal of the firm base, which again leads to more FDI spillovers. Such an effect was not found for general indicators that measure barriers to entrepreneurship.