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Determinants of firms' inputs sourcing choices: the role of institutional and regulatory factors

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Determinants of Firms' Inputs Sourcing Choices:

The Role of Institutional and Regulatory Factors[1]

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Abstract

Using the theoretical framework of global sourcing with firm heterogeneity, we examine determinants of inputs sourcing choices of manufacturing firms established in the EU countries. To this purpose, we combine information on the ownership structure and company accounts from the *Orbis* data set with input-output data from the World Input-Output Tables (WIOT) and with information on institutional and regulatory factors at country level provided by international organisations. Our research findings indicate that 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. The probability of integrating inputs by manufacturing firms across EU countries is positively linked with the strength of legal systems, flexibility of labour markets and negatively linked to corporate tax rates and financial development in host countries. Less efficient insolvency procedures are associated with a higher probability of sourcing inputs intra-firm via FDI relative to arm's length sourcing. 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.

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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 established theoretically and empirically that trade and foreign direct investment (FDI) patterns are jointly determined with organisational structures such as vertical integration and outsourcing 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).

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 production and trade 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.

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 States levels could improve productivity and competitiveness. Specifically, it has been 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 design policies aimed at competitiveness and growth at the firm, industry, country and European levels. This paper examines the inputs sourcing strategies of manufacturing 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 paper is structured as follows. Section 2 reviews the relevant theoretical and empirical evidence and provides a conceptual framework for the analysis. Section 3 describes the data and empirical methodology used. Next, Section 4 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. Finally, Section 5 summarizes the key findings of the empirical analysis and, on that basis, discusses policy implications for strengthening the Single Market.

2   Theoretical and Empirical Background

This section provides an overview of the relevant theoretical and empirical literature on firms' inputs sourcing 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 organisational choices.

Grossman and Helpman (2002) were among the pioneers of this new strand of the international trade literature. They examine firms' choice between outsourcing and vertical integration. In determining their organisational mode, firms, which 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 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) formalise theoretically 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 organization choices of firms. He highlights that productivity differences are linked to different choices for the organization 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, more productive than non-exporters. Another established empirical fact is that only a few large firms export to large 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 in 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 specific 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 the low level of enforcement of contract clauses and legal remedies.

Alfaro et al. (2017) 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 position 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. Further, 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); 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 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 exporters only, while a small number of firms engage in international sourcing only or in foreign direct investment only. Firms engaged simultaneously in more than one type of outward international activity are only a 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 explain better 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 outsourcing 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 literature on global sourcing of production inputs provides useful insights and suggests the following predictions which guide the empirical analysis in this paper:

- 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 at 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' inputs sourcing strategies?

In particular, the evidence provided by this paper contributes to better understand 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 levels aiming at removing regulatory barriers to competitiveness and integration and a more efficient allocation of resources across firms and sectors in the Single Market of goods and services.

3   Data and Descriptive Analysis

For the purpose of this analysis, we combine information on the ownership structure and company accounts from the *Orbis* data set with input-output (I-O) data from the World Input-Output Tables (WIOT) data set.[2]

Using the most recent information on ownership (information on company hierarchical ownership links updated to April 2017) combined with company accounts from the *Orbis* data set (we use information on financial variables for 2014), we identify parent companies established in the 28 EU countries. Using the NACE codes for primary activities, we identify 7,012 parent companies in manufacturing for which financial variables are available. Using the ownership structure of the identified parent companies, we uncover 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. Sectors

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[2] See Timmer et al. (2015) for a description of the WIOT data set.

other than manufacturing and services include: agriculture, forestry, fishing; mining and quarrying; utilities; and construction.

3.1   *Firms' input sourcing choices: integration vs. outsourcing*

For each parent company (global ultimate owner, *g*) we identify integrated and outsourced inputs following the methodology used by Alfaro et al. (2017)[3] by combining information on firms' ownership structure from the *Orbis* data set[4] with Input-Output (I-O) data for the EU countries.

For each *g*, we identify the primary NACE 2-digit code as its output industry *j*. Given that the WIOT data allow to identify input-output linkages across countries, for each output industry *j* in each home country *c* we identify a set of production inputs $I^{i,h}_{j,c} = \{i : a_{ihjc} > 0\}$. a_{ihjc} is 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*, we then identify integrated and outsourced inputs as follows. The set of integrated inputs $I^{i,h}_{j,c}$ comprises the affiliates in country *h* whose primary (NACE 2-digit) activity corresponds to a production input *i* for output *j* in country *c*, as identified in the input-output tables. We designate the remainder of $I^{i,h}_{j,c}$ inputs for which no affiliate is detected as *possible* outsourced inputs.[5]

By linking the ownership information with the input-output data for the 28 EU countries we identify 10,492,482 possible input-output production linkages for the parent companies in manufacturing, of which 14,245 are integrated links between parent and affiliated firms.

As mentioned above, the number of affiliates in the data is larger than the number of identified integrated input linkages which implies that some parent companies source the same input from multiple affiliates in the same country. In the descriptive analysis in this section we disregard these multiple affiliates, 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 1 below describes patterns of inputs sourcing by manufacturing parent companies established in the EU countries. Table 1 shows that, on average, manufacturing parent firms source 2.04 inputs intra-firm; by construction, the average number of possible outsourced is much larger, 1,566. The maximum number of integrated inputs by one parent company is 109 while the lowest number of possible outsourced inputs is 1,459.

Table 1: Inputs sourcing by manufacturing companies established in EU countries

	Mean	Median	Min	Max
Integrated inputs	2.04	1	1	109
Possible outsourced inputs	1,566	1,567	1,459	1,567

Source: Authors' calculations based on the linked data from *Orbis* and WIOT data sets.

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[3] Alfaro et al. (2017) draw on Fan and Lang (2000).

[4] We extract the most recent data available in the *Orbis* data set provided by the Bureau van Dijk.

[5] 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, we are left to label the set of industry-country combination inputs with no corresponding ownership link as outsourced inputs. However, we are aware that each firm may decide to source only a fraction of the latter inputs, hence our notation refers to possible outsourced inputs.

Table 2 disaggregates the information on integrated inputs by the sector of the affiliate. Among the 7,012 parent firms in manufacturing, 2,191 source manufacturing only, 2,689 source service inputs only, 1,596 source both manufacturing and service inputs, while 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 which source both manufacturing and services inputs.

Table 2: Patterns of integrated inputs by manufacturing firms established in EU countries

Linkage type	Number of parent companies (GUOs)	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: Authors' calculations based on the linked data from *Orbis* and WIOT data sets.

Table 3 show summary statistics of the characteristics of parent firms broken down by 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 which integrate services inputs only are larger, less productive, and less intensive in capital and skills.

Table 3: 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: Authors' calculations based on the linked data from *Orbis* and WIOT data sets.

Table 4 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 have also the highest average integrated inputs by services firms.[6]

Table 4: The distribution of parent companies and the intensity of integrated inputs across EU countries

Country of parent company - GUO	Number of manufacturing GUOs	Mean number of integrated inputs by manufacturing GUOs
Austria	23	6.91
Belgium	147	2.72
Bulgaria	4	2
Czech Republic	398	1.48
Germany	612	4.01
Denmark	5	15
Estonia	34	1.15
Spain	1,151	1.53
Finland	336	2.79
France	375	2.7
United Kingdom	30	17.1
Croatia	21	1.48
Hungary	40	1.45
Ireland	2	26
Italy	2,275	1.61
Luxembourg	5	1.8
Latvia	3	1
Netherlands	9	25.22
Poland	45	2.53
Portugal	320	1.36
Romania	8	1.13
Sweden	959	1.47
Slovenia	94	1.61
Slovakia	116	1.53
Total	**7,012**	**2.04**

Source: Authors' calculations based on linked data from *Orbis* and WIOT data sets.

Table 5 below shows the distribution of the number of parent firms and integrated inputs by industry. The largest number of parent firms are 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.

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[6] 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: 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	1,104	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	1,104	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	**7,012**	**2.04**

Source: Authors' calculations based on linked data from *Orbis* and WIOT data sets.

3.2   The intensity of intra-EU production linkages

The ownership information about integrated inputs can be analysed also 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 6 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, manufacturing 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. The remaining subgroup of linkages, across services and manufacturing, show a lower average input-output coefficient.

Table 6 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 reduces a great deal 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 6: 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	0.051
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	0.034	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	0.051

Source: Authors' calculations based on linked data from *Orbis* and WIOT data sets.
Notes: 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. *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 the integration decision of large GUOs, in the above table, any specific input identified for each GUO is counted only once.

In the empirical analysis, the intensity of integrated inputs will be exploited as an outcome variable additional to the binary variable for the sourcing choice . Country level determinants of integration or outsourcing can also affect the choice of which input to integrate. For this purpose, we construct a measure of average integration specific to each parent firm *g* in each host country *h* as follows:

$$Intensity_{gich} = \frac{1}{I}\sum_{i=1}^{I} \alpha_{ihjc} \tag{1}$$

4   Determinants of Intra-EU Production Linkages

The focus of this analysis is on the sourcing strategies of EU manufacturing companies. Specifically, we examine determinants of integration versus outsourcing choices of manufacturing companies located in the EU countries. We consider integrated manufacturing and services inputs and focus on integrated inputs across EU countries. For the purpose of this analysis, we combine information on ownership from the *Orbis* data set with data from I-O tables for EU countries available from the WIOT database.

The empirical analysis is based on estimates obtained with the following linear probability model:

$$\Pr\big(Integ_{gjcih} = 1\big) = \alpha + \sum_r \beta_r X_{gjcih} + \sum_t \delta_t C_h + \sum_q \gamma_q P_{ih} + \eta_{cji} + \varepsilon_{gicih} \tag{2}$$

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, skill 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).[7]

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 2-digit output-input pair in each country of residence of the parent firm which affects 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 A1 in the Appendix. Table A2 in the Appendix shows the performance of EU countries relative to the EU average for the institutional and regulatory indicators used in the empirical analysis: employment protection legislation (EPL) for regular contracts; employment protection legislation (EPL) for temporary contracts; the impact of service regulations in downstream industries; sectoral restrictions to FDI; barriers to entrepreneurship; product market regulations (PMR); rule of law; domestic bank credit to private sector (measuring financial development); time to resolve insolvency (measuring contractual frictions).

As mentioned in section 3, besides the decision to integrate or outsource inputs, we also consider the intensity of integrated inputs in production as an additional outcome variable. For this purpose, we estimate the following model:

$$\Pr\big(Intensity_{gjcih}\big) = \alpha + \sum_r \beta_r X_{gjcih} + \sum_t \delta_t C_h + \sum_q \gamma_q P_{ih} + \eta_{cji} + \varepsilon_{gicih} \tag{3}$$

where the dependent variable corresponds to the average I-O share of integrated inputs for each parent firm g in each host country h.[8]

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[7] All the policy variables 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.

[8] A concern in relation to specifications (3) and (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

4.1 Determinants of sourcing choices of manufacturing firms

Table 7 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 – 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 above, to alleviate concerns about reverse causality, we also remove firm specific variation (with parent firm fixed effects).[9] 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.[10]

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, in countries with lower production costs, 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. Our 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. Further, 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

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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 vary 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, we 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 A3-A4 in the Appendix and show that the main findings concerning the country characteristics leading to the decision to integrate or outsource inputs are upheld.

[9] These estimates are reported in Tables A3-A4 in the Appendix.

[10] The observations in column 1 of Tables 7 and 8 below are larger than the sum of the observations in columns 2, 3 and 4. This is because in column 1 parent companies with affiliates in sectors other than manufacturing and services are also included (i.e. primary sectors and construction).

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 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 is available, the correlation between EPL for regular contracts and EPL for temporary contracts is low, 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 7: Determinants of sourcing choices for manufacturing firms, intra-EU vertical production linkages

	(1)	(2)	(3)	(4)
	All Man HQ	Man HQ – Serv. Affiliates	Man HQ – Man. Affiliates	Man HQ – Man & Serv. Affiliates

Parent firm characteristics

	(1)	(2)	(3)	(4)
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

	(1)	(2)	(3)	(4)
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 x 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: Authors' calculations based on linked data from the *Orbis* and WIOT data sets.
Notes: Estimates are obtained with linear probability estimators. The dependent variable is equal to 1 if 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.' $p<0.15$, * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

4.2 *Determinants of the intensity of integrated inputs*

Table 8 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 3.2. 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 affect significantly 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 8: Determinants of the intensity of integrated inputs by manufacturing firms, intra-EU vertical production linkages

	(1) All Manufacturing HQ	(2) Man HQ – Serv. Affiliates	(3) Man HQ – Man. Affiliates	(4) Man HQ – Man & Serv. Affiliates
Parent firm characteristics				
Productivity	0.000212	0.000330	0.00322	0.0000786
	(0.000244)	(0.000232)	(0.00319)	(0.000323)
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)
	0.0000276	-0.000342	-0.0117***	0.0000765
EPL for regular contracts	(0.000923)	(0.00141)	(0.00369)	(0.00104)
	-0.000486	0.000932	0.00916**	-0.000851
EPL for temporary contracts	(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 x	0.00508***	-0.000252	0.0447***	0.00561***
Financial development	(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)
			0	
Sectoral restrictions to FDI	-0.00323	-0.00306	.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: Authors' calculations 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 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, again this 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.

5   Key Findings and Policy Implications

This paper examines the extent and determinants of intra-EU production and trade linkages using firm-level data for manufacturing. 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 parent firms integrating manufacturing and services inputs.

Manufacturing firms that source inputs intra-firm via 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. Our 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 FDI 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 service 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. Further, 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 service 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, 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 affect significantly 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

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 of inputs at arms' length. Lowering barriers to entrepreneurship in host countries could foster sourcing of services inputs by manufacturing firms at arm's length. Lowering 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 European Commission could play an important role in benchmarking and facilitating the adoption of best practices among EU Member States.

References

Alfaro, Laura, Pol Antràs, Davin Chor, Paola Conconi (2017), "Internalizing Global Value Chains: A Firm-Level Analysis", NBER Working Paper No. 21582, forthcoming in *Journal of Political Economy*.

Antràs, Pol (2003). "Firms, Contracts, and Trade Structure", *Quarterly Journal of Economics*, 118(4): 1375-1418.

Antràs, Pol (2015), *Global Production: Firms, Contracts and Trade Structure*, Princeton University Press.

Antràs, Pol and Elhanan Helpman, E. (2004). "Global Sourcing", *Journal of Political Economy* 112: 552-580.

Antràs, Pol, Mihir A. Desai,. and C. Fritz Foley (2009). "Multinational Firms, FDI Flows, and Imperfect Capital Markets", *The Quarterly Journal of Economics*, 1171-1219.

Antràs, Pol and Davin Chor (2013). Organizing the Global Value Chain, *Econometrica* vol. 81(6); 2127-2204.

Baldwin, Richard, and Anthony Venables (2013), "Spiders and Snakes: Offshoring and Agglomeration in the Global Economy", *Journal of International Economics* 90(2): 245-254.

Bernard, Andrew, B., J. Bradford Jensen, Stephen J. Redding, and Peter Schott (2012). "The Empirics of Firm Heterogeneity and International Trade", *Annual Review of Economics* (4): 283-313.

Costinot, Arnaud, Jonathan Vogel, and Su Wang (2013), "An Elementary Theory of Global Supply Chains", Review of Economic Studies 80(1): 109-144.

Desai, Mihir A., C. Fritz Foley and James R. Hines Jr. (2004), "A Multinational Perspective on Capital Structure Choice and Internal Capital Markets", *Journal of Finance*, 59:6, pp. 2451-2488.

Eaton, Jonathan, Samuel Kortum, and Francis Kramarz (2004). "Dissecting Trade: Firms, Industries and Export Destinations", *American Economic Review* 94(2): 150-154.

Égert, Balázs, and Isabelle Wanner (2016), "Regulations in Services Sectors and their Impact on Downstream Industries: The OECD 2013 REGIMPACT Indicator, OECD Economics Department Working Paper No. 1303.

European Commission (2015). Single Market Integration and Comeptitiveness inthe EU and its Member States, Report 2015, DG Internal Market, Industry, Entrepreneurship and SMEs.

Feinberg, Susan E., and Michael P. Keane (2006). "Accounting for the Growth of MNC-Based Trade Using a Structural Model of U.S. MNCs." *American Economic Review*, 96(5): 1515-1558.

Francois, Joseph, and Julia Wörz (2008). Producer services, manufacturing linkages and trade, *Journal of Industrial Competition and Trade*, 8, 199-229.

Foster-McGregor, Neil, Robert Stehrer, and Marcel Timmer (2013). 'International Fragmentation of Production, Trade and Growth: Impacts and Prospects for EU Member States', wiiw Research Report, No. 387, Vienna.

Foster-McGregor, Neil, and Robert Stehrer (2013). Value added content of trade: A comprehensive approach, Economics Letters, 120(2), 354-357.

Girma, Sourafel, Holger, Görg, and Eric Strobl (2004). "Exports, International Investment and Plant Performance. Evidence from a Non-Parametric Test", *Economics Letters* 83(3): 317-324.

Girma, Sourafel, Richard Kneller, and Mauro Pisu (2005). "Exports versus FDI: An Empirical Test", *Review of World Economics* 141(2): 193-218.

Görg, Holger, Aoife Hanley, and Eric Strobl, (2008). "Productivity effects of international outsourcing: evidence from plant-level data". *Canadian Journal of Economics*, 41: 670–688.

Grossman, Gene and Elhanan, Helpman (2002). "Integration versus Outsourcing in Industry Equilibrium", *Quarterly Journal of Economics* 117(1): 85-120.

Grossman, Gene, Elhanan Helpman, and Adam Szeidl (2005). "Complementaries between outsourcing and foreign sourcing", *American Economic Review* 95: 19-24.

Harms, Philipp, Oliver Lorz, and Dieter Urban (2012), "Offshoring along the Production Chain", Canadian Journal of Economics 45(1): 93-106.

Head, Keith, and John Ries (2003). "Heterogeneity and the FDI versus Export Decision of Japanese Manufacturers", *Journal of the Japanese and International Economies* 17(4): 448-467.

Helpman, Elhanan, Marc J. Melitz, and Stephen R. Yeaple (2004). "Export versus FDI with Heterogeneous Firms", *American Economic Review* 94(1): 300-316.

Helpman, Elhanan (2006). "Trade, FDI and the Organisation of Firms", *Journal of Economic Literature*, Vol. XLIV: 589-630.

Kohler, Wilhelm (2004), "International Outsourcing and Factor Prices with Multistage Production", *Economic Journal* 114(494): C166-C185.

Leitner, Sandra M., and Robert Stehrer (2014), Trade Integration, Production Fragmentation and Performance in Europe - Blessing or Curse? A Comparative Analysis of the New Member States and the EU-15, wiiw Research Report, No. 397, Vienna.

Nunn, Nathan, and Daniel Trefler (2013). "Incomplete Contracts and the Boundaries of the Multinational Firm, *Journal of Economic Behavior & Organization*, 94(1): 330-344.

Pilat, Dirk, and Anita Wölfl (2005). "Measuring the Interaction between Manufacturing and Services", OECD Science, Technology and Industry Working Papers 2005/5, OECD, Directorate for Science, Technology and Industry.

Siedschlag, Iulia, and Gavin Murphy (2015). "Firms' Engagement in Global Value Chains", in Richard E. Baldwin and Filippo di Mauro (eds.), Europe in the Age of Global Value Chains: Maps and Policy Issues, pp.175-186, London: CEPR Press, July 2015.

Spencer, Barbara (2005). "International Outsourcing and Incomplete Contracts", *Canadian Journal of Economics*, 38(4): 1107-1135.

Stehrer, Robert, Marcin Borowiecki, Bernhard Dachs, Doris Hanzl-Weiss, Steffen Kinkel, Johannes Pöschl, Magdolna Sass, Thomas C. Schmall and Andrea Szalavet (2012), 'Global Value Chains and the EU Industry, wiiw Research Report, No. 383, Vienna.

Stöllinger, Roman, Neil Foster-McGregor, Mario Holzner, Michael Landesmann, Johannes Pöschl, (2013), A 'Manufacturing Imperative' in the EU – Europe's Position in Global Manufacturing and the Role of Industrial Policy', wiiw Research Report, No. 391, Vienna.

Timmer, M. P., Dietzenbacher, E., Los, B., Stehrer, R. and de Vries, G. J. (2015), "An Illustrated User Guide to the World Input–Output Database: the Case of Global Automotive Production", *Review of International Economics.*, 23: 575–605

Tomiura, Eiichi (2007). "Foreign Outsourcing, Exporting, and FDI: A Productivity Comparison at the Firm Level", *Journal of International Economics* 72: 113-127.

Yeaple, Stephen R. (2003). "The Complex Integration Strategies of Multinational and Cross Country Dependencies in the Structure of Foreign Direct Investment", *Journal of International Economics* 60(2): 293-314.

Appendix

Table A1   Description of variables and data sources

Variable	Description	Data source
Firm-level variables		
Productivity	Value added per employee	*Orbis*, Bureau van Dijk
Tangible capital stock	Total fixed assets per employee	*Orbis*, Bureau van Dijk
Intangible capital stock	Total intangible fixed assets per employee	*Orbis*, Bureau van Dijk
Human capital	Total labour cost per employee	*Orbis*, Bureau van Dijk
Size	Total number of employees	*Orbis*, Bureau van Dijk
Country factors		
Capital intensity	Gross fixed capital formation, % of GDP	The World Bank
Human capital	Share of labour force with tertiary education	The World Bank
R&D intensity	Private and public R&D expenditures (current and capital expenditures), % of GDP	The World Bank
GDP per capita	GDP per inhabitant	The World Bank
GDP	GDP	The 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	The 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	The World Bank
Efficiency of insolvency	Number of days to solve insolvency	The 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 A2   *Institutional and regulatory performance of EU countries relative to the EU*

	EPL regular contracts	EPL temporary contracts	Impact of service regulations	Sectoral restrictions to FDI	Barriers to entrepreneurship	PMR total	Rule of Law	Labor Market Regulations	Domestic Bank Credits to Private Sector (% to GDP)	Time to resolve Insolvency
AT	1.061	0.735	0.894	3.347	0.777	0.827	1.661	0.834	0.973	0.558
BE	0.848	1.330	1.048	1.240	1.056	0.961	1.283	1.055	0.642	0.457
BG	n/a	n/a	n/a	n/a	1.008	1.092	-0.066	1.079	0.657	1.674
CY	n/a	n/a	n/a	n/a	1.240	1.144	0.899	1.139	2.762	0.761
CZ	1.310	0.805	1.173	0.345	1.079	0.975	0.964	1.182	0.549	1.065
DE	1.200	0.630	0.558	0.848	0.981	0.891	1.572	0.872	0.875	0.609
DK	0.985	0.770	0.809	0.942	0.747	0.839	1.777	1.102	1.948	0.507
EE	0.811	1.680	1.552	0.476	0.925	0.896	1.158	0.881	0.752	1.522
ES	0.917	1.435	0.869	0.457	1.248	1.000	0.795	0.814	1.427	0.761
FI	0.971	0.875	1.261	0.587	0.917	0.897	1.800	0.814	1.032	0.457
FR	1.068	2.030	1.140	1.753	0.999	1.018	1.245	0.838	1.042	0.964
UK	0.491	0.210	0.328	1.557	0.881	0.752	1.602	1.192	1.526	0.507
GR	0.949	1.260	1.072	1.063	1.135	1.207	0.293	0.664	1.286	1.775
HR	n/a	n/a	n/a	n/a	1.178	1.439	0.264	0.999	0.764	1.572
HU	0.711	0.700	0.762	0.531	1.004	0.921	0.422	0.969	0.476	1.014
IE	0.626	0.350	1.047	1.604	1.173	1.009	1.529	1.071	0.897	0.203
IT	1.200	1.120	1.010	1.744	0.726	0.894	0.286	0.977	0.981	0.913
LT	n/a	n/a	n/a	1.110	0.931	1.051	0.769	1.161	0.452	1.167
LU	1.006	2.100	1.021	0.065	1.017	1.011	1.609	0.884	1.010	1.014
LV	n/a	n/a	n/a	0.755	1.207	1.115	0.734	1.133	0.566	0.761
MT	n/a	n/a	n/a	n/a	1.296	1.087	1.024	1.138	1.158	1.522
NL	1.264	0.525	0.756	0.653	0.708	0.635	1.682	1.086	1.278	0.558
PL	0.999	0.980	1.221	1.632	0.971	1.143	0.694	1.141	0.576	1.522
PT	1.426	1.015	1.047	0.168	0.801	0.898	0.959	0.902	1.427	1.014
RO	n/a	n/a	n/a	0.149	1.225	1.170	0.127	1.070	0.343	1.674
SE	1.168	0.455	0.971	1.921	1.015	1.054	1.691	0.989	1.446	1.014
SI	1.166	1.015	1.261	0.140	1.073	1.180	0.828	0.922	0.606	0.406
SK	0.825	0.980	1.201	0.914	0.682	0.893	0.401	1.093	0.550	2.029

Source: Authors calculations based on data provided by the OECD and the World Bank

Table A3   *Determinants of sourcing choices for manufacturing firms, intra-EU vertical production linkages. Estimates with parent firms fixed effects.*

	(1) All Manufacturing HQ	(2) Man HQ – Serv. Affiliates	(3) Man HQ – Man Affiliates	(4) 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	0.000729***	0.000120***	-0.00178
	(0.000308)	(0.000147)	(0.0000439)	(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***	0.00110***	-0.0000316	0.0159***
	(0.000731)	(0.000296)	(0.000100)	(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***	-0.00123***	-0.000277***	-0.0112***
	(0.000403)	(0.000152)	(0.0000418)	(0.00152)
Barriers to entrepreneurship	0.000324	0.000957***	-0.000153*	0.000729
	(0.000418)	(0.000240)	(0.0000781)	(0.00184)
Constant	0.0579***	0.0189***	0.000199	0.230***
	(0.0105)	(0.00427)	(0.00144)	(0.0421)
Observations	7,310,487	2,803,345	2,282,961	1,665,815

Source: Authors' calculations 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 A4   *Determinants of the intensity of integrated inputs by manufacturing firms, intra-EU vertical production linkages. Estimates with parent firms 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	5,300	800	147	4,316

Source: Authors' calculations 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.' $p<0.15$, * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

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