Background documents for the European Semester

Comparative performance of indigenous and multinational firms operating in Ireland

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Final Report

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Summary of Key Findings

Indigenous and foreign-owned firms in Ireland: Descriptive patterns and trends

- Ireland is one of the most globalised economies in the world with a large share of foreign-owned firms.
- Among all EU countries, Ireland stands out with respect to the contribution of affiliates of multinational firms to economic performance and competitiveness including value-added, productivity and high-tech exports.
- Ireland's attractiveness to foreign direct investment (FDI) is linked to a range of factors including membership of the European Single Market Area, skilled and flexible labour force, business-friendly environment, competitive statutory and effective tax rates.
- Foreign-owned firms are concentrated in high-productivity sectors including manufacture of computers, electronic and optical products; pharmaceuticals; chemicals; telecommunications; office support and other business support activities and computer programming, consultancy and related services;
- Foreign-owned firms are also concentrated geographically around Dublin and other major cities including Limerick, Cork and Sligo.
- Breaking down the foreign-owned firms in EU-owned and non-EU owned affiliates, while in terms of the number of firms the two groups of foreign affiliates account for similar proportions, the non-EU owned affiliates account for larger shares in employment, as well as gross output and gross value added.
- Apart from being concentrated in high-tech industries and knowledge-intensive services, a key feature of the foreign-owned firms is their significantly larger scale relative to the size of Irish-owned firms.
- The productivity gap between foreign-owned firms and Irish-owned firms has increased over time and is larger in services in comparison to manufacturing.
- The analysis of productivity distributions indicates that most of the productivity differentials between Irish-owned and foreign-owned firms are concentrated in the distributions tails, while the central parts of the distributions are rather similar for the two groups of firms and appear to be stable over time.
- Regardless ownership, productivity growth has been concentrated in the top percentile of firms while the productivity performance of the rest of the first has been lagging behind. This pattern of productivity divergence is present in both manufacturing and services for Irish-owned and non-EU owned affiliates, and for EU-owned affiliates in manufacturing. In contrast, productivity growth in EU-owned affiliates in services appears to be on a convergence path.

Foreign-ownership *premia*

- The estimated foreign-ownership *premia* controlling for unobserved industry, region and time specific effects indicate significant differentials in the performance of the two groups of firms.
- Relative to Irish-owned firms, foreign-owned firms are more productive, pay higher wages, invest more in tangible and intangible assets. On average, relative to Irish-owned firms, foreign-owned firms export a larger proportion of their output and import more relative to their output.

The impact of investment in innovation on innovation outputs and productivity

- Overall, a larger proportion of foreign-owned firms invest in innovation in comparison to Irish-owned firms. However, it is worth noticing that the performance of Irish-owned firms in this respect has improved in recent years. A similar pattern is found for the propensity of firms to introduce innovation outputs, again with Irish-owned firms' performance improving while the share of foreign-owned firms with innovation outputs remaining unchanged.
- In terms of investment in innovation and its impact on innovation outputs and productivity, the results of this analysis uncover both similarities and differences in the behaviour and performance of Irish-owned and foreign-owned firms.
- For both Irish-owned and foreign-owned firms, the propensity to invest in R&D appears to be higher for larger firms, firms operating in international markets, and firms with higher investment in fixed tangible assets in the previous year (a proxy for collateral). Irish-owned firms which received operating subsidies are more likely to invest in R&D while competition in the Irish market increases the foreign-owned firms' propensity to invest in R&D. Further, younger Irish-owned firms are more likely to invest in R&D.
- Conditional on investing in R&D, the intensity of R&D investment is driven by different factors in Irish-owned and foreign-owned firms. In Irish-owned firms R&D intensity is positively linked to the amount of operating subsidies received in the previous year, as well as the skills intensity, and competition. In contrast, in foreign-owned firms, higher competition in the Irish market is associated with a lower R&D intensity.
- The propensity to invest in non-R&D assets in both Irish-owned and foreign-owned is positively associated with firm size and higher collateral, with the effect of the latter factor being larger for Irish-owned firms. The propensity to invest in non-R&D assets is positively associated with exporting in Irish-owned firms and with past operating subsidies in foreign-owned firms. In both Irish-owned and foreign-owned firms, the intensity of investment in non-R&D assets is negatively linked with competition in the Irish market.
- Higher R&D intensity is positively associated with the propensity of Irish-owned firms to introduce product innovations, while foreign-owned with a high R&D intensity appear less likely to introduce product innovations. Investing in non-R&D assets is a significant determinant for the probability of introducing marketing innovations in foreign owned firms. The probability to introduce innovations in both Irish-owned and foreign-owned firms is positively associated with firm size and engagement in co-operation for innovation. In addition, the propensity of Irish owned firms to introduce innovations is positively

associated with their export intensity and past investment in tangible fixed assets. With the exception of marketing innovations, younger Irish-owned firms are more likely to introduce innovations.

- Over and above other factors, all four types of innovations are linked to productivity gains in Irish-owned firms. The largest productivity elasticity is for marketing innovations (0.21) and the lowest for process innovations (0.18). In foreign-owned firms, only process and organisational innovations are positively and significantly linked to productivity with the largest productivity gains in the case of organisational innovations (0.42).

Trade patterns

- Foreign-owned firms export and import a significantly large number of products in comparison to Irish-owned firms, 2 to 3 times more in recent years. Foreign-owned firms export to a larger number of destinations and import from more countries both EEA and extra-EEA countries.
- The analysis also shows that foreign-owned firms are integrated in more complex production and trade networks with a higher number of product - country combinations per firm. An interesting feature is the more important integration of foreign-owned firms in extra-EEA trade while Irish-owned firms tend to trade predominantly with EEA countries (mainly the UK).
- In terms of trade volumes, on average foreign-owned firms trade volumes 5 to 10 times larger than Irish-owned firms. The average value of exports per firm is larger than the imports per firm for both Irish-owned and foreign-owned firms. In terms of destinations/origins, the average value of exports and imports per firm-product are larger in with other EEA countries in comparison to extra-EEA countries.

Spillovers from foreign-owned firms on the trade performance of indigenous firms

- The results of this empirical analysis indicate that Irish-owned firms benefit to some extent from spillovers from foreign direct investment (FDI) mainly via supply chain linkages. There is also evidence suggesting that foreign-owned affiliates crowd-out the trade performance of Irish-owned firms.
- Spillovers vary depending on the type of spillover (*intra-industry*, *intra-region*, via *supply chain linkages*), the origin of FDI (*EU* vs. *non-EU based*), *the type of trade performance measure* (export/import intensity; number of products exported/imported; number of export destinations/import origins; number of products exported-export destinations; number of imported products-import origins).
- The evidence indicates only very limited intra-industry and intra-region FDI spillovers. It appears that Irish-owned firms benefit in terms of their export intensity from the presence in the same industry of affiliates of multinationals based outside the EU. However, the presence of multinationals crowd-out the export performance of Irish-owned firms within the same region. While the presence in the same region of affiliates of multinationals based in other EU countries affect negatively the export performance of Irish-owned firms in manufacturing, the presence of affiliates of non-EU multinationals have a negative effect of the export performance of Irish-owned firms in services.

- Irish-owned firms benefit in terms of diversification of their merchandise exports from supplies by affiliates owned by EU multinationals. In contrast, supplies by affiliates owned by non-EU multinationals have the opposite effect on the export diversification of indigenous firms.
- Irish-owned firms benefit from supplying affiliates of EU based multinationals in terms of the diversification of export markets and product-export market combinations. In contrast, supply linkages with affiliates of non-EU multinationals are associated with a lower number of products exported.

SMEs' access to finance and their export, investment and innovation performance

- The evidence indicates a continuing decline of the share of firms facing actual financing constraints from 29% of applicants in 2011 (the highest share over the analysed period), to 11% in 2016. While also declining, the share of firms facing actual financing constraints is the largest for micro firms (17%), youngest (33%) and for indigenous firms (12%).
- The proportion of firms with higher debts relative to the previous period was lower in the first semester of 2017, 15%, compared to 19% in early 2014. While the share of SMEs reporting higher debts has declined, particularly for micro firms (9% in 2017H1 compared to 20% in 2014H1), the share of large firms reporting higher debts has increased from 11% in the first half of 2014 to 23% in the first semester of 2017.
- The proportion of firms reporting higher investment has decreased from 38% (the highest rate over the analysed period) to 34% in the first semester of 2017. Over the analysed period, the proportion of firms reporting higher investment has increased for small firms from 34% to 41%, while all it has decreased for the other size groups, particularly for micro firms from 27 % in the first semester of 2014 to 19% in the first semester of 2017.
- The empirical results indicate that export engagement and export entry are less likely for firms accumulating higher debts over assets. Further, continuous exporting is less likely if firms face higher interest expenses.
- The evidence also indicates that higher investment is less likely for firms facing higher interest expenses or with a deteriorated credit history.
- Process innovation is less likely if firms accumulate higher debts over assets while product innovation appears to be associated with higher financial needs by firms.

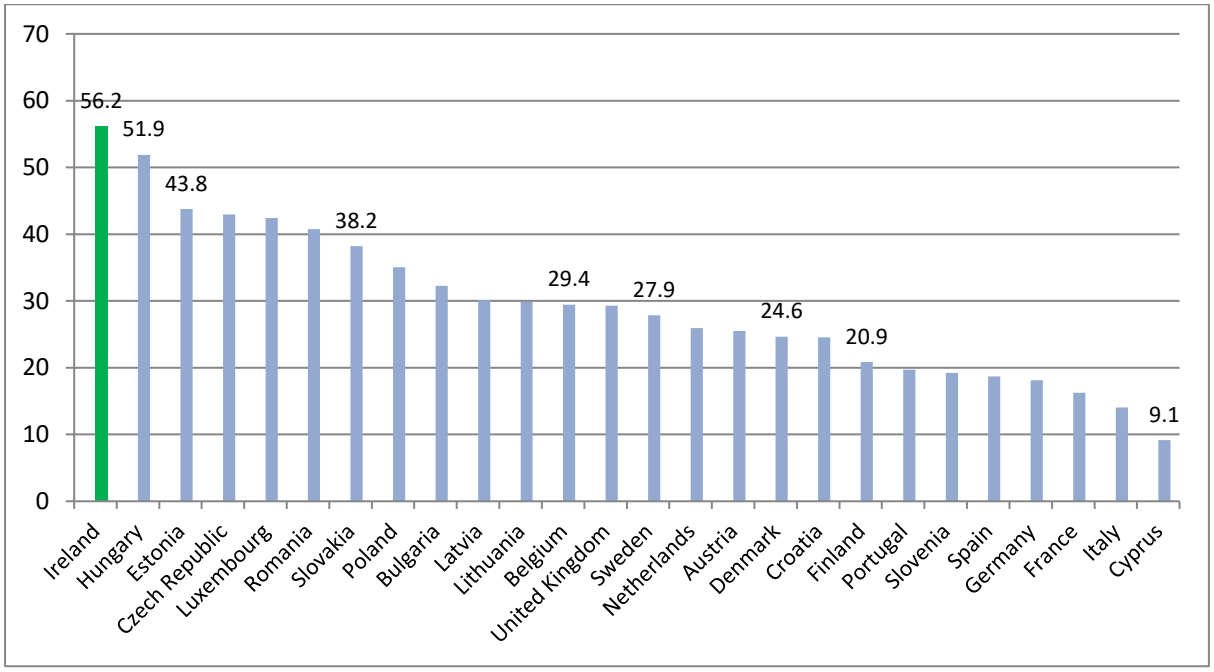
1 Introduction

1.1 Research and Policy Context

Ireland is one of the most globalised economies[1] in the world with a high share of multinational enterprises in its economic activity. Foreign affiliates make a significant contribution to Ireland's economic growth and competitiveness. Among all EU countries, Ireland stands out with respect to the high share of foreign affiliates in total value added (Figure 1.1).

Ireland's attractiveness to foreign direct investment is linked to a range of factors including its EU membership, skilled and flexible labour force, business-friendly environment and competitive corporate tax rates.[2]

Figure 1.1: Value added in foreign controlled enterprises as a share of total value added in EU countries, 2011.



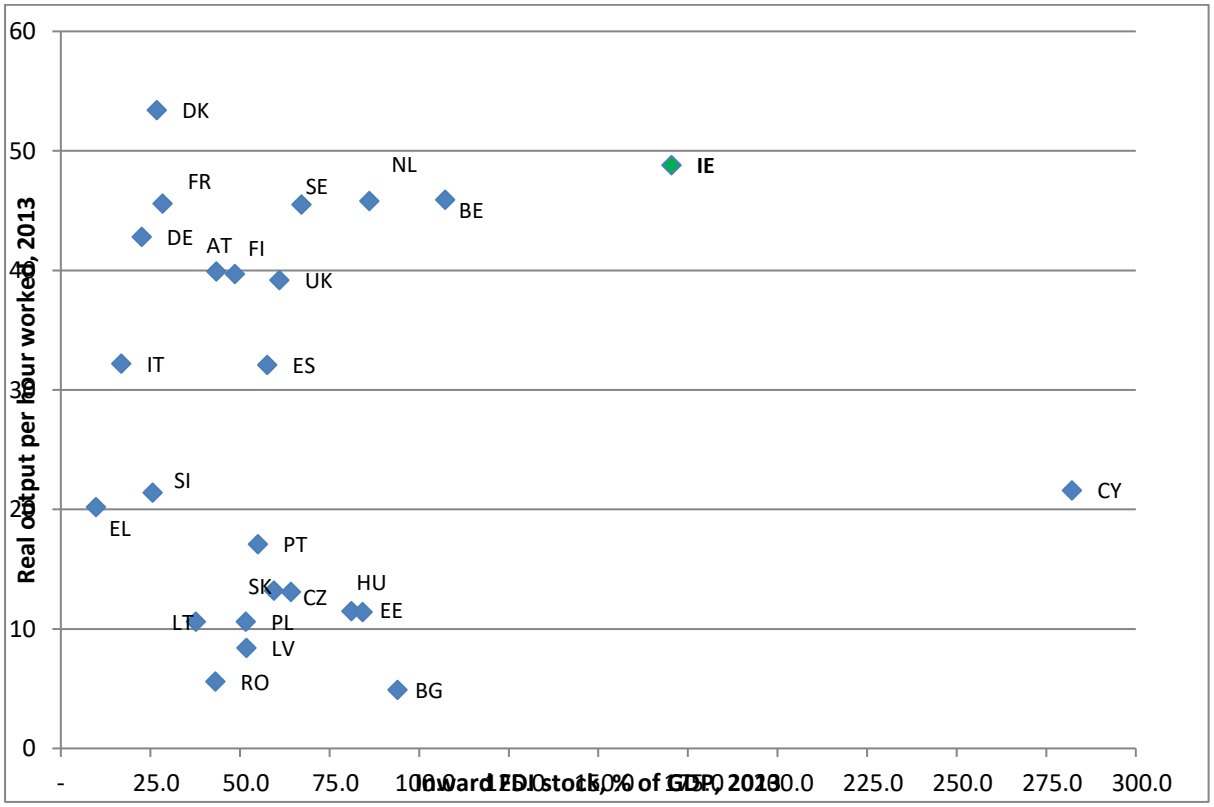
Source: Authors' calculations based on data from the Eurostat.

In contrast to other highly productive EU countries, Ireland's high productivity is linked to its large inward FDI stock relative to its small economic size (Figure 1.2). Ireland's high share of high-tech exports is also linked to foreign direct investment (Figure 1.3).

[1] The 2016 KOF Globalisation Index, measuring economic, social and political globalisation, ranks Ireland second among 207 countries. With respect to the economic dimension of globalisation, Ireland ranks second after Singapore. The rankings are based on data for 2013 available from: http://globalization.kof.ethz.ch/media/filer_public/2016/03/03/rankings_2016.pdf.

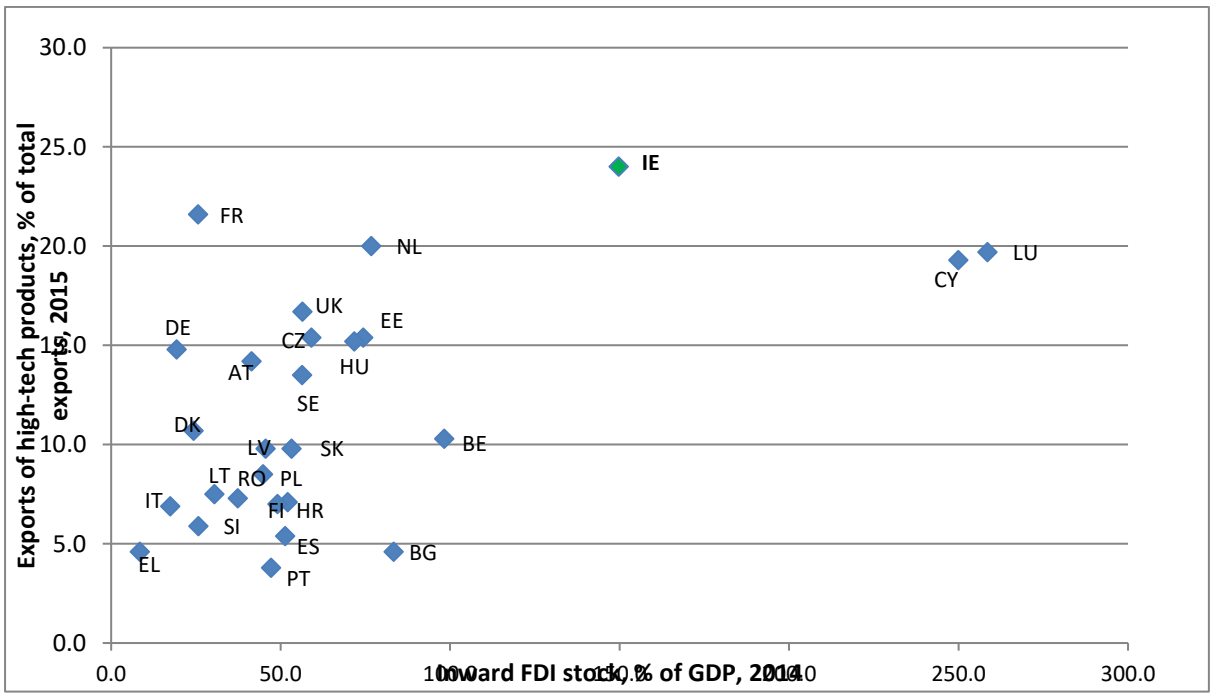
[2] Recent evidence on the attractiveness of Ireland and other EU countries to FDI is provided among others by Davies et al. (2016).

Figure 1.2: Inward FDI and productivity in EU countries, 2013



Source: Authors' calculations based on data from the Eurostat and UNCTAD.

Figure 1.3: Inward FDI and exports of high-tech products in EU countries, 2015



Source: Authors' calculations based on data from the Eurostat and UNCTAD.

This study provides evidence that will help to better understand the differences and driving forces behind the Irish-owned firms and the MNEs operating in Ireland. Specifically, the analysis focuses on the following key issues:

- A comparative analysis of the performance of indigenous and foreign-owned firms, in particular with respect to *employment and productivity* as well as their *sectoral and regional patterns*;
- *Investment in R&D and innovation* in both groups of firms and how these investments impact on their *innovation and productivity performance*;
- *The trade performance* of the two groups of firms and spillovers from foreign-owned firms on the trade performance of indigenous firms;
- *SMEs access to finance* and how financing constraints impact on their export, investment and innovation performance.

The evidence provided by this study will be used to put forward policy guidelines for Ireland in the context of the European Semester.

The reminder of this study is structured as follows. Chapter 2 describes the firm-level data used in the empirical analysis. Chapter 3 presents an overview of the performance of indigenous and foreign-owned firms in Ireland and their contributions to economic activity. Specifically, this descriptive analysis highlights the contributions of the two groups of firms in macroeconomic indicators including employment, gross output (turnover), gross value added, and productivity. Further, the analysis discusses sectoral and geographical patterns of economic activity. Further, foreign-ownership *premia* are quantified measuring the performance differential between foreign-owned and Irish-owned firms with respect to a range of firm performance indicators including productivity, investment in tangible and intangible assets, wages, export and import intensity. Chapter 4 discusses the results of a comparative empirical analysis of the impact of investment in innovation on productivity in Irish-owned and foreign-owned firms. Chapter 5 summarises the trade performance of indigenous and foreign-owned firms. Further, this section discusses the results of an econometric analysis of spillovers from foreign-owned firms to the trade performance of indigenous firms. Section 6 analyses the access to finance of SMEs and how this impacts on their export, investment and innovation performance. Section 7 summarises the key findings and on this basis discusses implications for policies aimed at enhancing productivity growth and competitiveness in Ireland. Finally, Section 8 proposes directions for further research with the aim to provide additional evidence which could be useful in the context of the European Semester.

2 Data

This analysis uses six datasets provided by Ireland's Central Statistics Office (CSO): the Business Register data, the Census of Industrial Production, the Annual Service Inquiry, the Community Innovation Survey, the External Trade data (Intra-stat and Extra-Stat) and the Access to Finance data. All datasets can be linked to each other by use of unique firm identifiers.

Business Register: this is the widest data source available, which spans over the entire population of Irish firms. It contains information on the total number of enterprises in Ireland, their date of birth and death, their location at the county level, the main sector of activity (NACE 4 digit), the number of persons employed and persons engaged.[3] The frequency of the dataset is annual. The available data cover the period 2008-2014.

Census of Industrial Production (henceforth CIP): the CIP covers all firms having their whole or primary activity in industrial production, NACE Rev 2. 05-39 (mining and quarrying, manufacturing and utilities), and having three or more persons engaged.[4] The information collected with the CIP survey includes location of ownership, turnover, employment and gross earnings, changes in capital assets, purchases of goods and services other than capital items. A more detailed questionnaire including information on changes in intangible assets, as well as exports and imports, is sent to firms with 20 and more persons engaged. The data is available for the period 2008-2014.

The Annual Service Inquiry (henceforth ASI) covers firms having their whole or primary activity in the distribution and services sectors from NACE 45 to 96 (excluding NACE 64 to 66): retail; wholesale; transportation and storage; accommodation and food; information and communication; real estate; professional, scientific, technical, administrative; and other selected services. The ASI is based on a census of firms with 20 and more persons and a stratified random sample for firms with less than 20 persons engaged.[5] The data collected with a more detailed questionnaire is sent to firms with 20 or more persons engaged, similarly to the CIP survey. The data is available for the period 2008-2014.

The Community Innovation Survey (henceforth CIS) is a biennial survey on innovation activities that is conducted by the Central Statistics Office. The survey covers firms in industry and in selected sectors[6], and is based on a census component for the largest enterprises and a stratified sample for smaller firms, but with more than 10 employees.[7] The CIS collects information about product and process innovation as well as organisational and marketing innovation during the preceding three year period. The information on innovation expenditures collected with the CIS include R&D expenditures (in-house R&D and purchased external R&D) as well as non-R&D expenditures (acquisitions of advanced machinery, equipment, software; acquisitions of other external knowledge such as purchased or licensed patented and non-patented inventions, know-how, and other types of knowledge from other enterprises and organisations for the development of new or significantly improved products and processes). The data cover the period 2006-2014.

The External Trade data sets include trade statistics (exports and imports) of intra-EU and extra-EU merchandise trade collected monthly from all VAT registered traders (Intra-Stat) and from

[3] Persons engaged count persons employed plus self-employed persons.
[4] In 2014, 3,200 enterprises were surveyed out of a total population of 16,500 enterprises.
[5] In 2014 the CSO indicates that 18,000 firms were covered by the ASI.
[6] NACE 05 - 09, 10 - 33, 35, 36 - 39, 46, 49 - 53, 58- 66, 71-73
[7] About 2000 firms are sampled in each wave.

administrative data of Revenue Commissioners (Extra-Stat). The following data are collected: Company VAT number; Commodity code (CN); Transaction type (import, export); Invoice value; Net mass and/or supplementary units; Country of destination for exports; Country of origin for imports; Delivery terms; Statistical value; Nature of transaction. The data is available for the period 1996-2015.

Survey on Access to Finance of Enterprises (SAFE). This survey commissioned by the European Commission and the European Central Bank is undertaken on a biannual basis. The last seven waves covering 2014-2017 are used in this study. Ireland's share of the survey sample is 500 firms per wave. In addition to information on financing conditions, SAFE data base includes information on firm size in terms of number of employees, turnover, age, type of ownership, parent country, main activity, export status, as well as information on access to finance.

3 A Portrait of Indigenous and Multinational Firms and their Contribution to Economic Activity

This chapter presents a descriptive analysis of the contribution of indigenous and foreign-owned firms to economic activity in Ireland over the period 2008-2014. Section 3.1 presents key features of indigenous and foreign-owned firms in terms of their numbers and shares in employment, gross output (turnover) and gross value added (GVA). Next, sectoral and regional patterns are examined in section 3.2, and section 3.3, respectively. Section 3.4 analyses various productivity patterns separately for manufacturing and services sectors including: average productivity, productivity distributions, and productivity growth over time. This analysis identifies a large and growing gap in productivity between Irish and foreign firms, in favour of the latter. Furthermore, productivity appears to grow very differently in different parts of the productivity distributions: firms in the top 10 percentiles grow much faster than all other firms, leading to further productivity divergence over time. Finally, section 3.5 examines the foreign ownership *premia* relative to indigenous firms with respect to a range of indicators including: productivity, human capital, gross output, investment in tangible and intangible assets, export intensity, and import intensity.

Key Findings

- Foreign-owned firms are concentrated in high-productivity sectors including manufacture of computers, electronic and optical products; pharmaceuticals; chemicals; telecommunications; office support and other business support activities and computer programming, consultancy and related services;
- Foreign-owned firms are also concentrated geographically around Dublin and other major cities including Limerick, Cork and Sligo.
- Breaking down the foreign-owned firms in EU-owned and non-EU owned affiliates, while in terms of the number of firms the two groups of foreign affiliates account for similar proportions, the non-EU owned affiliates account for larger shares in employment, as well as gross output and gross value added.
- Apart from being concentrated in high-tech industries and knowledge-intensive services, a key feature of the foreign-owned firms is their significantly larger scale relative to the size of Irish-owned firms.
- The productivity gap between foreign-owned firms and Irish-owned firms has increased over time and is larger in services in comparison to manufacturing.
- The analysis of productivity distributions indicates that most of the productivity differentials between Irish-owned and foreign-owned firms are concentrated in the distributions tails, while the central parts of the distributions are rather similar for the two groups of firms and and appear to be stable over time.
- Regardless ownership, productivity growth has been concentrated in the top percentile of firms while the productivity performance of the rest of the first has been lagging behind. This pattern of productivity divergence is present in both manufacturing and services for Irish-owned and non-EU owned affiliates, and for EU-owned affiliates in manufacturing. In contrast, productivity growth in EU-owned affiliates in services appears to be on a convergence path.

- The estimated foreign-ownership *premia* controlling for unobserved industry, region and time specific effects indicate significant differentials in the performance of the two groups of firms.
- Relative to Irish-owned firms, foreign-owned firms are more productive, pay higher wages, invest more in tangible and intangible assets. On average, relative to Irish-owned firms, foreign-owned firms export a larger proportion of their output and import more relative to their output.

3.1 Contribution to Economic Activity – Macroeconomic Indicators

Table 3.1 shows the contribution of indigenous and foreign-owned firms to economic activity in 2008 and 2014.

In 2014 Irish-owned firms accounted for over 98 per cent of the number of firms and over three quarters of persons engaged (a decrease by nearly four percentage points in comparison to 2008). In terms of output, Irish-owned firms accounted for nearly 48 per cent of the gross value added (GVA), 9 percentage points less than in 2008. As shown in Table 3.1, foreign-owned firms make a substantial contribution to gross output and GVA, over 52 per cent, an increase by nine percentage points in the case of GVA relative to 2008.

Breaking down the foreign-owned firms in EU-owned and non-EU owned affiliates, while in terms of the number of firms the two groups of foreign affiliates account for similar proportions, the non-EU owned affiliates account for much larger shares of the number of persons engaged (14.5 percent compared to 9.8 per cent) as well as gross output (42.3 per cent compared to 9.8 per cent) and GVA (42.5 per cent compared to 9.5 per cent).

Table 3.1: The importance of indigenous and foreign-owned firms in Ireland's economic activity

	2008		2008		2014		2014	
	Irish-owned affiliates	All foreign-owned affiliates	Foreign-owned affiliates owned by EU multinationals	Foreign-owned affiliates owned by non-EU multinationals	Irish-owned affiliates	All foreign-owned affiliates	Foreign-owned affiliates owned by EU multinationals	Foreign-owned affiliates owned by non-EU multinationals
Enterprises (Number)	98.6%	1.4%	0.7%	0.7%	98.5%	1.5%	0.8%	0.7%
Persons Engaged (Number)	79.4%	20.6%	8.7%	11.9%	75.7%	24.3%	9.8%	14.5%
Turnover (Euro Million)	58.5%	41.6%	10.9%	30.7%	47.3%	52.7%	10.4%	42.3%
GVA (Euro Million)	56.9%	43.1%	9.9%	33.3%	47.9%	52.1%	9.5%	42.5%

Source: Authors' calculations based on data from the Structural Business Statistics, Central Statistics Office, Ireland.

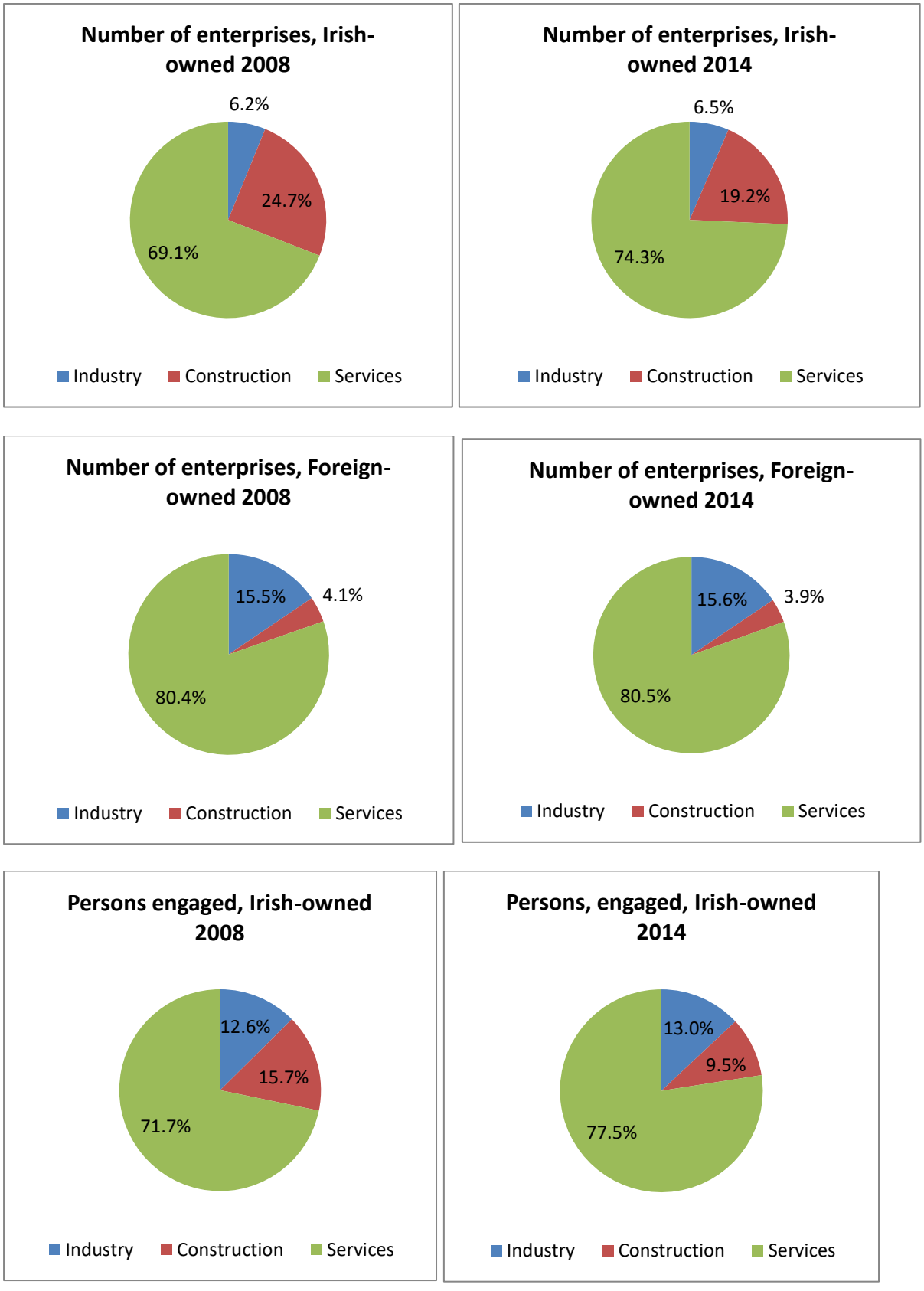
3.2 Sectoral Patterns

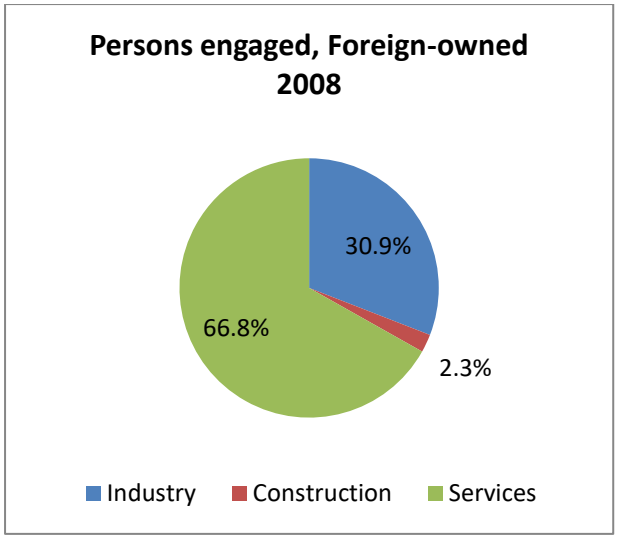
Figure 3.1 shows the sectoral distribution of Irish-owned and foreign-owned firms with respect to the economic indicators discussed above. Overall, foreign-owned firms have higher shares in industry and services, while the activity of Irish-owned firms in the construction sector while reduced compared to 2008 is still significantly larger relative to foreign-owned firms.

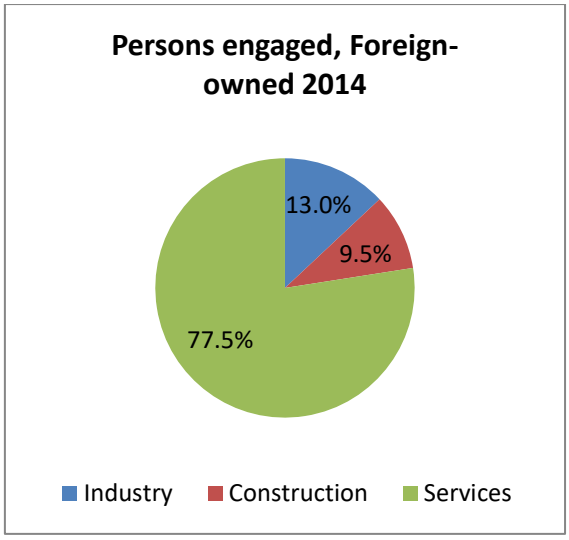
Figure 3.2 shows the shares of employment in foreign-owned firms in total employment in manufacturing by NACE 2-digit industry in 2008 and 2014. Tables A1 and A2 in the Appendix show the full rankings of industries in 2008 and 2014. Industries with the highest concentration of foreign-ownership in 2014 include other manufacturing; manufacture of computers, electronic and optical products; pharmaceuticals; manufacture of beverages; manufacture of tobacco and tobacco products; manufacture of chemicals and chemical products. As shown in Figure 3.2, the shares of pharmaceuticals and chemicals have declined in 2014 in comparison to 2008.

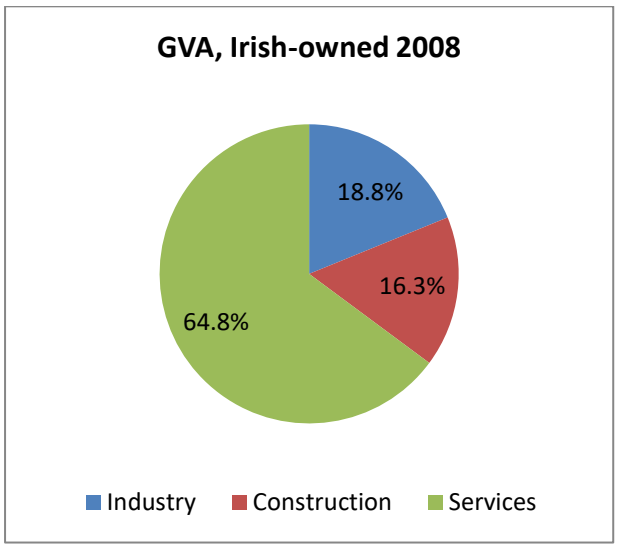
Figure 3.3 shows the shares of employment in foreign-owned firms in total employment in services by NACE 2-digit industry. The full rankings of service industries are shown in Tables A3 and A4 in the Appendix. The service industries with the highest shares of foreign-ownership include knowledge-intensive services such as telecommunications; office support and other business support activities and computer programming, consultancy and related services.

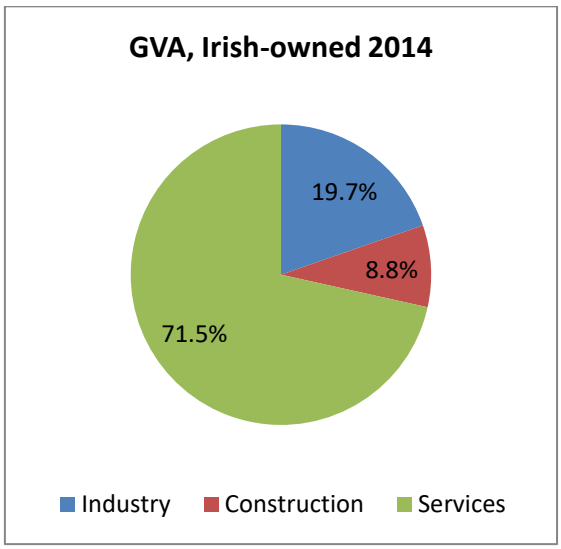
Figure 3.1: Sectoral patterns of Irish-owned and foreign-owned enterprises

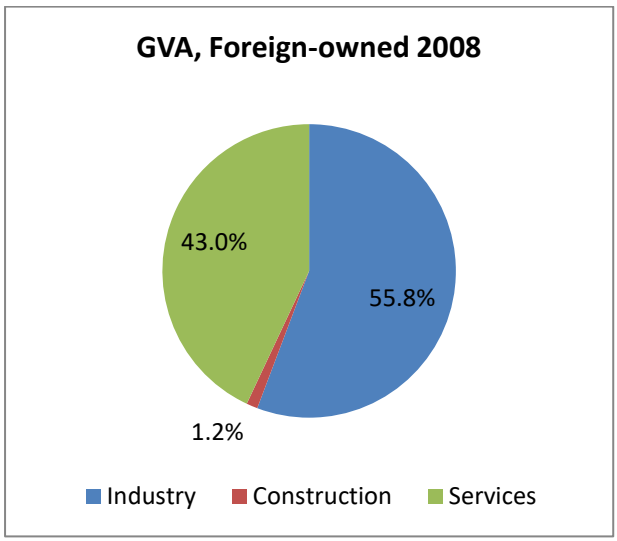


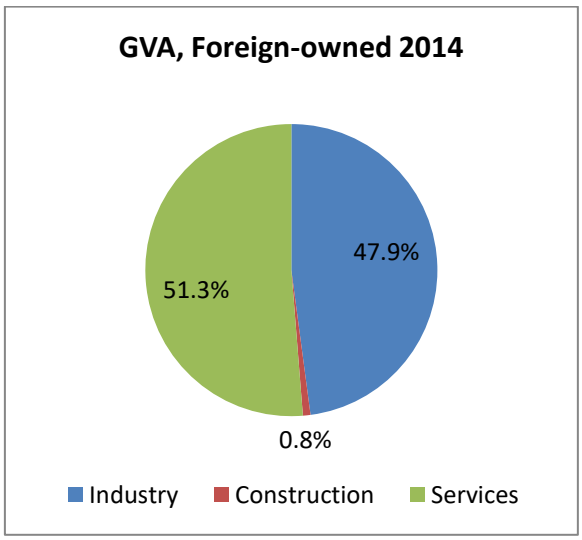






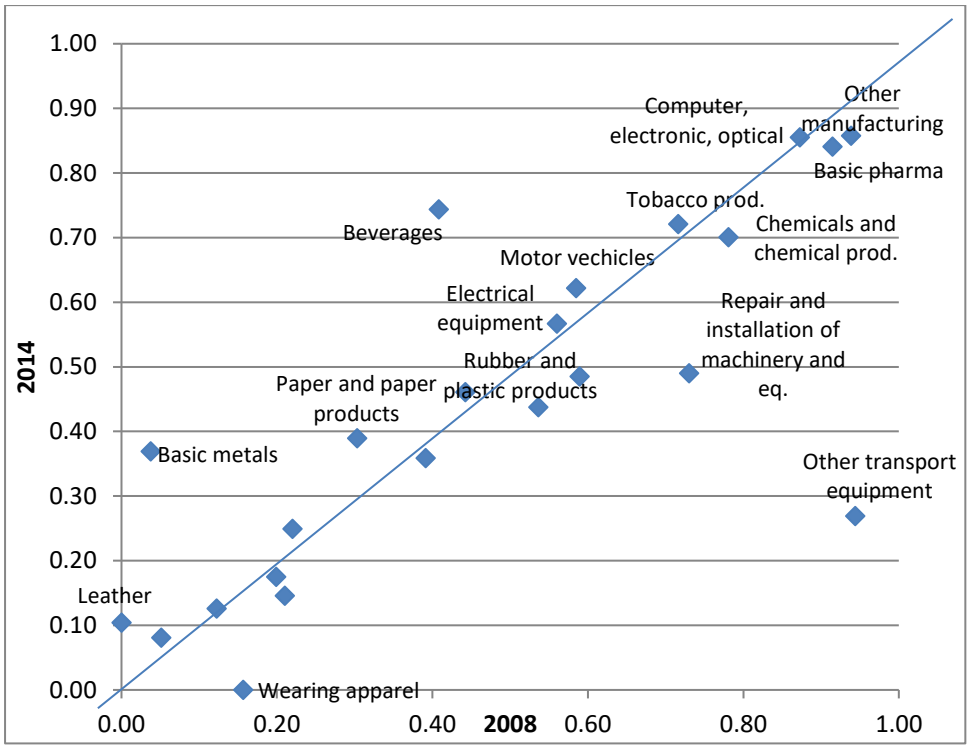






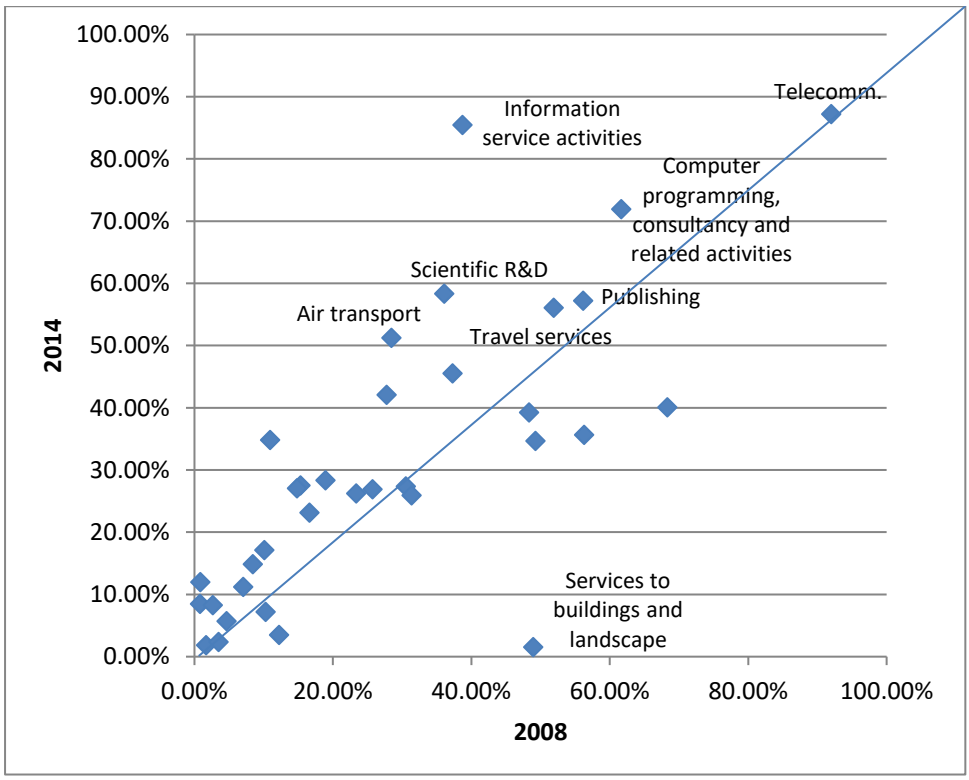
Source: Authors' calculations based on data from the Structural Business Statistics, Central Statistics Office, Ireland

Figure 3.2: The share of employment in foreign-owned firms in total employment, manufacturing



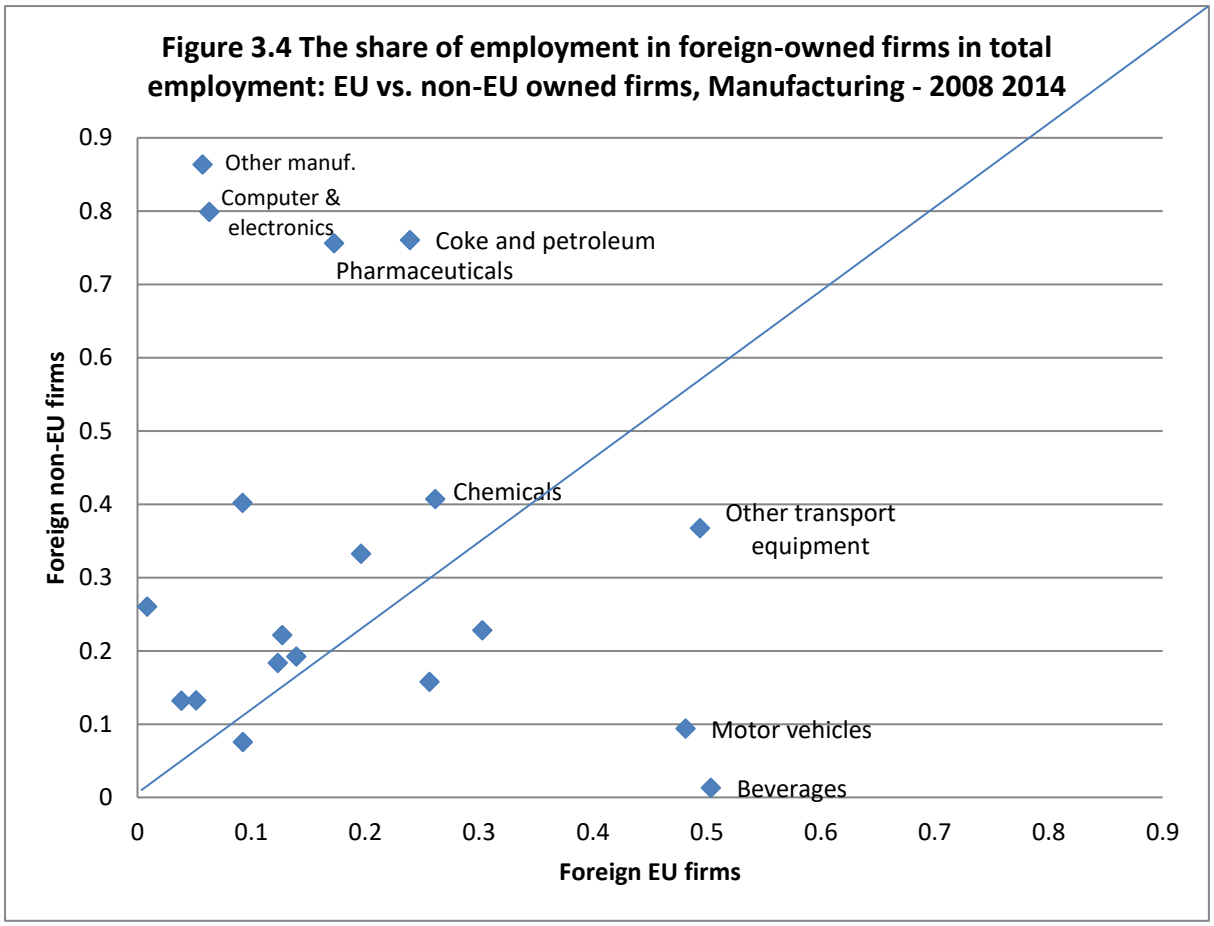
Source: Authors' calculations based on data from the Census of Industrial Production (CIP).

Figure 3.3: The share of employment in foreign-owned firms in total employment, services



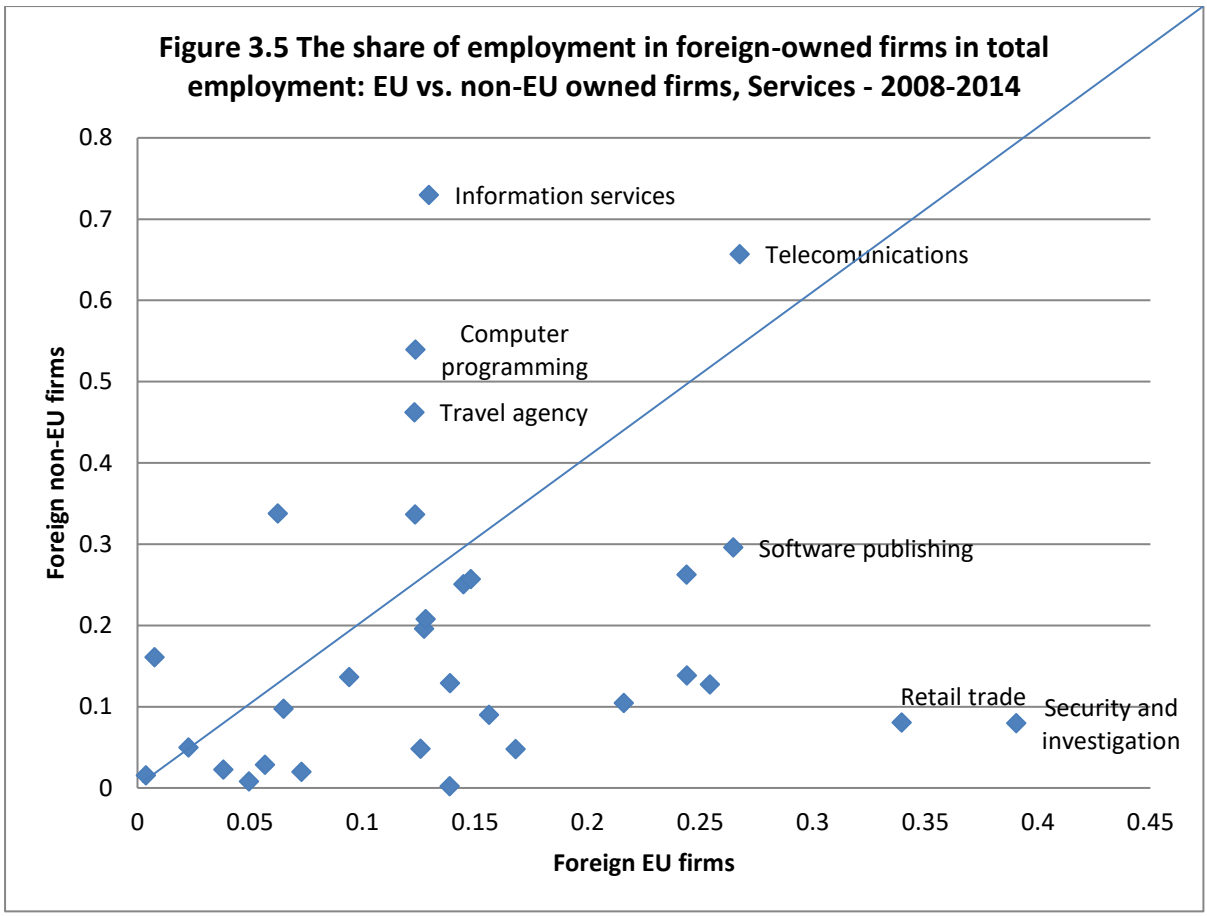
Source: Authors' calculations based on data from the Annual Services Inquiry (ASI).

Figures 3.4 and 3.5 compare employment shares by industry in EU-owned and non-EU owned affiliates Figure 3.4 shows that, relative to EU-owned affiliates, the presence of non-EU owned affiliates is stronger particularly in knowledge-intensive industries (computer, electronic and optical products; pharmaceuticals; electrical equipment; chemicals) while EU-owned affiliates have a stronger presence in traditional industries as well as motor vehicles.



Source: Authors' calculations based on data from the Census of Industrial Production (CIP).

A similar pattern emerges in services, with a stronger presence of non-EU owned affiliates in knowledge-intensive services including computer programming; and telecommunications.

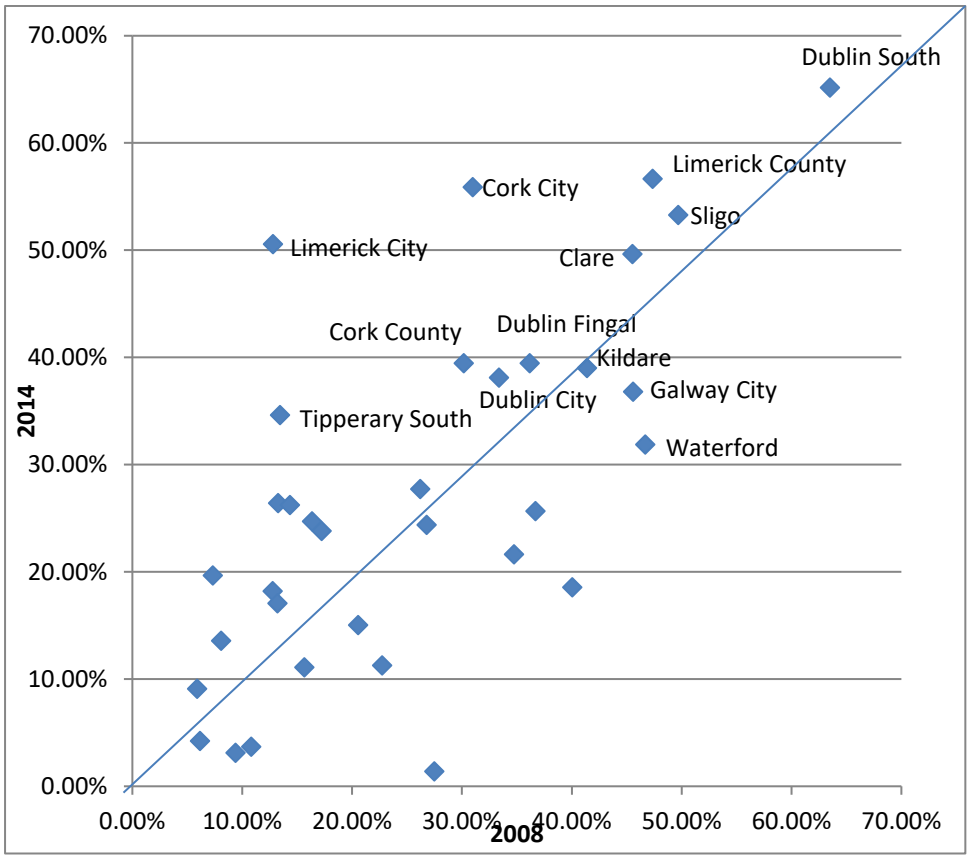


Source: Authors' calculations based on data from the Census of Industrial Production (CIP).

3.3 Regional Patterns

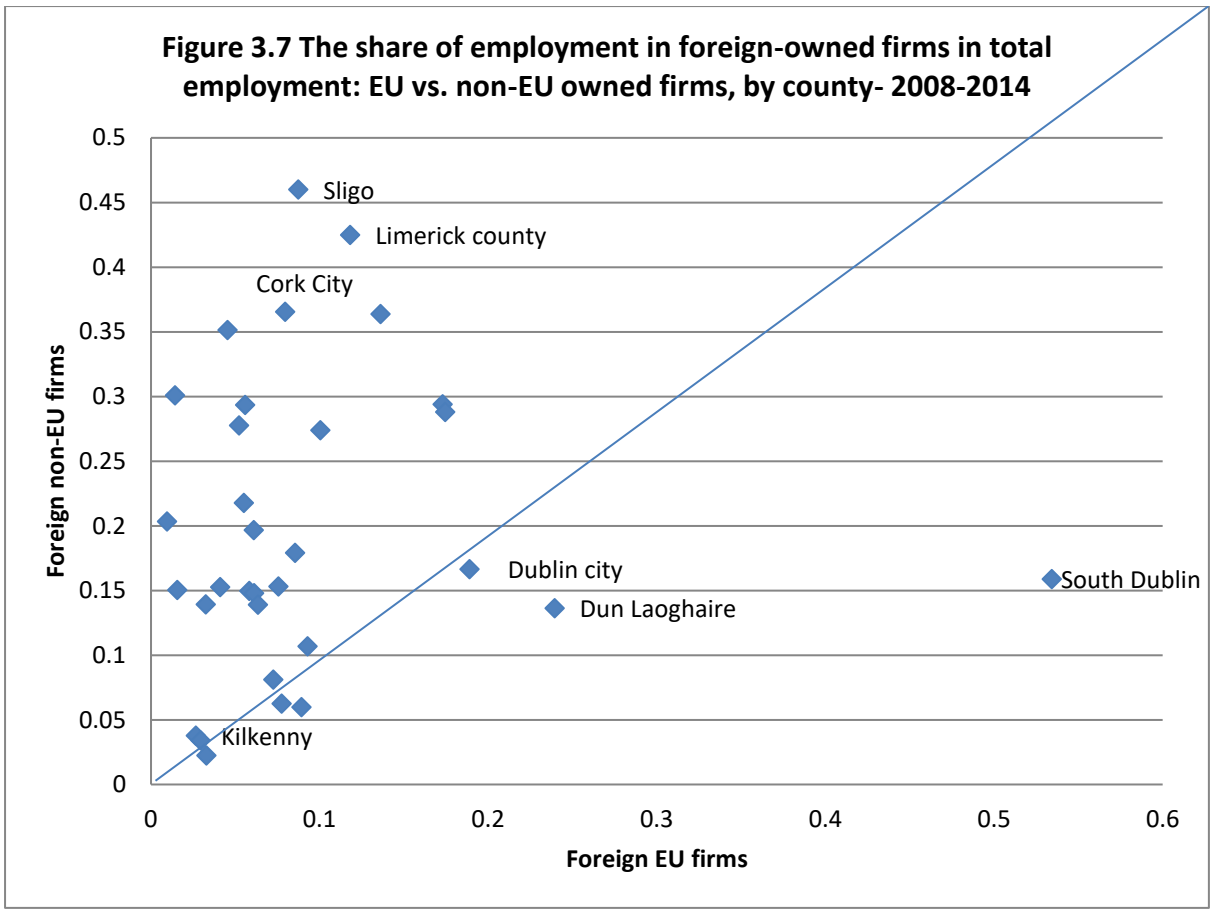
Figure 3.6 shows the share of employment in foreign-owned firms in total employment by local administrative units (counties) in 2008 and 2014. The full ranking of local administrative units is shown in Table A5 in the Appendix. Foreign-owned firms are concentrated geographically around Dublin and other major cities including Limerick, Cork and Sligo. Figure 3.6 indicates an increase in recent years of the foreign presence in a great number of counties.

Figure 3.6: The share of employment in foreign-owned firms in total employment by county (local administrative units)



Source: Authors' calculations based on data from the Census of Industrial Production (CIP) and Annual Services Inquiry.

Figure 3.7 shows the share of employment in EU and non-EU owned affiliates by counties over the period 2008-2014. The key message which emerges is that EU-owned affiliates are concentrated around Dublin while non-EU affiliates appear to be more spread over Ireland's region with the highest employment concentration in Sligo, Limerick and Cork.



Source: Authors' calculations based on data from the Census of Industrial Production (CIP) and Annual Services Inquiry.

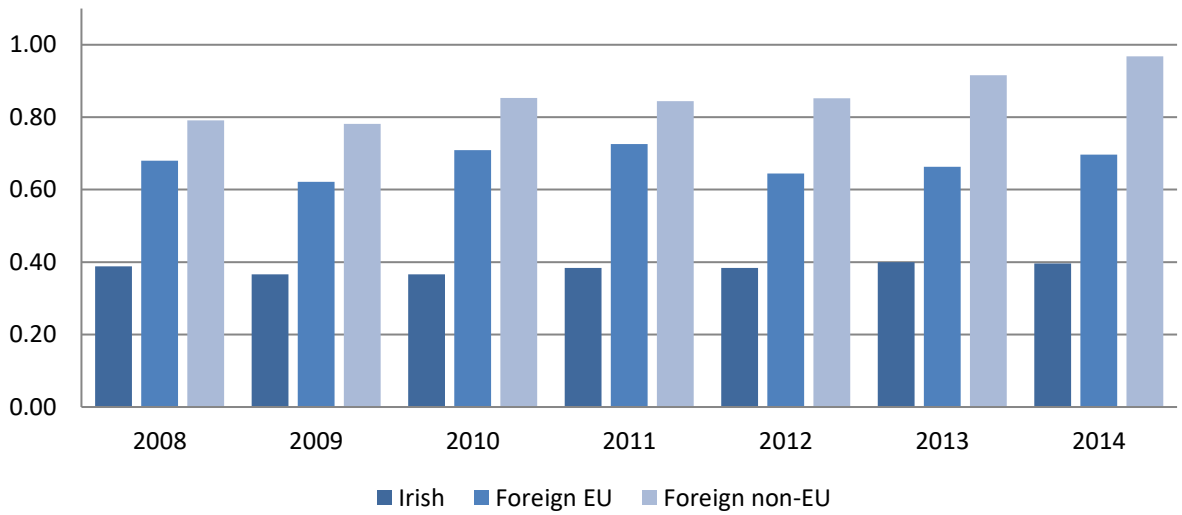
3.4 Productivity Patterns

Figures 3.8-3.21 show more detailed features of the productivity gap between Irish and foreign-owned firms. Both average productivity and the dispersion of the productivity distributions are examined, as well as the path of productivity growth. The analysis is conducted first separately for firms in manufacturing and in services; next, a finer disaggregation at the 2-digit sector level is provided. The analysis of productivity in this section is based on labour productivity measured as real value added per employee. Comparable descriptive statistics for total factor productivity (TFP) are presented in Appendix B.

3.4.1 Average productivity

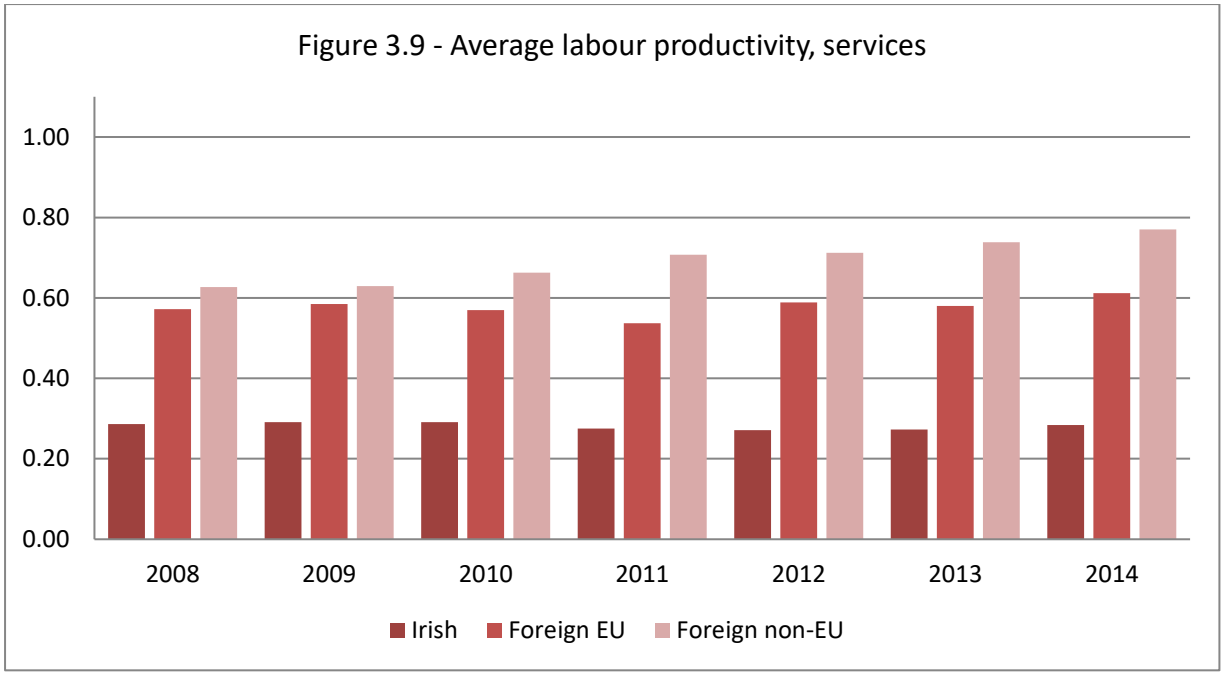
Figure 3.8 shows that, in manufacturing, the productivity of foreign non-EU owned firms is about twice as large as the productivity of Irish-owned firms. Foreign-EU owned firms are in between the two other subgroups, but their average productivity is closer to foreign non-EU firms than to Irish-owned firms. Notice also that the productivity gap between Irish and foreign non-EU firms has grown over time, due to the rising productivity of foreign non-EU firms.

Figure 3.8 - Average labour productivity, manufacturing



Source: Authors' calculations based on CIP data.

In services, Figure 3.9 shows the productivity gap between Irish-owned and foreign-owned firms is slightly larger than in manufacturing. The productivity of foreign non-EU firms is again the highest and more than twice as large the productivity of Irish firms. Foreign EU firms are again in between the other subgroups and, especially in the first years under analysis, their average productivity is very close to that of foreign non-EU firms. As already seen for manufacturing, also for service firms the gap in average productivity rises over time, due to the rising productivity of foreign non-EU firms.



Source: Authors' calculations based on ASI data.

Figures 3.10 and 3.11 show a further disaggregation of the CIP and the ASI data, with mean productivity for Irish and foreign firm being computed at the NACE 2 digit sector level.[8]

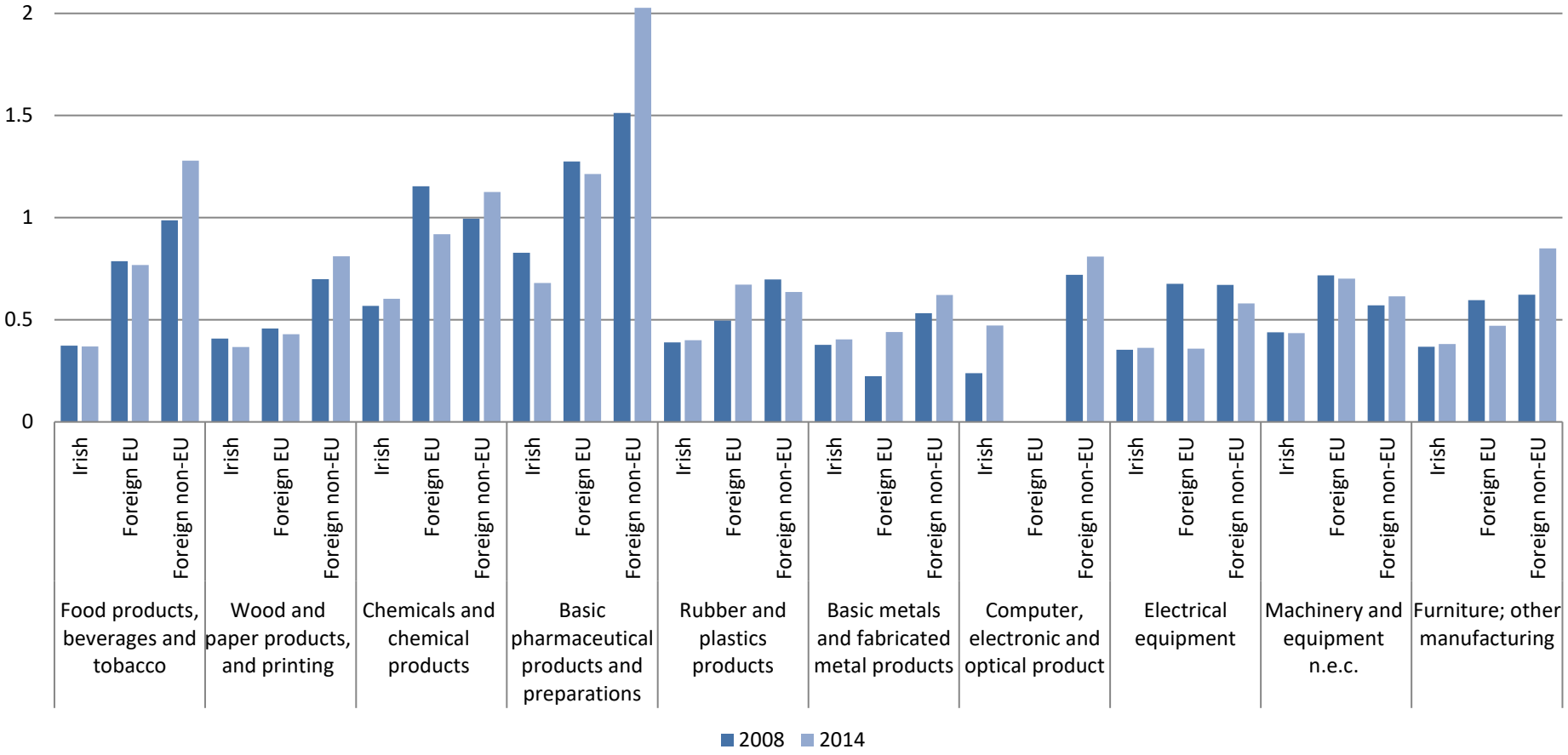
The productivity gap between Irish firms and both the EU and non-EU foreign firms appear in all sectors, both in manufacturing and services, albeit with some noticeable differences.

Among the manufacturing industries, in 2008 the productivity gap was largest in the computer and electronics industry, followed by manufacturing of food and chemicals. In 2014, the gap has widened in the vast majority of industries, with respect to both foreign EU and foreign non-EU firms, and is largest in the food industry, followed by pharmaceuticals and manufacturing of furniture. Interestingly, where the gap has widened it is because of an increase of foreign firms' productivity; the only industry where the gap has shrunk (electrical equipment), this is not due to a rise in productivity of Irish firms, but to a decline in productivity of foreign firms.

Among the service industries, in 2008 the productivity gap was largest in telecommunications, followed by wholesale and retail trade, and by the IT industry. Similarly to manufacturing, also among the service sectors the productivity gap has widened between 2008 and 2014 and is largest in the publishing industry, followed by telecommunications and wholesale and retail trade.

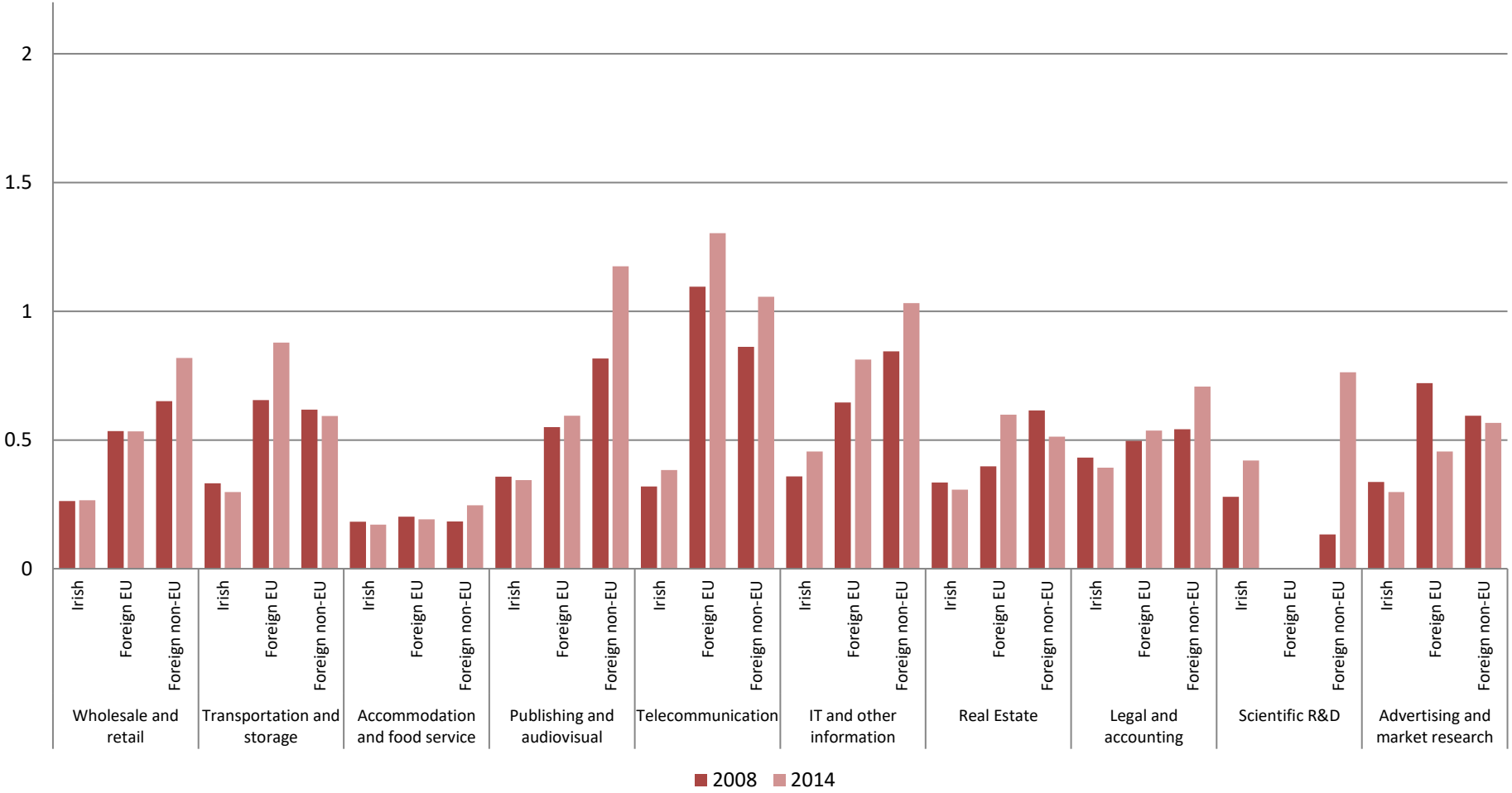
[8] We could not report figures for all 2-digit NACE sectors in figures 3.7.and 3.8. For statistical confidentiality reasons, all observations from sectors with a too low number of firms were removed from the figures.

Figure 3.10. Average labour productivity by sector - manufacturing, 2008-14



Source: Authors' calculations based on CIP data.

Figure 3.11 Average labour productivity by sector - services, 2008-14

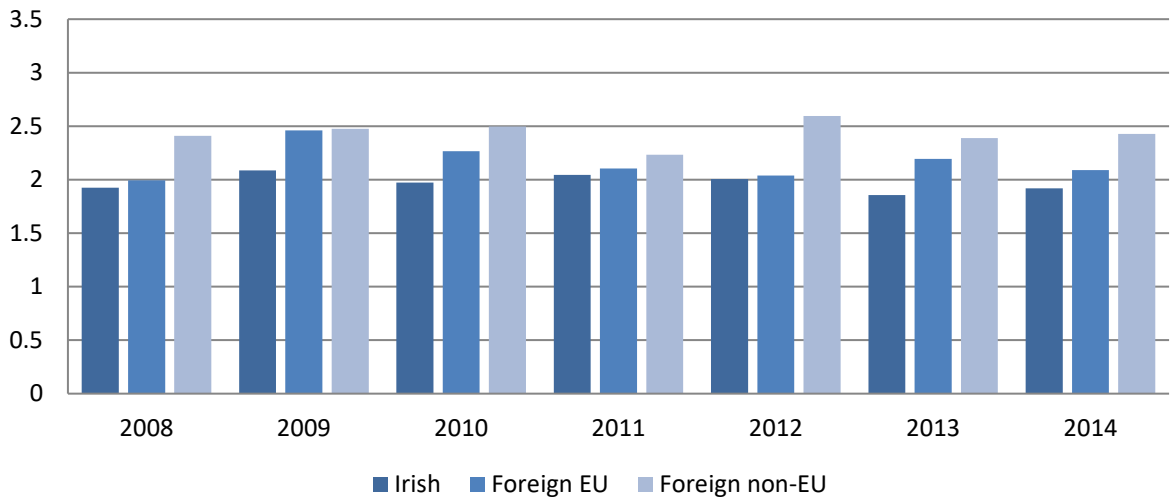


Source: Authors' calculations based on ASI data.

3.4.2 Productivity distributions

Figures 3.12-3.15 describe the distribution of labour productivity within the subgroups of Irish, foreign EU and foreign non-EU firms. Figure 3.9 and 3.10 show the ratio of productivity of the 75th percentile over the 25th percentile of the distributions, while figures 3.11 and 3.12 show the ratio of the mean productivity of firms in the top quintile over the mean productivity of firms in the bottom quintile of the distribution. Both sets of figures are informative, as they represent different cuts of the labour productivity distribution, and show where the largest disparities emerge.

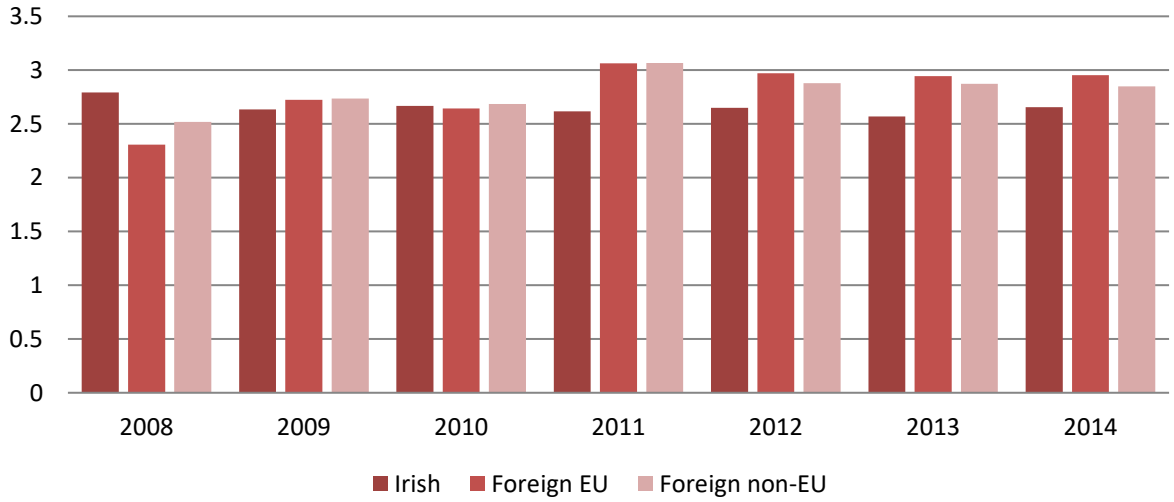
Figure 3.12 Labour productivity, 75th/25th percentile, manufacturing



Source: Authors' calculations based on CIP data.

In manufacturing, as shown in Figure 3.12, the ratio of the 75th over the 25th percentile is rather uniform across Irish and foreign firms: a firm at the 75th percentile is about 2 to 2.5 times more productive than a firm at the 25th percentile. However, the higher ratio for foreign-owned firms (especially non-EU owned firms) denotes a more dispersed distribution for these firms, relative to the Irish-owned ones.

Figure 3.13 Labour productivity, 75th/25th percentile, services



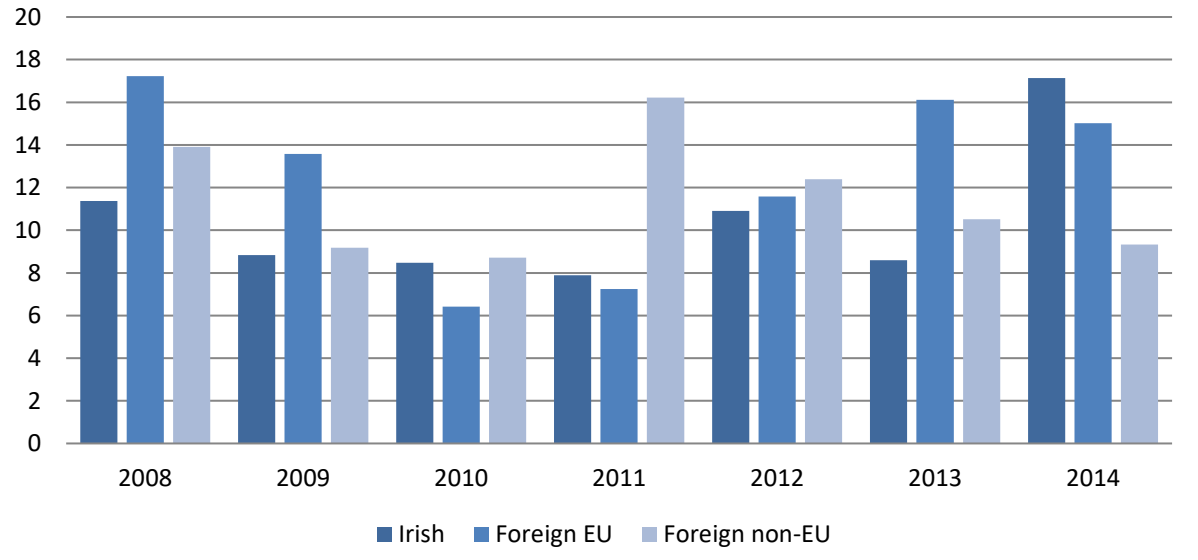
Source: Authors' calculations based on ASI data.

In services, as shown in Figure 3.13, regardless of ownership, the distribution of productivity is more dispersed than in manufacturing: a firm at the 75th percentile is about 2.5 to 3 times more productive than a firm at the 25th percentile. Notice also that the ratio is very similar across all firm sub-groups, and higher for foreign firms only in the last four years of data. This latter feature is likely due to the increase in labour productivity in the subgroup of foreign-owned firms, already described above in the analysis of mean productivity: Figure 3.12 suggests that this increase in productivity was mostly happening at the higher end of the distribution.

Figures 3.14 and 3.15 provide a similar analysis, but show that comparing the top and bottom quintiles of the labour productivity distribution yields much starker contrasts than when focusing on the more central parts of the distribution (75th versus 25th percentile).

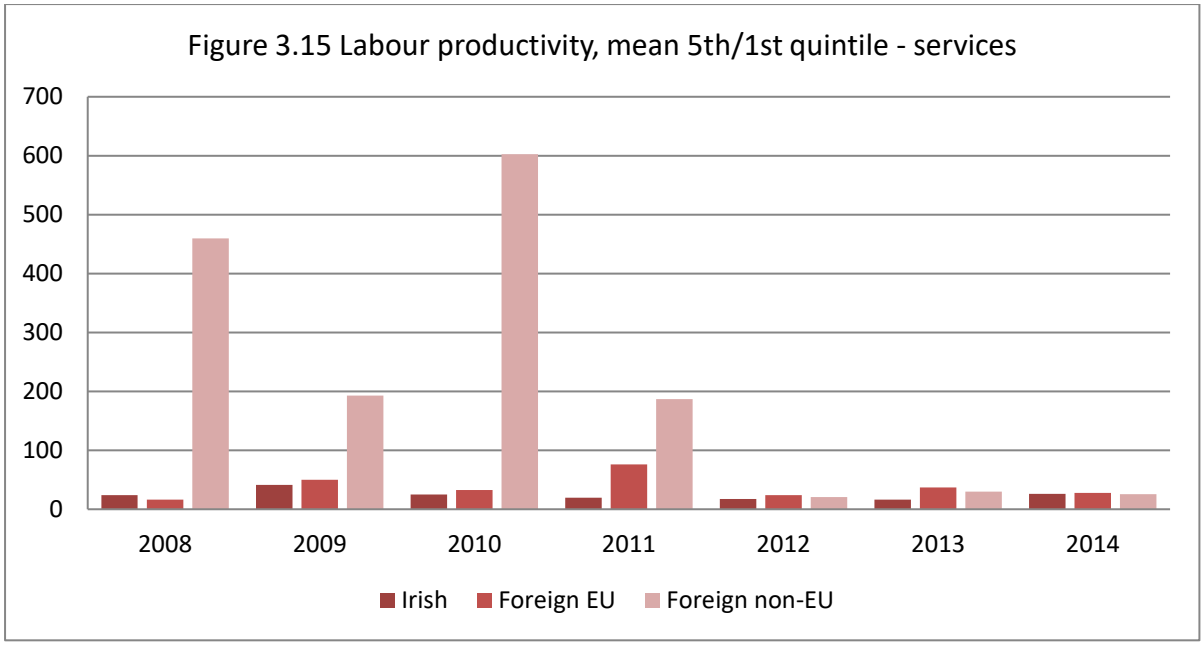
In manufacturing, Figure 3.14 shows that the top/bottom quintile ratios vary significantly over time and range between values of approximately 6 and 17. For Irish firms, the ratio is more stable than for foreign firms and oscillates between 11 and 8 from 2008 to 2013, and then rises to over 17 in 2014. For foreign firms the top/bottom quintile ratio is more erratic. Foreign-EU firms see a decline in productivity dispersion over the first half of the period analysed (from 17 to 6) and then an increase in the second half of the period (from 7 to 15). For foreign non-EU firms the ratio oscillates between 14 and 10 over the 2008-2014 period, with a spike of 16 in 2011.

Figure 3.14 Labour productivity, mean 5th/1st quintile, manufacturing



Source: Authors' calculation based on CIP data.

In services, Figure 3.15 shows, the top/bottom quintile ratios vary a great deal over time, with extremely large values calculated for the subgroup of foreign non-EU firms over the 2008-2011 period. Irish firms are again the subgroup for which the productivity distribution appears more stable over time, with the top/bottom quintile ratio varying between 23 in 2008 and 26 in 2008. For foreign-EU firms, the ratio is less erratic than that of foreign non-EU firms, but also varies considerably, from 16 in 2008 to 27 in 2014, but with a high value of 75 in 2011.



Source: Authors' calculations based on ASI data.

Overall, the analysis of the productivity distribution suggests that most of the differences in labour productivity between Irish and foreign firms are concentrated in the tail of the distributions. The central parts of the distribution, between the 75th and 25th quintile, are rather similar across firm subgroups and stable over time. The top/bottom quintile ratios show instead a much more varied picture, with some very large outliers in the distribution of foreign firms.

3.4.3 Ireland's productivity growth dispersion

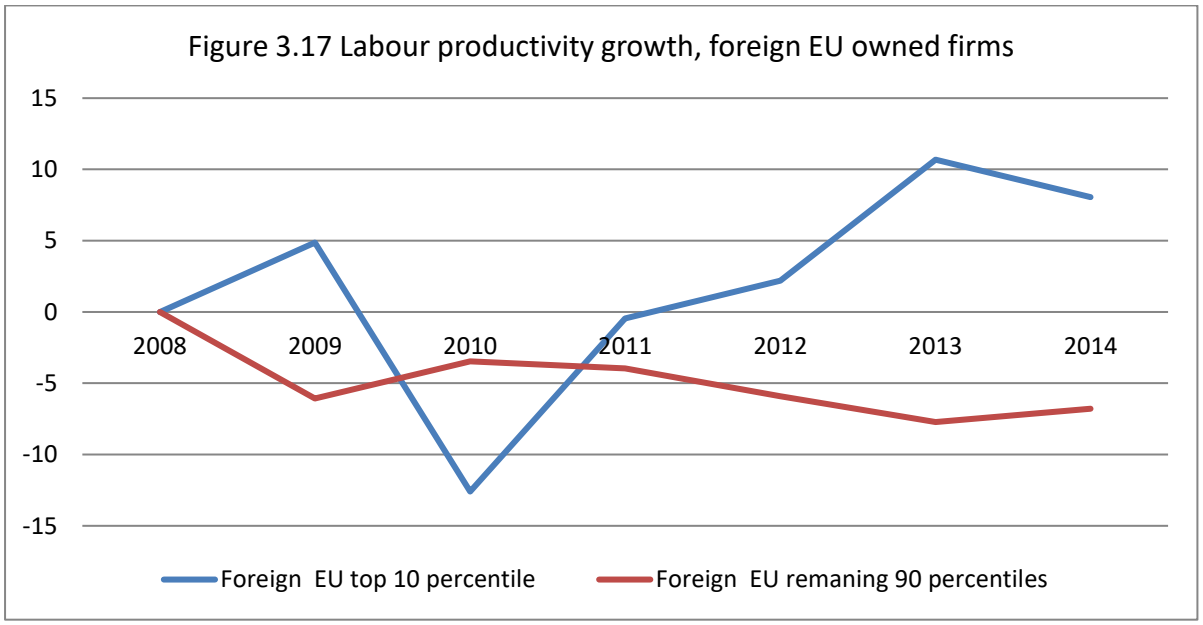
This section analyses the patterns of productivity growth in Irish, foreign EU and foreign non-EU firms.

Source: Authors' calculations based on CIP and ASI data.

In figures 3.16 to 3.18 we compare and contrast the average growth rates of firms in the top 10 percentiles of the productivity distribution with that of firms in the remaining 90 percentiles. In figures 3.19 to 3.21 we further separate the average growth rates between manufacturing and services firms. All growth rates are computed with respect to the productivity (in logs) in 2008 (hence the zero value for that year), which is the base years for all the subsequent years.

For Irish and foreign non-EU firms, the contrast in the rate of labour productivity growth between the top 10 and the bottom 90 percentiles is striking.

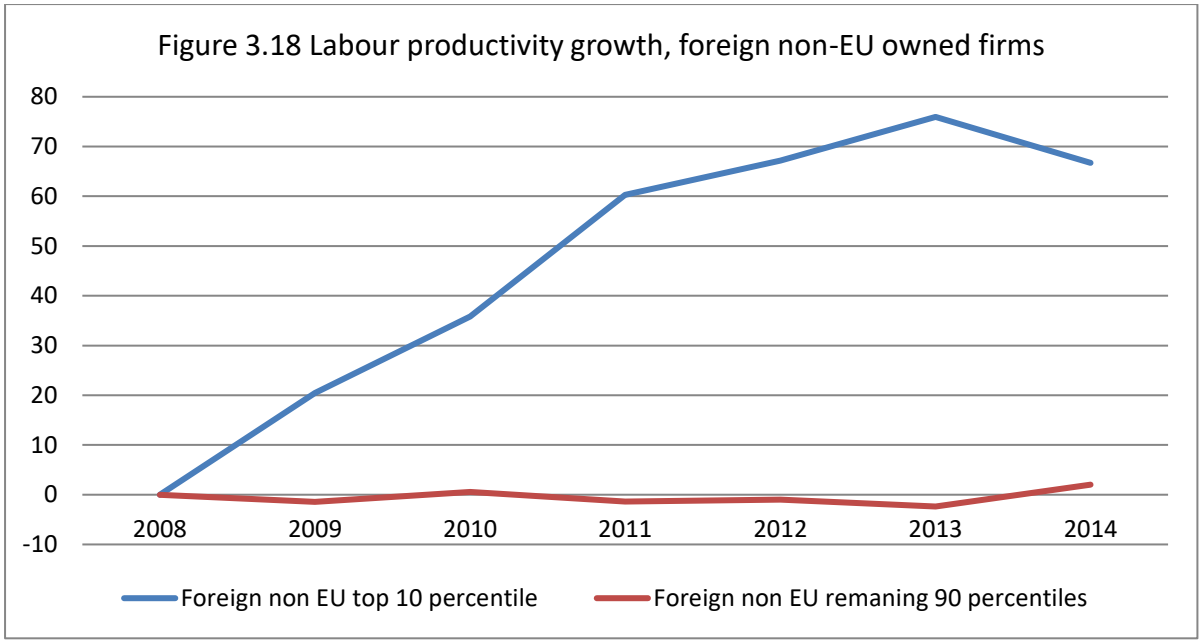
Among Irish firms, Figure 3.16 shows firms in the top 10 percentiles grew on average by 10% in 2009 with respect to the previous year, and kept growing also afterwards, although at a much slower rate. The remaining firms saw instead, on average, a negative growth rate with respect to 2008: the rates are especially negative over the first two years, and flatten out subsequently for the rest of the time span under analysis.



Source: Authors' calculation based on CIP and ASI data.

For foreign non-EU firms, Figure 3.18 shows a starker contrast between the top of the distribution and remaining firms. Firms in the top 10 percentiles grew in a substantial way every year, at a rate which, cumulatively, brought labour productivity to be 75% higher in 2013 with respect to 2008. The remaining firms, saw barely any improvement in their productivity over time, ending up with a very modest 2% higher labour productivity in 2014 with respect to 2008.

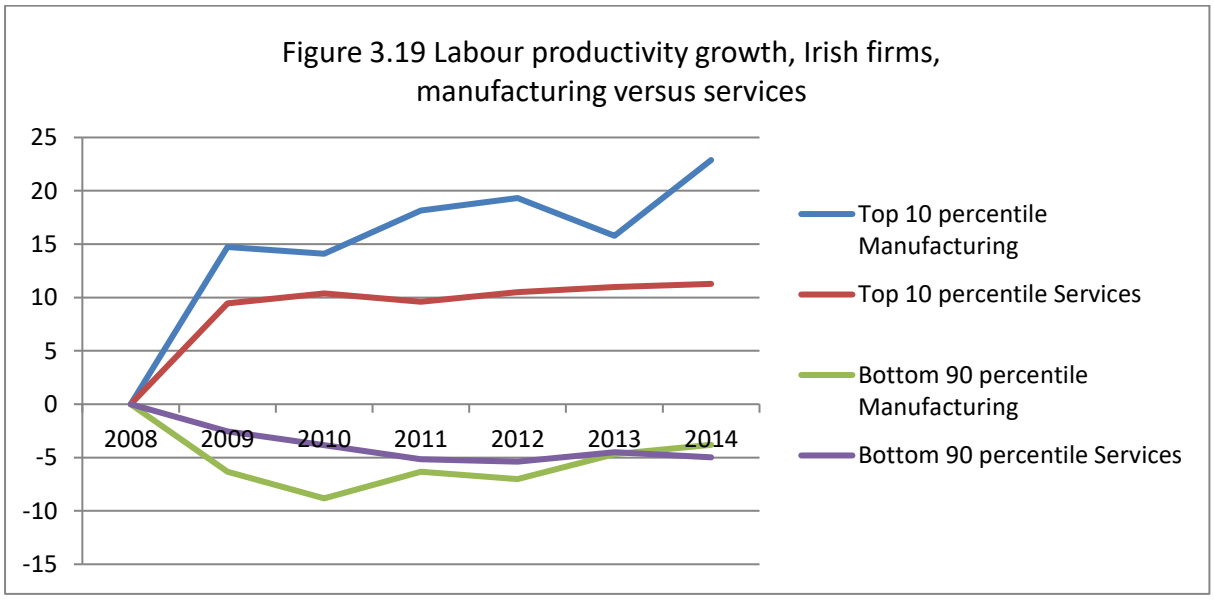
Finally, the subgroup of foreign EU firms (Figure 3.17), present the most heterogeneous path of productivity growth. Overall, firms in the top 10 percentiles saw an improvement in productivity, which ended up being approximately 8% higher in 2014 with respect to 2008. Over time, however, there were years with overall lower productivity, compared to the starting year. Firms in the bottom 90 percentiles had a steadier, albeit negative, path: labour productivity grew at negative rates throughout the 2008-2014 period, ending up being, on average, 7% lower than in 2008.



Source: Authors' calculations based on data from the CIP and ASI.

The diverging path of labour productivity described for the samples including firms in all sectors, is confirmed when the analysis is carried out separately for manufacturing and service firms, except for the subgroup of foreign EU firms in services.

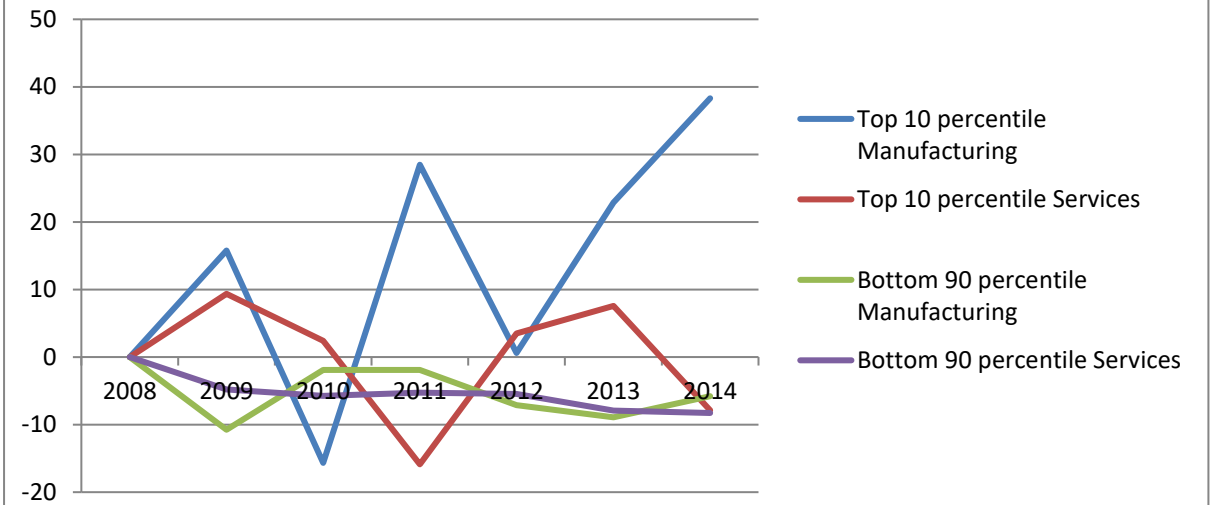
For Irish firms, despite the labour productivity divergence is observed in both sub-sectors, there is a neat separation between the growth rates of manufacturing and service firms: firms in the top 10 percentiles grew faster in manufacturing than in services, ending up with a productivity about 20% higher in 2014 with respect in 2008 for the former firms, and about 10% higher for the latter firms. Productivity of firms in the bottom 90 percentiles grew negatively in both subgroups, on average, with a final growth of about -5% for services and -4% for manufacturing.



Source: Authors' calculations based on data from the CIP and ASI.

For foreign EU firms, the growth rates of productivity are very different between manufacturing and service firms. In manufacturing, we observe a dispersion of productivity growth over time: despite an erratic path time, for firms in the top 10 percentiles, average productivity is about 38% higher in 2014 with respect to 2008, while it is about 6% lower for the remaining firms.

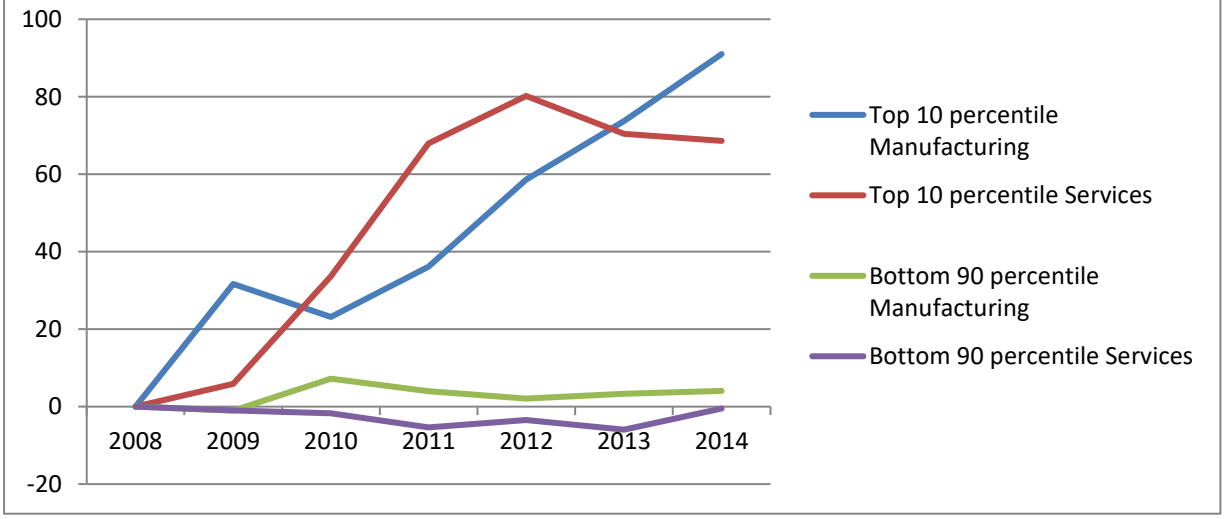
Figure 3.20 Labour productivity growth, foreign EU firms, manufacturing versus services



Source: Authors' calculations based on data from the CIP and ASI.

In services, there is little productivity dispersion: for firms in the top 10 percentiles, productivity growth oscillated between positive and negative values, ending up about 8% lower in 2014 than in 2008. This outcome is very similar to that for the remaining services firms, whose productivity followed a steadier path, but was about 8% lower in 2014 than in 2008.

Figure 3.21 Labour productivity growth, foreign non-EU firms, manufacturing versus services



Source: Authors' calculations based on data from the CIP and ASI.

The highest degree of productivity dispersion is observed in the subsample of foreign non-EU firms. Labour productivity grew at fast rates over time, resulting approximately 90% and 70% higher in 2014 with respect to 2008, respectively in manufacturing and services. Firms in the bottom 90 percentiles exhibited much lower growth rates, with the difference that firms in manufacturing grew over time (+4%), whereas firms in services saw a decrease in productivity over the central part of the time span analysed, ending approximately at the same productivity level in 2014, compared to 2008.

3.5 Foreign Ownership Premia

In this section we provide a descriptive analysis of average differences in key characteristics between Irish and foreign-owned firms. The foreign ownership premium, with respect to Irish ownership, is estimated with the following specification:

$$\ln(y_{ijt}) = \alpha + \beta\ Foreign\_EU_{ijt} + \gamma\ Foreign\_nonEU + \eta_j + \lambda_t + \rho_r + \varepsilon_{ijt} \qquad (5.1)$$

The dependent variable is the logarithm of the firm characteristic under examination, *Foreign_EU* and *Foreign_nonEU* are categorical variables taking value 1 and 2, respectively if the firm is foreign-owned and 0 if the firm is Irish-owned, η_j and λ_t, ρ_r denote full sets of NACE 2-digit industry, year and region fixed effects. The coefficients of interest are β, and γ. The foreign ownership *premia* (percentage difference in the firm characteristic due to foreign ownership) are obtained as the [exp(β,Υ)-1]*100.

Table 3.2 reports estimation results from exploiting the full sample of all CIP and ASI firms.

The estimates indicate that the performance of foreign-owned firms is significantly higher than the performance of Irish-owned firms across all outcome indicators with the exception of the intensity of R&D investment. With the exception of investment in intangible assets and import intensity, the performance differential between Irish-owned firms and foreign-owned firms is higher for affiliates owned by parent firms located outside the EU.[9]

Affiliates of EU-based multinationals are more productive by 25.1% while affiliates of multinationals with parent companies outside the EU are more productive by 42.6%. On average, foreign-owned firms pay higher wages. Wages are higher by 64% in affiliates of EU-based multinationals and by 76% in affiliates of non-EU multinationals. Export intensity is higher by 11% in affiliates of EU-based multinationals and by 20% in affiliates of non-EU multinationals. Import intensity is higher by 5.6% in affiliates of EU-based multinationals and by 5.4% in affiliates of non-EU multinationals.

[9] Most of these firms are US multinationals.

Table 3.2: Foreign-ownership *premia*, CIP and ASI data, 2008-2014

	(1) Ln(Value added per Employee)	(3) Ln(Wages per Employee)	(4) Ln(R&D per Employee)	(5) Ln(Turnover)	(6) Ln(Intangibles per Employee)	(7) Ln(Tangibles per Employee)	(8) Ln(Export Intensity)	(9) Ln(Import Intensity)
Foreign EU	0.224***	0.493***	0.0128	1.867***	0.106***	0.423***	0.104***	0.0549***
	(0.021)	(0.022)	(0.014)	(0.064)	(0.030)	(0.050)	(0.007)	(0.006)
Foreign non-EU	0.355***	0.565***	0.0188	2.461***	0.0620**	0.472***	0.182***	0.0528***
	(0.025)	(0.022)	(0.017)	(0.070)	(0.029)	(0.048)	(0.009)	(0.005)
Constant	0.639***	0.359***	0.0246*	5.272***	0.0650*	0.302***	0.109***	0.00111
	(0.017)	(0.072)	(0.015)	(0.131)	(0.036)	(0.094)	(0.012)	(0.008)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	80268	80488	80488	81189	66285	66283	80733	80733

Notes: Investment in intangibles is computed by cumulating investment in software, R&D, patents and other intangible fixed assets. Investment in tangibles is computed as the difference between total investment in fixed assets and investment in intangible fixed assets. Robust standard errors clustered at the sector level in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Source: Authors' estimates based on linked data from the Census of industrial Production (CIP) and the Annual Services Inquiry (ASI), 2008-2014.

4 The Impact of Investment in Innovation on Innovation Outputs and Productivity

This chapter analyses innovation patterns across firms in Ireland, over the 2006-2014 period. Irish and foreign firms are examined separately, although average figures for all firms are also presented. Section 4.1 describes the shares of firms involved in innovation activities, whereas section 4.2 presents the results of an econometric analysis of the impact of innovation activity on firm productivity. In this section data from the bi-annual Community Innovation Surveys (CIS) are exploited covering the period from 2008 to 2014. While the descriptive analysis (Section 4.1) uses the full CIS dataset, the econometric analysis (Section 4.2) is based on the CIS data linked to CIP and ASI data sets.[10]

Key Findings

- Overall, a larger proportion of foreign-owned firms invest in innovation in comparison to Irish-owned firms. However, it is worth noticing that the performance of Irish-owned firms in this respect has improved in recent years. A similar pattern is found for the propensity of firms to introduce innovation outputs, again with Irish-owned firms' performance improving while the share of foreign-owned firms with innovation outputs remaining unchanged.
- In terms of investment in innovation and its impact on innovation outputs and productivity, the results of this analysis uncover both similarities and differences in the behaviour and performance of Irish-owned and foreign-owned firms.
- For both Irish-owned and foreign-owned firms, the propensity to invest in R&D appears to be higher for larger firms, firms operating in international markets, and firms with higher investment in fixed tangible assets in the previous year (a proxy for collateral). Irish-owned firms which received operating subsidies are more likely to invest in R&D while competition in the Irish market increases the foreign-owned firms' propensity to invest in R&D. Further, younger Irish-owned firms are more likely to invest in R&D.
- Conditional on investing in R&D, the intensity of R&D investment is driven by different factors in Irish-owned and foreign-owned firms. In Irish-owned firms R&D intensity is positively linked to the amount of operating subsidies received in the previous year, as well as the skills intensity, and competition. In contrast, in foreign-owned firms, higher competition in the Irish market is associated with a lower R&D intensity.
- The propensity to invest in non-R&D assets in both Irish-owned and foreign-owned is positively associated with firm size and higher collateral, with the effect of the latter factor being larger for Irish-owned firms. The propensity to invest in non-R&D assets is positively associated with exporting in Irish-owned firms and with past operating subsidies in foreign-owned firms. In both Irish-owned and foreign-owned firms, the intensity of investment in non-R&D assets is negatively linked with competition in the Irish market.
- Higher R&D intensity is positively associated with the propensity of Irish-owned firms to introduce product innovations, while foreign-owned with a high R&D intensity appear less

[10] The data matching results in a reduction of the number of firm-year observations in the analysed sample.

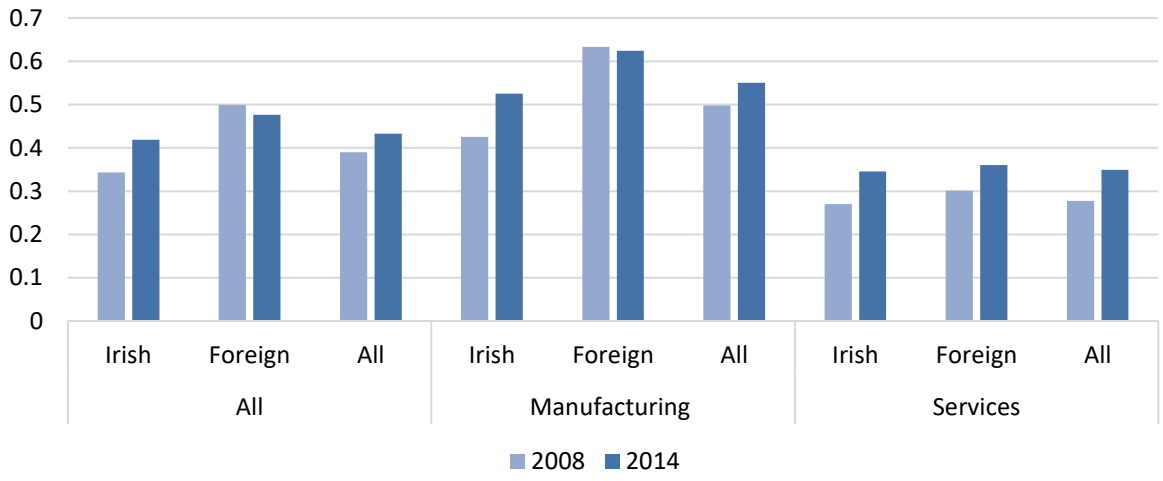
likely to introduce product innovations. Investing in non-R&D assets is a significant determinant for the probability of introducing marketing innovations in foreign owned firms. The probability to introduce innovations in both Irish-owned and foreign-owned firms is positively associated with firm size and engagement in co-operation for innovation. In addition, the propensity of Irish owned firms to introduce innovations is positively associated with their export intensity and past investment in tangible fixed assets. With the exception of marketing innovations, younger Irish-owned firms are more likely to introduce innovations.

- Over and above other factors, all four types of innovations are linked to productivity gains in Irish-owned firms. The largest productivity elasticity is for marketing innovations (0.21) and the lowest for process innovations (0.18). In foreign-owned firms, only process and organisational innovations are positively and significantly linked to productivity with the largest productivity gains in the case of organisational innovations (0.42).

4.1 Innovation expenditure and innovation output

Figures 4.1 shows the share of firms with innovation expenditure, separately for Irish and foreign firms, and for firms in manufacturing and in services. Two years of data are presented, at the beginning and at the end of the time span available in the data, to observe the evolution of the innovation spending patterns over time.

Figure 4.1 The share of firms with innovation expenditure, 2008-2014

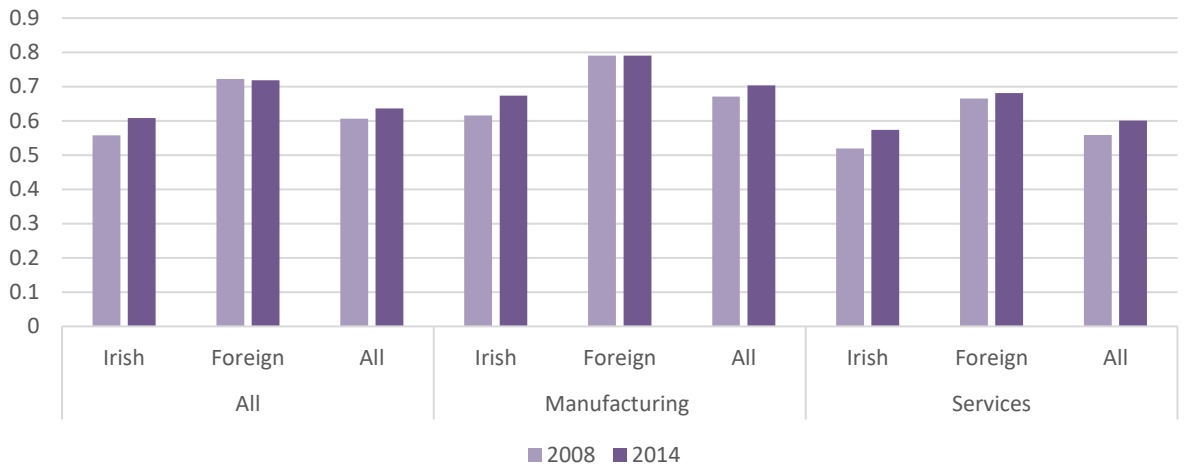


Source: Authors' calculations based on data from the Community Innovation Surveys, 2008 and 2014.

The share of foreign firm with innovation spending exceeds the share of Irish firms, both in 2008 and 2014, and both in manufacturing and in services. Firms in manufacturing present a substantially higher share of firms spending on innovation than firms in services. While the share of Irish-owned firms investing in innovation ha increased over the period, the share of foreign-owned firms with innovation expenditures has declined mainly due to a lower proportion of foreign-owned manufacturing firms investing in innovation.

Figure 4.2 shows the share of firms reporting to have innovated over the three years preceding the CIS survey (i.e., for the 2008 CIS survey, firms might have innovated in 2006, 2007 or 2008). All types of innovation are considered, i.e. product, process, organizational and marketing innovation.

Figure 4.2 The share of firms with innovation output, 2008-2014



Source: Authors' calculations based on data from the Community Innovation Surveys, 2008 and 2014.

For innovation output, a similar pattern to innovation spending is observed. Foreign firms are, on average, more likely to innovate than Irish firms; manufacturing firms are more likely to innovate than services firms. However, over the period under analysis foreign firms saw a decline in the share of firms that innovated. This contrasts with the experience of Irish firms, for which the share of firms with innovation output increased in 2014, with respect to 2008.

Finally, notice that the shares of firms with innovation output are systematically higher than the shares of firms with innovation spending. This signals that, even if important, innovation spending is not the only factor which might determine innovation output: this will be analysed with more rigour in the next section, where various determinants of innovation are included in the econometric models.

4.2 Determinants of innovation spending, innovation output, and impact of innovation on productivity

Tables 4.1-3 show the estimates on the relationships between investment in innovation (R&D and non-R&D expenditures), innovation outputs and productivity for Irish-owned and foreign-owned firms. The estimates are obtained with a modified CDM structural model (Crépon, Duguet, Mairesse, 1998). The empirical model is described in Appendix C.

We use a panel of linked annual data from four waves of the Community Innovation Survey (2008, 2010, 2012, 2014) and the CIP and ASI surveys over the period 2008-2014. The variables used in the regression analysis are described in Table C1 in the Appendix.

Table 4.1 shows the estimates for the propensity of firms to invest in innovation (R&D and non-R&D expenditures) and conditional on investing, the innovation expenditure intensity measured as R&D

and non R&D expenditures per employee. The results indicate both similarities and differences with respect to the investment behaviour of Irish-owned and foreign-owned firms.

Table 4.1: Determinants of Firms' Investment in Innovation

	(1) Ln (R&D / Emp)	(2) Pr.(R&D)	(3) Ln(Non-R&D/Emp)	(4) Pr.(Non - R&D)	(5) Ln (R&D / Emp)	(6) Pr.(R&D)	(7) Ln(Non-R&D/Emp)	(8) Pr.(Non - R&D)
	Intensity	Selection	Intensity	Selection	Intensity	Selection	Intensity	Selection
	Irish firms				Foreign firms			
Market Share$_{t-1}$	-0.208**	0.539	-0.620***	0.250	0.616**	-0.989**	0.435**	-0.077
	(0.082)	(0.542)	(0.128)	(0.510)	(0.255)	(0.477)	(0.199)	(0.438)
Ln(Wage/Empl)	0.250***		0.246***		0.249		0.138	
	(0.045)		(0.062)		(0.190)		(0.118)	
Ln(Subsidies/Empl)$_{t-1}$	0.827***		0.023		-0.681		0.390	
	(0.259)		(0.357)		(1.803)		(0.307)	
Ln(Tangibles/Empl)$_{t-1}$		1.453***		0.815***		0.907***		0.272*
		(0.248)		(0.209)		(0.188)		(0.151)
Ln(Age)		-0.248***		-0.179***		-0.073		0.041
		(0.060)		(0.058)		(0.083)		(0.079)
Ln(Employees)		0.314***		0.161***		0.369***		0.208***
		(0.036)		(0.034)		(0.053)		(0.049)
Subsidies dummy$_{t-1}$		0.229***		0.068		0.292*		0.287*
		(0.082)		(0.079)		(0.157)		(0.148)
Exporter		0.583***		0.315***		0.461**		0.027
		(0.086)		(0.083)		(0.191)		(0.181)
Importer		0.250**		0.081		0.532*		0.356
		(0.097)		(0.092)		(0.297)		(0.274)
Lambda	-0.048***		0.004		0.280***		0.261***	
	(0.012)		(0.027)		(0.079)		(0.088)	
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Sector tech. int. FE[a]	N	Y	N	Y	N	Y	N	Y
Nace 2 dig FE	Y	Y	Y	Y	Y	Y	Y	Y
Observations	1680	1680	1685	1685	664	664	664	664

Source: Authors' estimates based on data from the linked CIS, CIP and ASI data sets, 2008-2014.

Notes: Robust standard errors clustered at the firm level in parentheses; ' p <0.15, * p <0.10, ** p <0.05, ***p < 0.01. Results were obtained with the two-step Heckman estimator, because of the lack of convergence of the maximum likelihood estimator. [a] representing technology intensity in manufacturing and services sectors, according to Eurostat classification, http://europa.eu/eurostat/cache/metadata/Annexes/htec_esms_an3.pdf.

For both Irish-owned and foreign-owned firms, the propensity to invest in R&D is higher for firms which, in the previous year, invested more in tangible and were in receipt of operating subsidies. Furthermore, the likelihood of investing in R&D is positively related to being and importer and an exporter and to being larger. Age appears to matter for Irish firms only, with younger firms being more likely to spend on R&D. Competition, instead, affects only foreign firms, which are found to be more likely to spend on R&D when competition is higher, i.e., their market share is lower.

Conditional on investing in R&D, the R&D intensity is determined by different factors for Irish-owned and foreign-owned firms. For Irish-owned firms, the amount spent on R&D per employee is positively associated with the amount of operating subsidies received during the previous year, as well as with the skill intensity of the firm, proxied by the average wage per employee. For Irish firms, higher competition is associated with a higher amount of R&D spending per employee; whereas the opposite is found for foreign firms: conditional on investing in R&D, lower competition increases the amount of R&D spending per employee.

In the case non-R&D assets, the propensity of spending, in both Irish-owned and foreign-owned firms, is higher for larger firms and firms which invested a larger amount in tangibles in the previous year. The effect of tangibles, however, is found to be larger for Irish than for foreign firms. Being an exporter is positively associated with the likelihood of non-R&D spending, but in Irish firms only. Having received operating subsidies, increases the likelihood of spending on non-R&D assets, but only in foreign-owned firms.

Conditional on spending on non-R&D assets, for both Irish and foreign firms the intensity of investment in non-R&D is positively associated with their market share: a lower degree of competition, is associated with a larger amount spent on non-R&D assets.

Table 4.2: Determinants of Firms' Propensity to Innovate

	(1) Product Innovation	(2) Process Innovation	(3) Organiz. Innovation	(4) Marketing Innovation	(1) Product Innovation	(2) Process Innovation	(3) Organiz. Innovation	(4) Marketing Innovation
	Irish firms				**Foreign firms**			
R&D/Emp (predicted)	2.260*	-1.035	-0.615	0.090	-1.269**	0.464	0.034	-0.758'
	(1.188)	(1.152)	(1.136)	(1.142)	(0.503)	(0.339)	(0.549)	(0.494)
Non-R&D/Emp (predicted)	-0.890	0.518	0.329	-0.351	0.581	-0.153	1.110	2.282**
	(0.730)	(0.692)	(0.689)	(0.658)	(1.009)	(0.906)	(1.130)	(0.943)
Ln(Export Intensity)$_{t-1}$	0.870***	0.509***	0.292**	0.233*	-0.127	0.082	-0.036	-0.307
	(0.150)	(0.144)	(0.142)	(0.141)	(0.243)	(0.221)	(0.233)	(0.226)
Ln(Tangibles/Emp)$_{t-1}$	1.101***	0.504**	0.417*	0.260	-0.194	0.014	0.045	-0.437**
	(0.261)	(0.247)	(0.250)	(0.242)	(0.193)	(0.184)	(0.180)	(0.214)
Ln(Age)	-0.165***	-0.153***	-0.238***	0.031	-0.057	0.035	-0.055	0.109
	(0.061)	(0.059)	(0.058)	(0.057)	(0.097)	(0.099)	(0.090)	(0.103)
Ln(Employees)	0.215***	0.259***	0.258***	0.098***	0.284***	0.347***	0.227***	0.006
	(0.036)	(0.034)	(0.034)	(0.033)	(0.072)	(0.071)	(0.069)	(0.066)
Cooperation	1.223***	0.922***	0.801***	0.825***	0.959***	1.107***	0.857***	0.823***
	(0.097)	(0.089)	(0.089)	(0.086)	(0.128)	(0.133)	(0.137)	(0.128)
Corr(Product, Process)	0.620***				0.501***			
	(0.046)				(0.088)			
Corr(Product, Organizational)	0.505***				0.213***			
	(0.044)				(0.074)			
Corr(Product, Marketing)	0.562***				0.496***			
	(0.044)				(0.073)			
Corr(Process, Organizational)	0.620***				0.627***			
	(0.043)				(0.075)			
Corr(Process, Marketing)	0.521***				0.479***			
	(0.043)				(0.081)			
Corr(Organizational, Marketing)	0.585***				0.437***			
	(0.043)				(0.075)			
Sector technology FE[a]	Y	Y	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y	Y	Y
N	1678	1678	1678	1678	661	661	661	661

*Source: A*uthors' estimates based on data from the linked CIS, CIP and ASI data sets, 2008-2014.
Notes: Robust standard errors clustered at the firm level in parentheses; ' p <0.15, * p <0.10, ** p <0.05, ***p < 0.01. The method of estimation is simulated maximum likelihood (with 10 draws) on a quadrivariate probit model. [a]:representing technology intensity in manufacturing and services sectors, according to the Eurostat classification available from: http://europa.eu/eurostat/cache/metadata/Annexes/htec_esms_an3.pdf.

Table 4.2 shows the estimates of the second set of regressions for the links between investment in innovation and the likelihood of Irish-owned and foreign-owned firms to introduce product, process, organisational and marketing innovations. The propensity of firms to introduce the four types of innovations is estimated using a quadri-variate probit estimator which accounts for the fact that unobserved firms characteristics may affect simultaneously the decisions to introduce the four types of innovations.

A key finding is that higher R&D investment intensity is associated with a higher probability of product innovations, but only for Irish firms. For foreign firms the opposite results is found. R&D spending does not appear to affect any of the other types of innovations, neither for Irish, nor for foreign firms.

Spending on non-R&D assets is not a statistically significant determinant of innovation, of any kind, except for marketing innovation and for foreign firms only, where higher non-R&D spending has a positive effect.

Concerning the other determinants of firm innovation, for both Irish-owned and foreign-owned firms, the propensity of firms to introduce all four types of innovations is higher for larger firms and firms engaged in co-operation for innovation. Also a higher past export intensity and larger investment in tangibles per employee have a positive impact on the likelihood of innovating, but only for Irish firms. Also age is a factor affecting Irish firms only: younger firms are more likely to introduce all types of innovations, except marketing innovations.

Table 4.3 shows the impact of the four types of innovation on productivity for Irish-owned and foreign-owned firms.

Table 4.3: The Impact of Innovation on Productivity

	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
	Value added per employee in t+1 Irish firms					Value added per employee in t+1 Foreign firms				
Product Inn. (predicted)	0.183*** (0.048)				1.302*** (0.271)	0.260' (0.169)				-2.439' (1.681)
Process Inn. (predicted)		0.176*** (0.057)			-1.196** (0.546)		0.316** (0.149)			0.180 (1.403)
Organiz. Inn. (predicted)			0.189*** (0.065)		0.523 (0.496)			0.418** (0.188)		3.129' (1.990)
Marketing Inn. (predicted)				0.208*** (0.075)	-0.832** (0.344)				0.186 (0.292)	-0.215 (0.877)
Ln(Age)	0.043** (0.020)	0.042** (0.020)	0.048** (0.020)	0.033' (0.020)	0.094*** (0.029)	0.025 (0.069)	0.016 (0.069)	0.028 (0.069)	0.014 (0.070)	0.025 (0.100)
Ln(Wage/Empl)	1.524*** (0.152)	1.556*** (0.152)	1.553*** (0.152)	1.578*** (0.152)	1.390*** (0.157)	2.813*** (0.704)	2.722*** (0.696)	2.700*** (0.690)	2.911*** (0.696)	2.307*** (0.663)
Ln(Tang/Empl)	0.258** (0.115)	0.296** (0.116)	0.302*** (0.115)	0.306*** (0.115)	0.119 (0.120)	0.374*** (0.140)	0.364*** (0.138)	0.360*** (0.139)	0.375*** (0.144)	0.248* (0.141)
Year dummies	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
NACE 2-dig. FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	1004	1004	1004	1004	1004	471	471	471	471	471

Source: Authors' estimates based on data from the linked CIS, CIP and ASI data sets, 2008-2014.
Notes: Robust standard errors clustered at the firm level in parentheses; ' p <0.15, * p <0.10, ** p <0.05, ***p < 0.01.

The results indicate that over and above other factors, all four types of innovations are linked to productivity gains in Irish-owned firms. For foreign firms, only process and organizational innovations appear to affect positively firm productivity, with product innovation being only marginally significant. The magnitude of the effect of innovation on productivity is roughly similar for the four types of innovation in the case of Irish-owned firms; for foreign firms the effect is clearly largest for organizational innovation, with this coefficient being about twice as large as what found for Irish firms.

Concerning the remaining determinants of firm productivity analysed in table 4.3, for both Irish-owned and foreign-owned firms, a higher skill intensity and larger investment in tangible capital are positively linked to productivity. These effects are larger for foreign-owned firms. Finally, only for Irish firms it is found that older firms are more productive than older firms.

5 Trade Performance

This chapter examines the trade performance of indigenous and foreign-owned firms over the period 2008-2014 and the extent to which the trade performance of indigenous firms is affected by the presence of multinational firms operating in Ireland. Section 5.1 describes patterns of export and import intensity across Irish and foreign owned firms in manufacturing and services. Section 5.2 uses highly detailed data at the transaction level available for merchandise trade and analyses the trade performance of indigenous and foreign-owned firms for a range of extensive margin indicators including the number of products traded; the number of export destinations/import origins; the number of product/destinations and product/import origins. Next, Section 5.3 presents summary statistics on contract manufacturing which in Ireland is sizeable. Finally, Section 5.4 presents the results of an econometric analysis of spillovers from foreign-owned firms on the trade performance of indigenous firms.

Key Findings

- Foreign-owned firms export and import a significantly large number of products in comparison to Irish-owned firms, 2 to 3 times more in recent years. Foreign-owned firms export to a larger number of destinations and import from more countries both EEA and extra-EEA countries.
- The analysis also shows that foreign-owned firms are integrated in more complex production and trade networks with a higher number of product - country combinations per firm. An interesting feature is the more important integration of foreign-owned firms in extra-EEA trade while Irish-owned firms tend to trade predominantly with EEA countries (mainly the UK).
- In terms of trade volumes, on average foreign-owned firms trade volumes 5 to 10 times larger than Irish-owned firms. The average value of exports per firm is larger than the imports per firm for both Irish-owned and foreign-owned firms. In terms of destinations/origins, the average value of exports and imports per firm-product are larger in with other EEA countries in comparison to extra-EEA countries.
- The results of this empirical analysis indicate that Irish-owned firms benefit to some extent from spillovers from foreign direct investment (FDI) mainly via supply chain linkages. There is also evidence suggesting that foreign-owned affiliates crowd-out the trade performance of Irish-owned firms.
- Spillovers vary depending on the type of spillover (*intra-industry*, *intra-region*, via *supply chain linkages*), the origin of FDI (*EU* vs. *non-EU based*), *the type of trade performance measure* (export/import intensity; number of products exported/imported; number of export destinations/import origins; number of products exported-export destinations; number of imported products-import origins).
- The evidence indicates only very limited intra-industry and intra-region FDI spillovers. It appears that Irish-owned firms benefit in terms of their export intensity from the presence in the same industry of affiliates of multinationals based outside the EU. However, the presence of multinationals crowd-out the export performance of Irish-owned firms within the same region. While the presence in the same region of affiliates of multinationals based

in other EU countries affect negatively the export performance of Irish-owned firms in manufacturing, the presence of affiliates of non-EU multinationals have a negative effect of the export performance of Irish-owned firms in services.

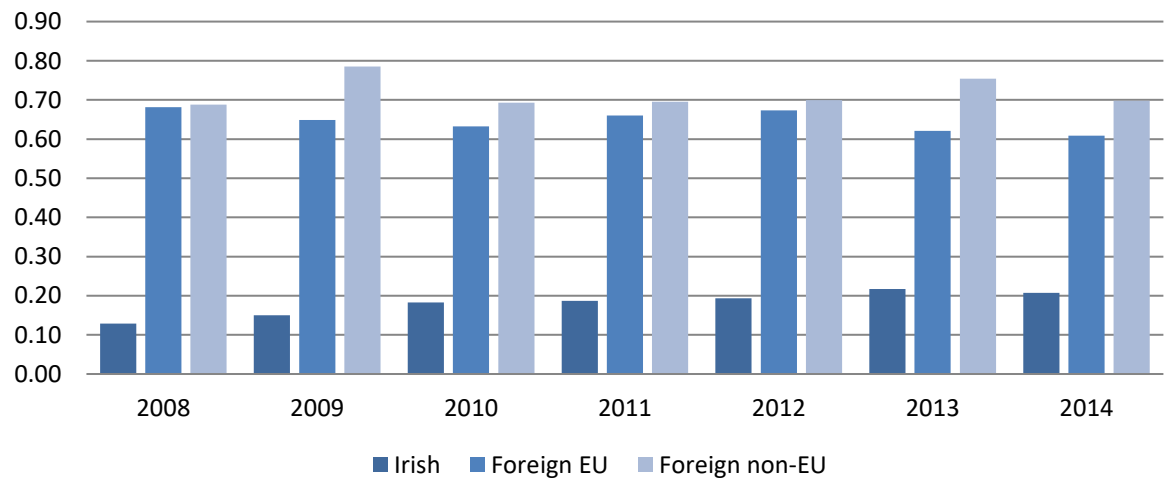
- Irish-owned firms benefit in terms of diversification of their merchandise exports from supplies by affiliates owned by EU multinationals. In contrast, supplies by affiliates owned by non-EU multinationals have the opposite effect on the export diversification of indigenous firms.
- Irish-owned firms benefit from supplying affiliates of EU based multinationals in terms of the diversification of export markets and product-export market combinations. In contrast, supply linkages with affiliates of non-EU multinationals are associated with a lower number of products exported.

5.1 Export and Import Intensity

This section compares patterns of export and import intensities across indigenous and foreign-owned firms in manufacturing and services. Export and import intensities are measured as export sales/import purchased per turnover. Aggregate measures of average intensities for manufacturing and services as well as more disaggregated measures by industry are discussed.

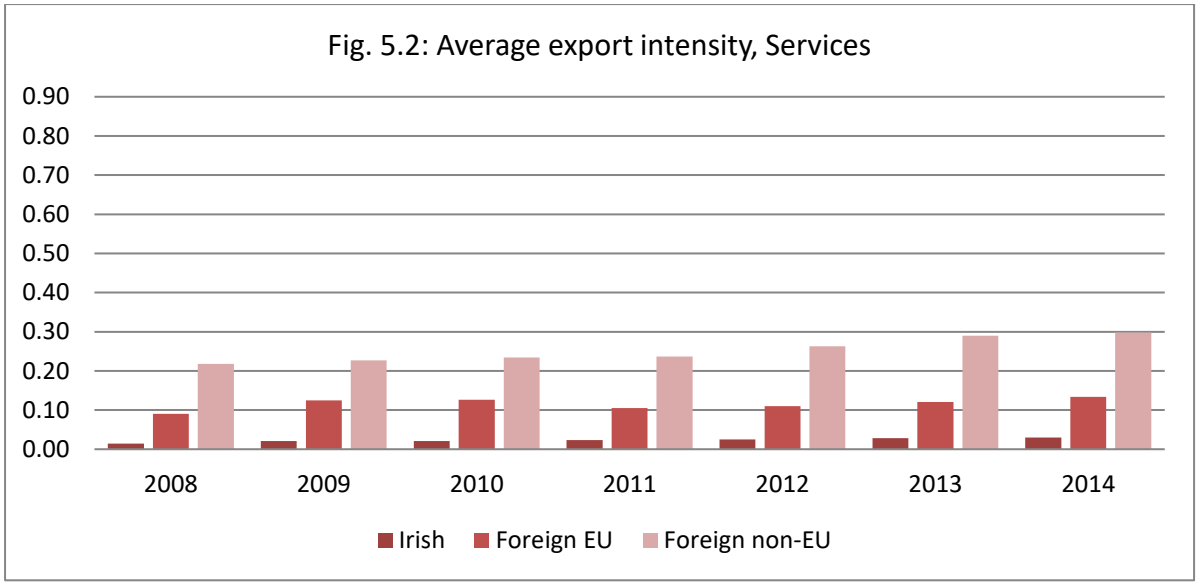
As shown in Figures 5.1 and 5.2, the average export intensity is much larger in manufacturing than in services, with affiliates owned by non-EU firms leading in both sectors. In manufacturing, while the performance of Irish-owned firms has improved over the period, export intensity has declined in EU owned affiliates and improved only slightly for non-EU affiliates.

Fig. 5.1: Average export intensity, Manufacturing



Source: Authors' calculations based on data from the Census of Industrial Production (CIP).

While significantly lower than in manufacturing, the average export intensity in services has improved for all three groups of firms.

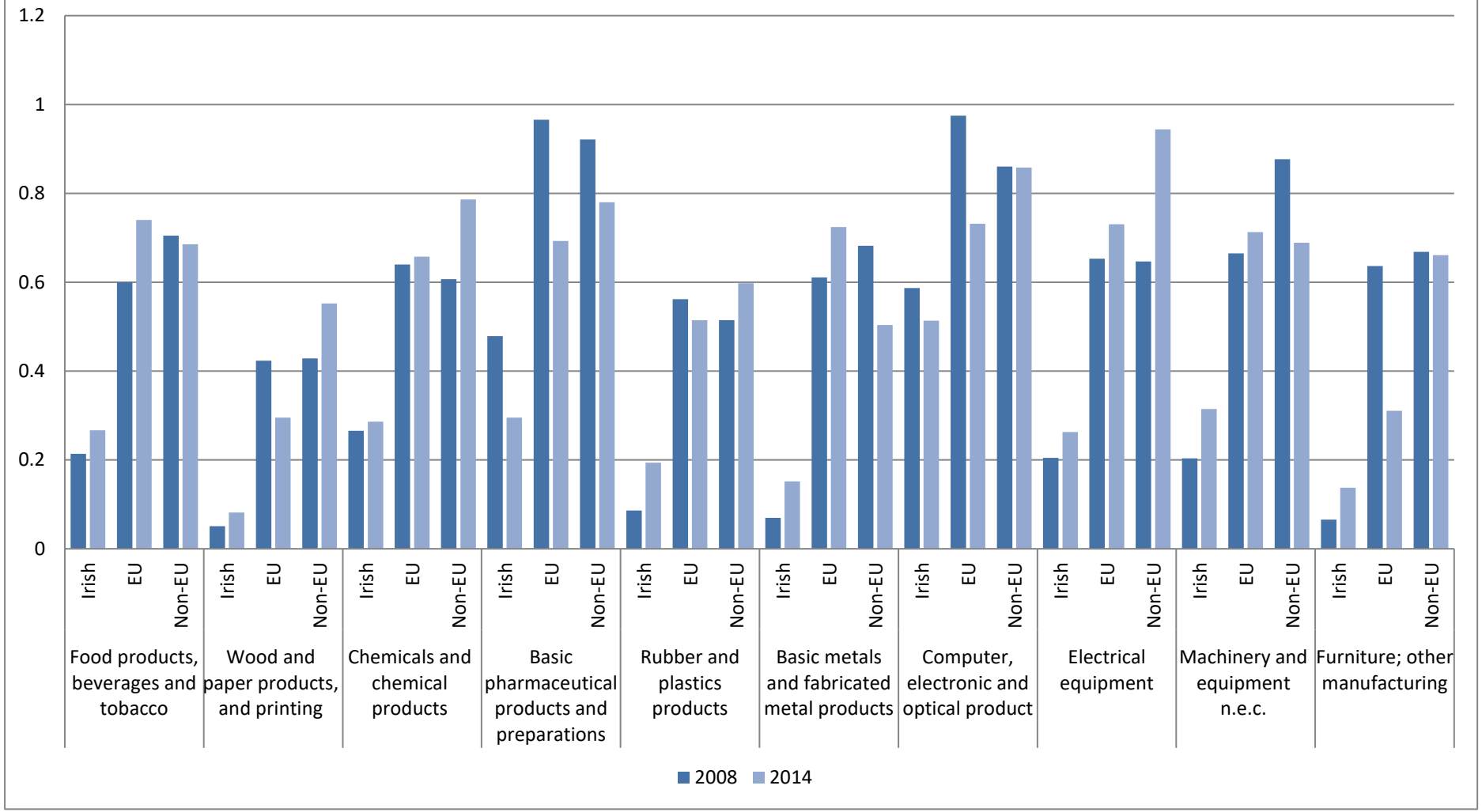


Source: Authors' calculations based on data from the Annual Services Inquiry (ASI).

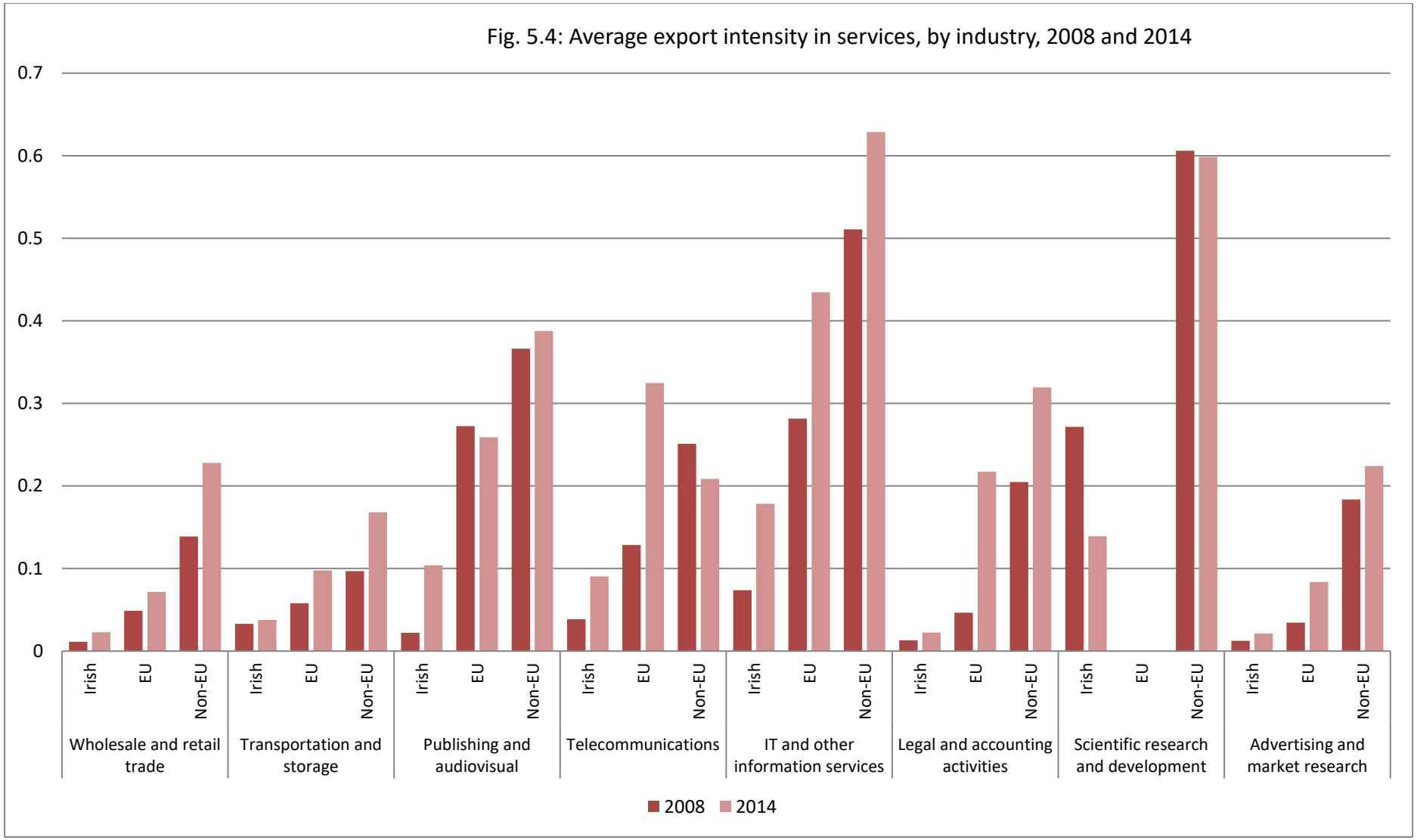
Figure 5.3 shows average export intensity in manufacturing by industry for Irish-owned and foreign-owned firms in 2008 and 2014. For Irish-owned firms export intensity is the highest in computer, electronic, and optical products; basic pharmaceutical products and preparations; chemicals and chemical products; food, beverages, and tobacco; electric equipment; and machinery and equipment not elsewhere classifies (n.e.c.). Among these industries, the export intensity in Irish-owned firms has increased over the period in food, beverages, and tobacco; chemicals and chemical products; electrical equipment; machinery and equipment (n.e.c.) and it has decreased in the other two industries. Across EU-owned firms, the highest export intensity at the beginning of the period was in computer, electronic and optical products; basic pharmaceuticals; machinery and equipment n.e.c.; chemicals and chemical products; furniture and other manufacturing. In 2014, the highest export intensity was for food products, beverages and tobacco; computer, electronic and optical products; electrical equipment; basic metals and fabricated metal products; machinery and equipment n.e.c.; Export intensity has increased in food, beverages and tobacco; and in basic metals and fabricated metal products. Export intensity across non-EU affiliates is the highest in computer, electronic and optical products; pharmaceuticals; and electric equipment with the highest increase over the period in the latter.

Figure 5.4 shows average export intensity in services by industry for Irish-owned and foreign-owned firms in 2008 and 2014. The highest export intensities in 2014 for all types of firms were in IT and other information services. Also highly import-intensive is the scientific R&D sector; next in importance, especially for foreign-owned firms, are publishing and audio-visual services, and the telecommunication sector.

Fig. 5.3: Average export intensity in manufacturing by industry, 2008 and 2014

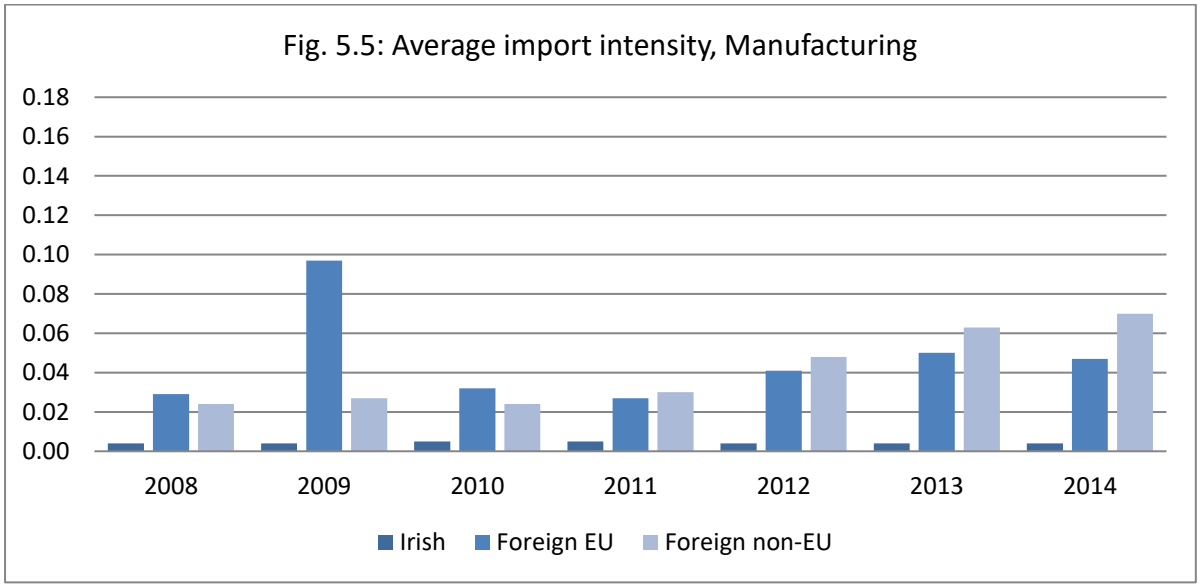


Source: Authors' calculations based on data from the Census of Industrial Production (CIP).



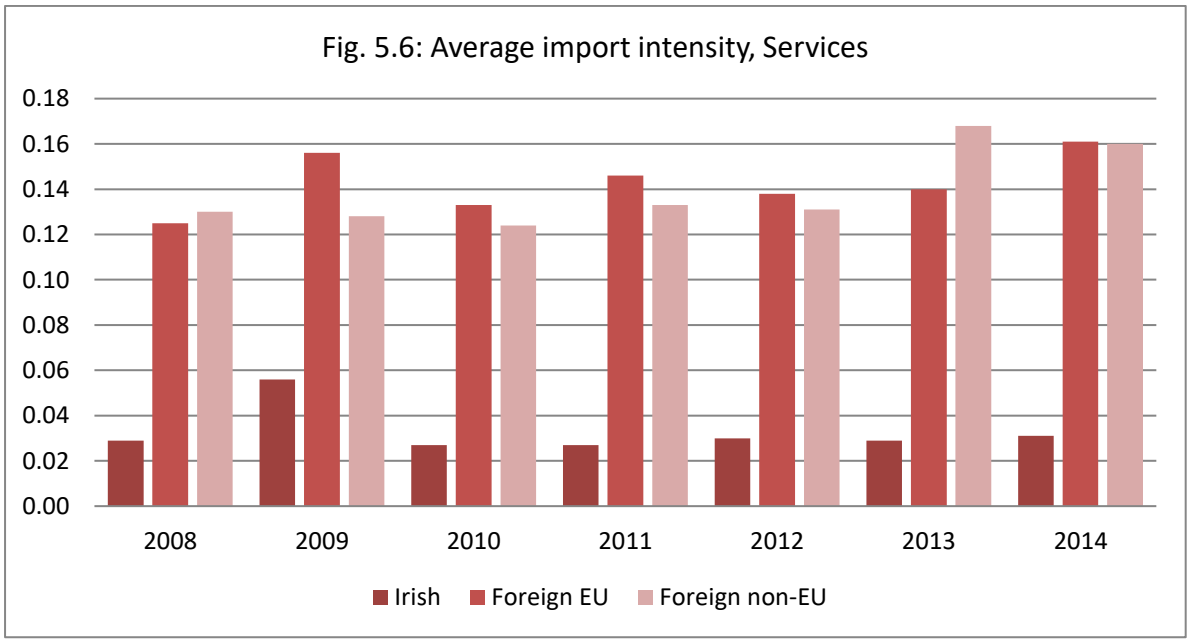
Source: Authors' calculations based on data from the Annual Services Inquiry (ASI).

Figure 5.5 shows that, averaged over all manufacturing sectors, the import intensity in Irish-owned firms is very low in comparison to foreign-owned firms. Over the 2008-2014 period, import intensity has increased both in affiliates owned by EU and non-EU firms, with a spike in 2009 for EU-owned affiliates.



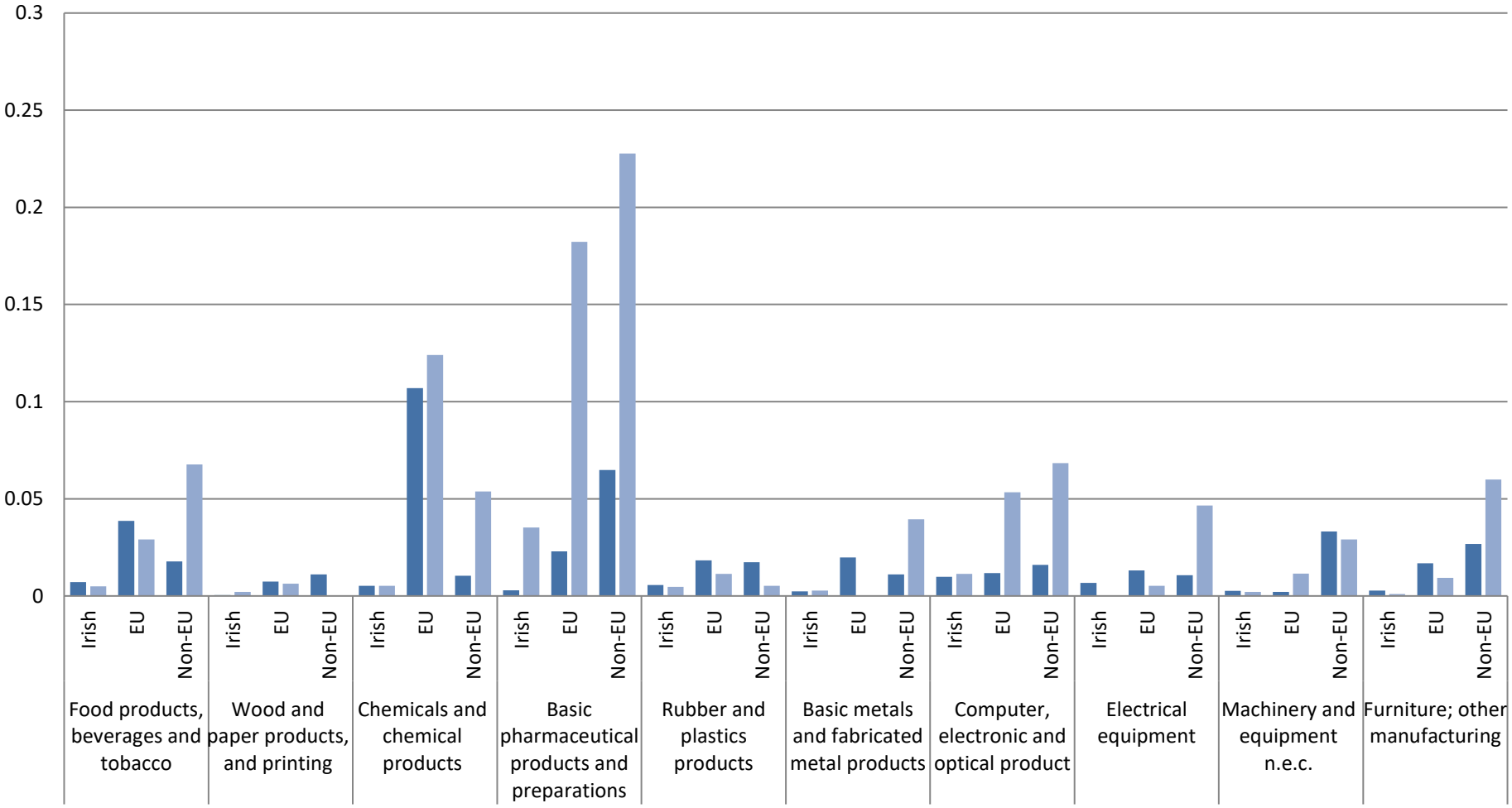
Source: Authors' calculations based on data from the Census of Industrial Production (CIP).

As shown in Figure 5.6, also in services import intensity is much lower in Irish-owned firms than in foreign-owned firms, with EU and non-EU owned firms having approximately equal import intensities in 2014.



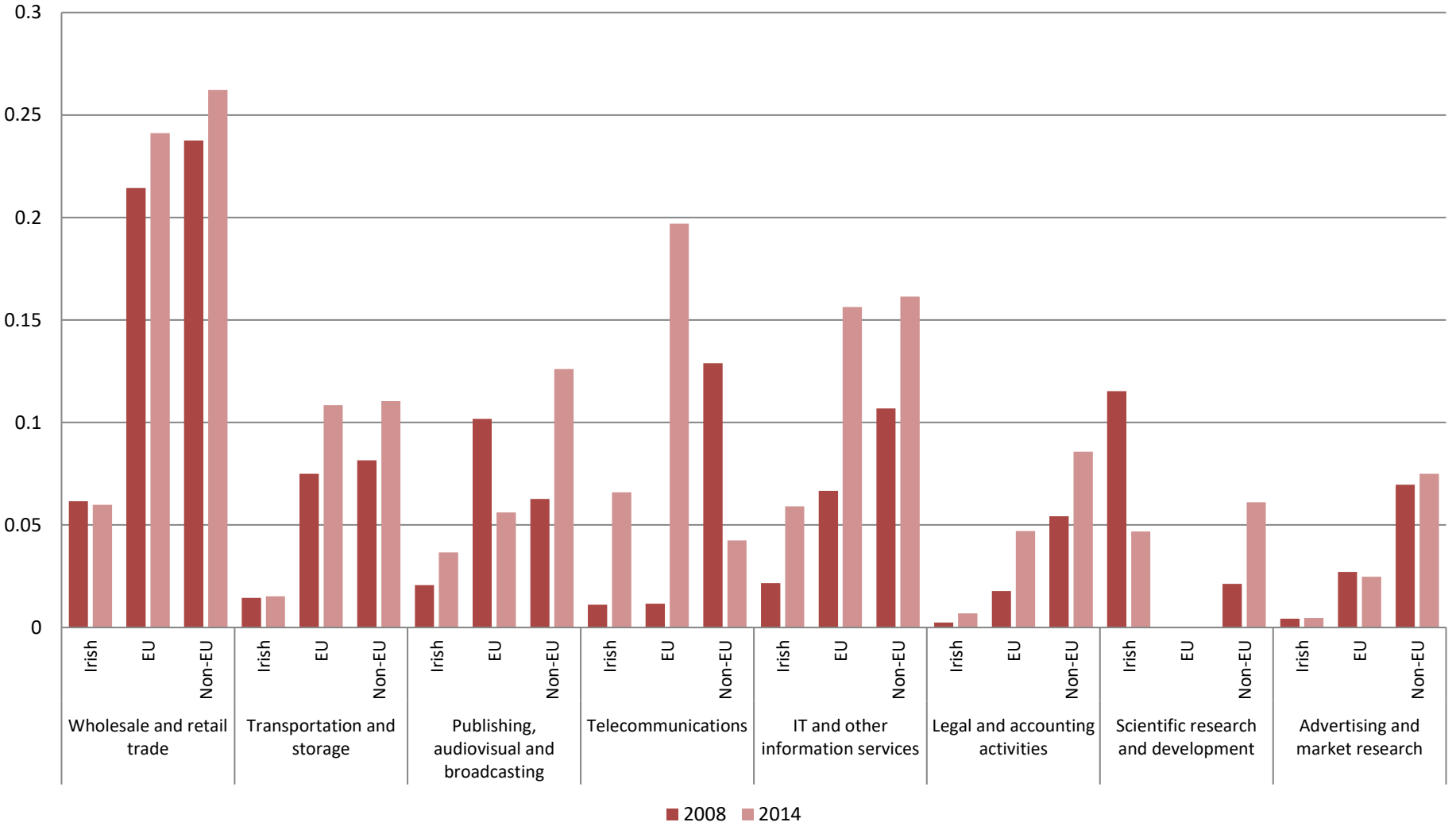
Source: Authors' calculations based on data from the Annual Services Inquiry (ASI).

Fig. 5.7: Average import intensity in manufacturing, by industry, 2008 and 2014



Source: Authors' calculations based on data from the Census of Industrial Production (CIP).

Fig. 5.8: Average import intensity in services, by industry, 2008 and 2014



Source: Authors' calculations based on data from the Annual Services Inquiry (ASI).

Figure 5.7 shows the import intensity in manufacturing by industry at the beginning and at the end of the analysed period. Across all industries, the import intensity of foreign-owned firms in pharmaceuticals is by far the largest and has increased substantially in both EU and non-EU owned firms in comparison to 2008. Relative to Irish-owned and non-EU firms, EU owned firms have also a substantially larger import intensity in chemicals and chemical products, while non-EU owned firms have higher import intensities in computer, electronic and optical products; and in food products, beverages and tobacco.

As shown in Figure 5.8, among services sectors, the highest import intensity for Irish-owned firms at the end of the period is in telecommunications, which recorded a large increase compared to 2008; next in importance are IT and other information services, and wholesale and retail trade. In both EU and non-EU firms import intensity at the end of the period is highest in wholesale and retail trade, and it has increased in comparison to 2008. Import intensity in EU owned firms is also large in telecommunications and in IT and other information services, after a large increase from 2008 to 2014.. In contrast, in non-EU owned firms, import intensity is large and it has increased substantially in IT services and in publishing, audio-visual and broadcasting.

5.2 Merchandise trade patterns at the extensive margins

The richness of the merchandise trade data, with information by product exported/imported and by destination/origin of the shipments, allows a detailed comparison between Irish-owned and foreign-owned firms with respect to a range of extensive margins indicators.

5.2.1 The number of products exported/imported

Table 5.1 presents the average number of products exported and imported by firms with domestic and foreign ownership, for each of the years available in the firm-level linked trade and Census of Industrial Production (CIP) data sets. Products are classified at the CN 8-digit level,[11] with the average figures disregarding the origin and the destination of the shipments (i.e. a product is accounted only once, even if shipped to multiple destinations).

Starting from the columns reporting the total figures, it is evident how the average number of products traded grew steadily over the years under examination, for both exports and imports.

A key feature highlighted in Table 5.1 is that foreign-owned firms export and import a significantly larger number of products than Irish firms, with the proportion ranging from 2 to three 3 times over the years.

Overall, it is noteworthy that the number of imported products always exceeds the number of exported products, possibly signalling that firms based in Ireland are involved in stages of production close to the end of the value chains.

[11] The product classification has been harmonised using concordance tables over the years in the dataset to account for the changes in classification which occurred over time.

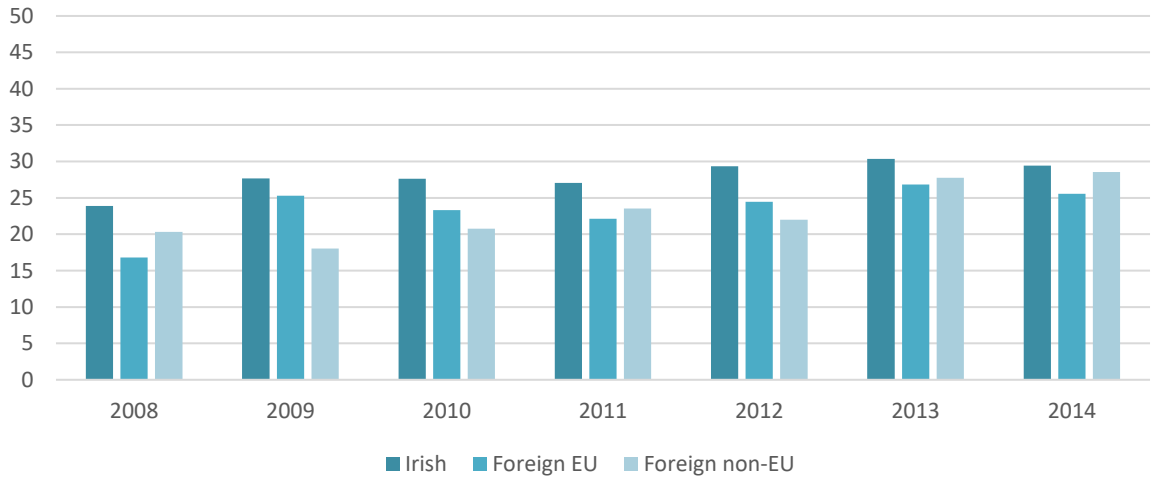
Table 5.1: Average number of products exported and imported by Irish and foreign firms

	Exports			Imports		
Year	**Irish**	**Foreign**	**Total**	**Irish**	**Foreign**	**Total**
2008	7	16	10	18	54	27
2009	9	17	12	19	53	28
2010	9	19	12	18	56	27
2011	9	21	13	20	63	31
2012	10	22	14	22	66	34
2013	10	22	14	23	66	35
2014	10	22	14	24	68	36
Total	9	20	13	20	61	31

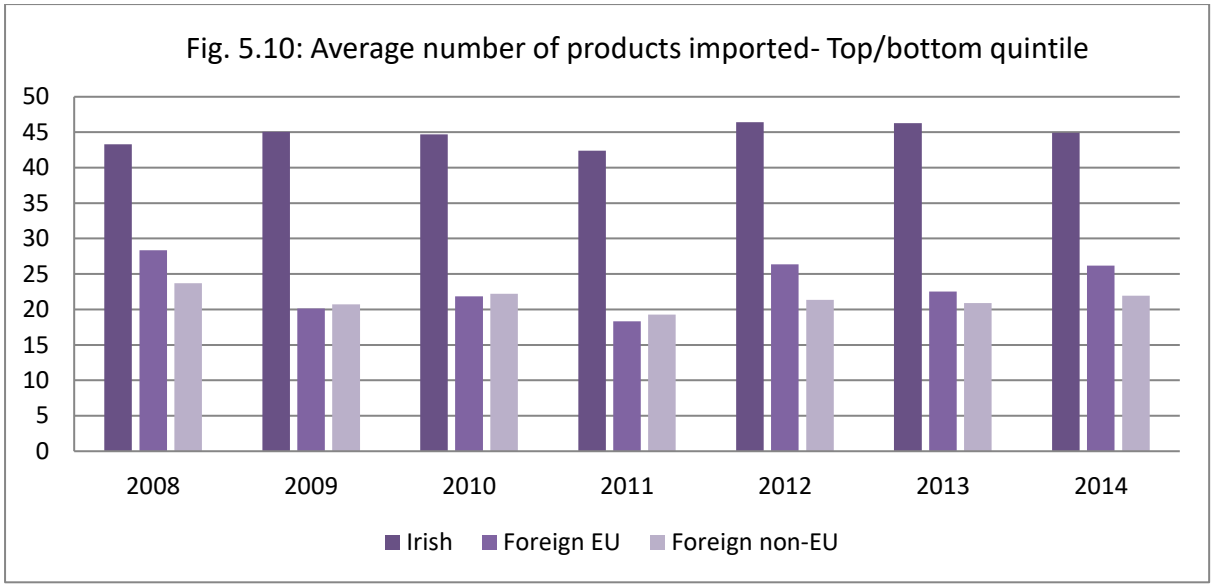
Source: Authors' calculation based on trade and CIP data.
Note: Products are classified at the CN 8-digit level.

Examining the distributions of the number of products exported/imported, Figures 5.9 and 5.10 show that Irish-owned firms have the highest dispersion (measured as the ratio between the top and bottom quintiles) for both exported and imported products and this gap has increased over time. The ratio between the top and bottom quintiles across Irish-owned firms has increased over the analysed period, 2008 -2014 from 23.8 to 29.4 for products exported and from 43.3 to 44.9 for products imported. The dispersion between the top and bottom quintiles appears to be lower in the case of both EU and non-EU owned affiliates, in particular for imported products.

Fig. 5.9: Average number of products exported, Top/bottom quintile



Source: Authors' calculation based on linked trade and CIP data.



Source: Authors' calculation based on linked trade and CIP data.

The average number of products exported varies across industries and across firm ownership. For Irish-owned firms the largest average number of products exported at the end of the period are in three industries: computer, electronic and optical products; electrical equipment; machinery and equipment n.e.c. In all these industries there was a substantial increase in the number of exported products in 2014 in comparison to 2008. Exports are more diversified in non-EU owned firms relative to EU-owned firms, particularly in computer, electronic and optical products, where the number if products exported per firm increased from 37 in 2008 to nearly 68 in 2014. Exports of computer, electronic and optical products per firm have also increased substantially in the case on EU-owned firms from 14 to 42 over the analysed period.

Figure 5.12 shows dispersion patterns with respect to the average number of products exported per firm by industry for Irish and foreign-owned firms. At the beginning of the period, the ratio between the 75th and the 25th quartile was the largest for Irish-owned firms in chemicals industry, while at the end of the period it was the largest for EU-owned firms in furniture and other manufacturing. The dispersion is lower in the case of non-EU owned firms, indicating the internationalisation is more evenly spread within this group of firms.

In terms of import diversification, Figure 5.13 shows that foreign-owned have again a better performance in comparison to Irish-owned firms. At the end of the period, the average number of products imported per firm is particularly large in non-EU owned firms in computer, electronic, and optical products (160 up from 142 in 2008); electrical equipment (140 up from 54); furniture and other manufacturing (112 up from 75). Imports are less diversified in the case of EU and Irish-owned firms. At the end of the period, the largest number of imported products per EU-owned firm is in furniture and other manufacturing (72 up from 69); and in chemicals and chemical products (69 up from 58). The largest number of imported products per Irish-owned firm is in machinery and equipment n.e.c. (41 up from 21 in 2008); and electrical equipment (36 up from 29).

Fig. 5.11: Average number of exported products by industry, 2008 and 2014

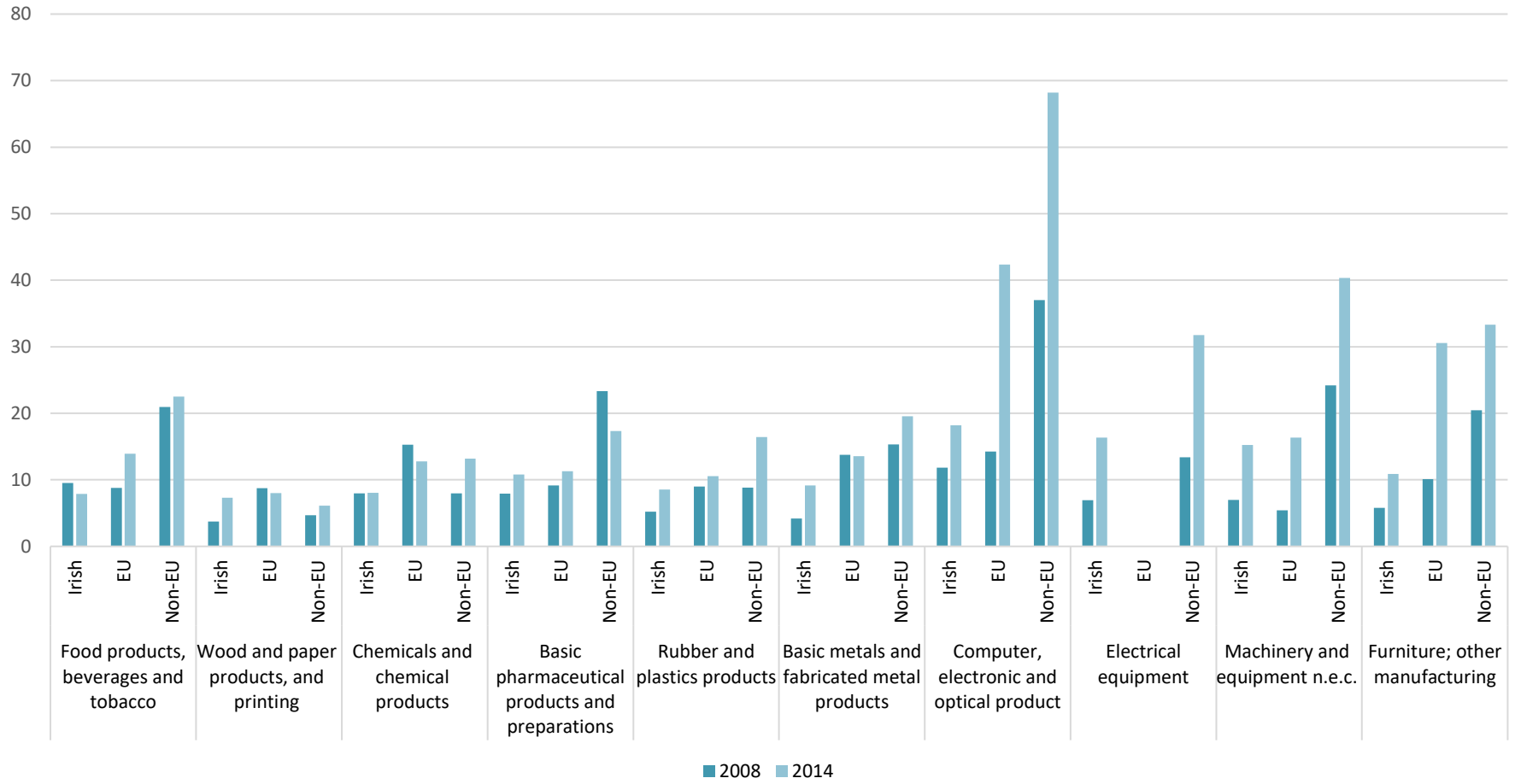


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Fig. 5.12: Average number of products exported: 75th/25th quartiles, 2008 and 2014

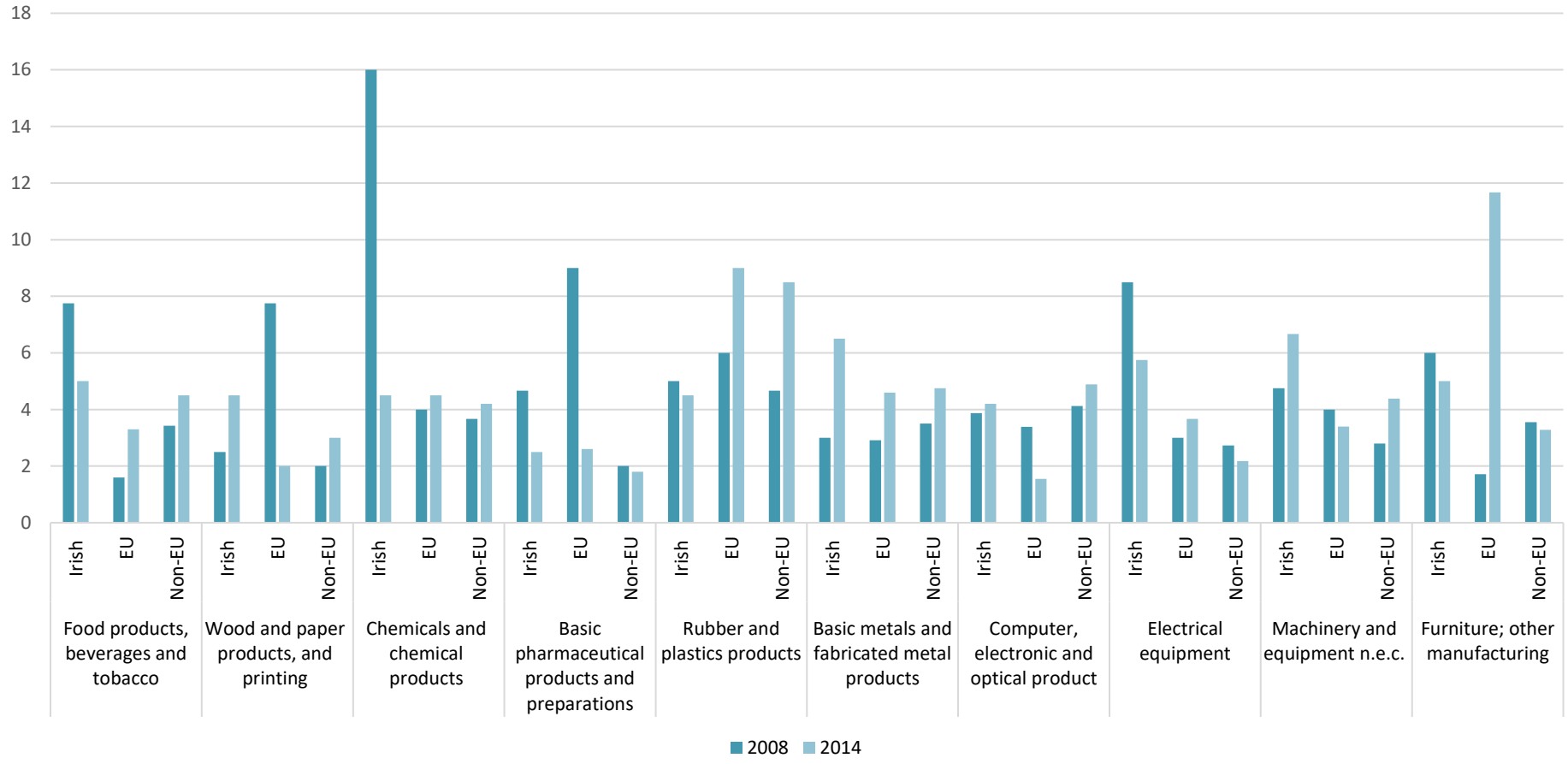

Fig. 5.13: Average number of imported products, 2008 and 2014

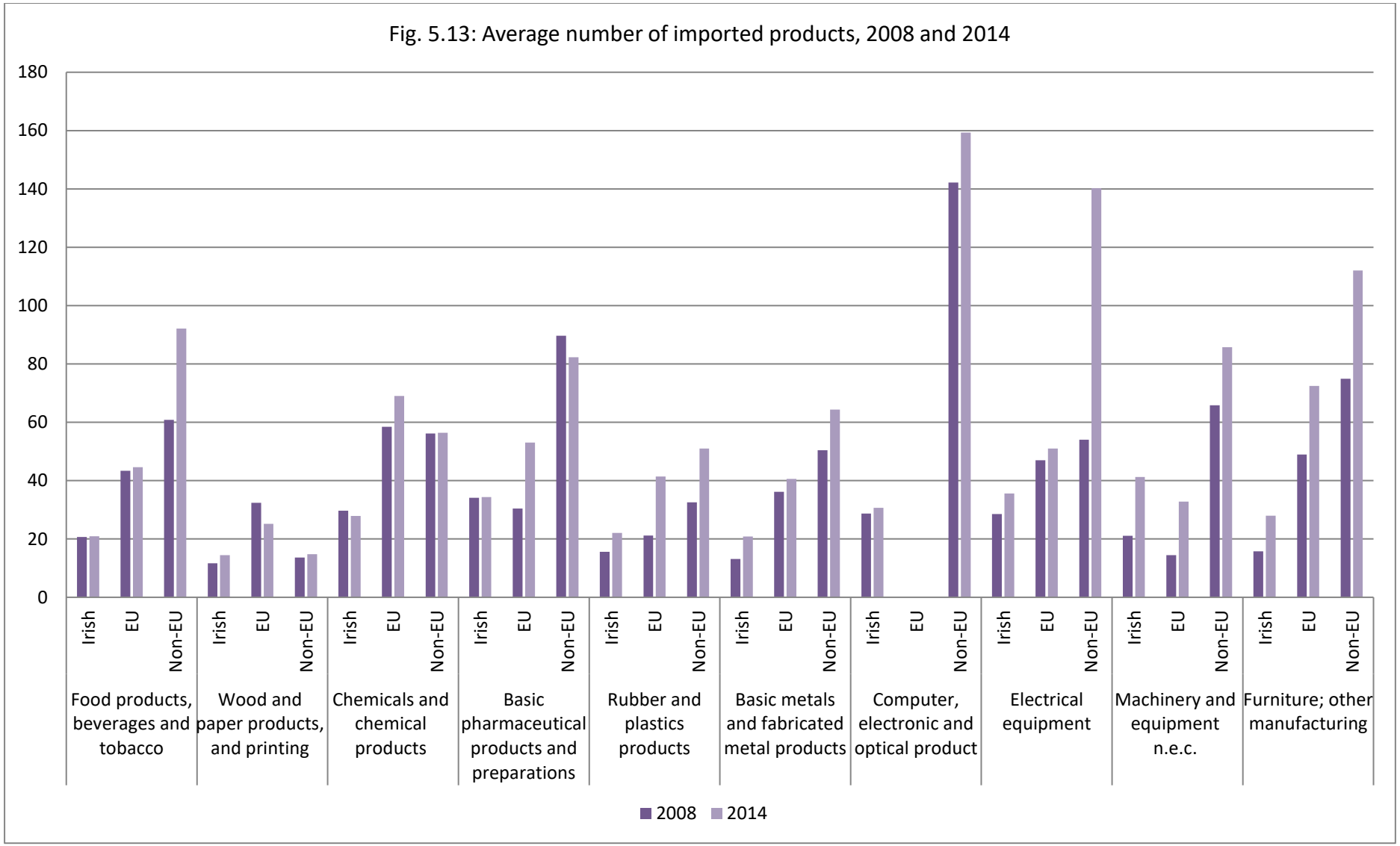

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Fig. 5.14: Average number of imported products: 75/25 quartiles, 2008 and 2014

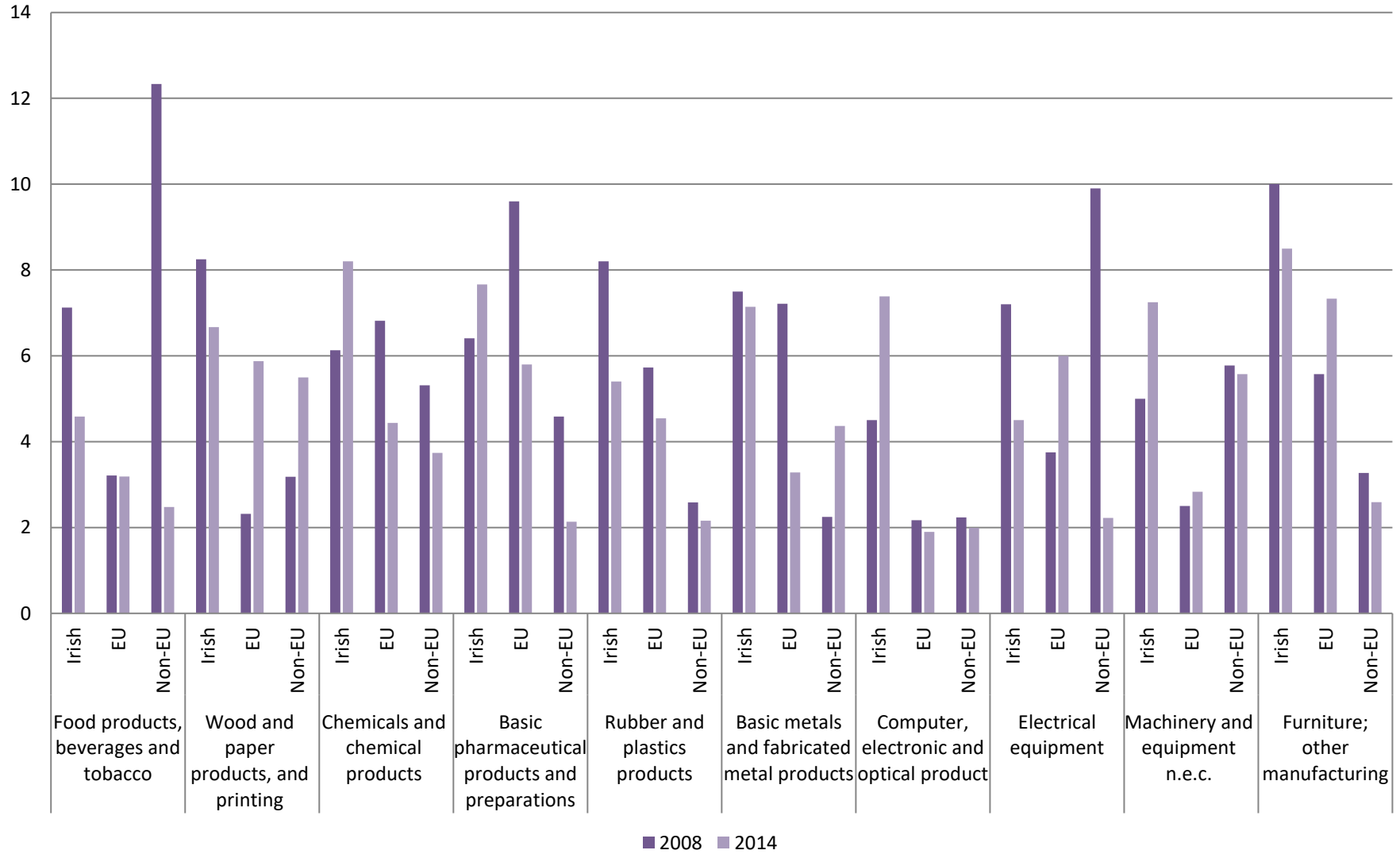


Figure 5.14 shows Irish-owned firms have the largest dispersion (measured as the ratio between the 75th and the 25th quartiles) with respect to the average number of products imported per firm across industries. At the end of the period, the largest dispersion for Irish-owned firms was in furniture and other manufacturing; and chemicals and chemical products). The dispersion appears large also for EU-owned firms (the largest in furniture and other manufacturing; and electrical equipment) and it is lowest for non-EU firms.

5.2.2 The number of export destinations/import origins

Table 5.2 focuses on the average number of destinations and origins reached by Irish exporters and importers. The table separates these figures by Irish and foreign producers, other than by the group of countries in the EEA and the rest of the world.

Contrary to the rising trend uncovered for the number of products traded, the average number of destinations and origins served by firms based in Ireland remained very stable over time.

Not surprisingly, producers with foreign ownership present a larger portfolio of origins and destinations, relative to Irish producers, both for exports and for imports, and for both the EEA and the extra-EEA countries.

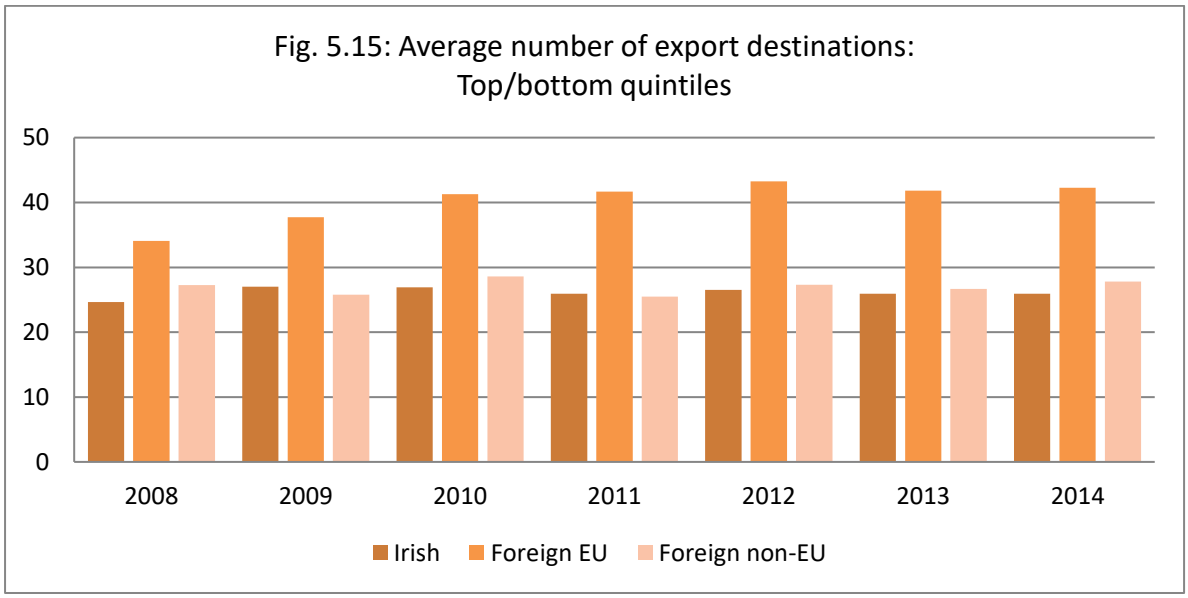
While Irish firms do not present a stark difference in the number of intra-EEA versus extra-EEA countries served, with the former figures slightly dominating the latter, foreign firms clearly ship to a larger number of extra-EEA destinations than intra-EEA destinations. This can be interpreted as being consistent with the deeper involvement of foreign-owned firms in wider production networks, spanning beyond the EEA.

Table 5.2: Average number of destinations (exports) and origins (imports), intra and extra EEA, by Irish-owned and foreign-owned firms

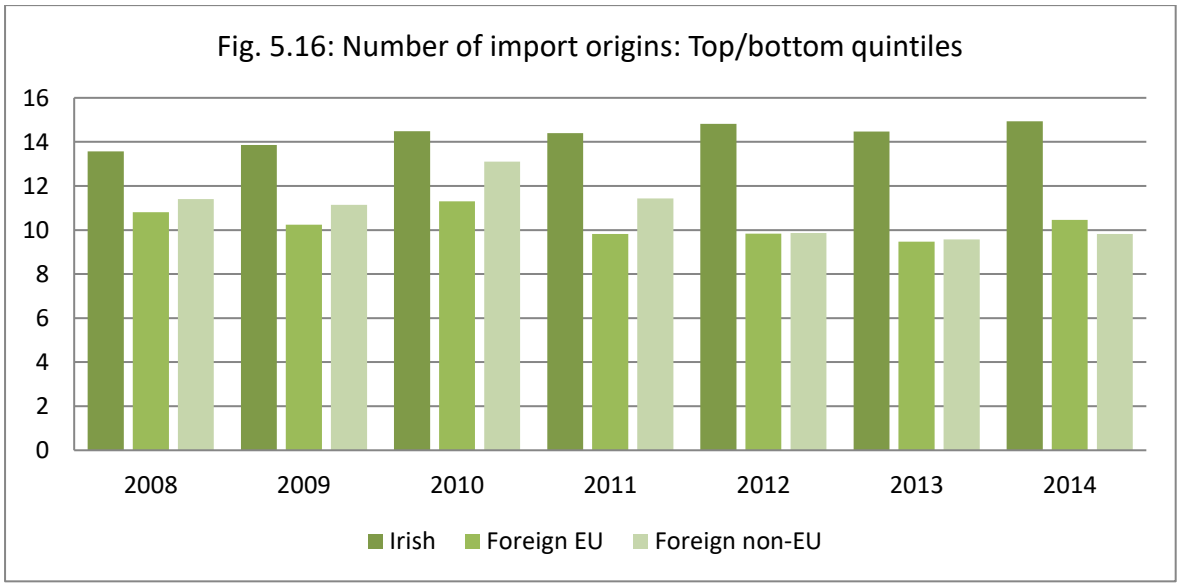
IRISH FIRMS						
	Extra-EEA			Intra-EEA		
Year	Exports	Imports	Total	Exports	Imports	Total
2008	4	3	3	5	4	5
2009	5	3	4	5	4	5
2010	5	3	4	5	4	5
2011	6	3	4	5	4	5
2012	6	3	4	6	4	5
2013	6	3	4	6	4	5
2014	6	3	4	6	5	5
FOREIGN FIRMS						
	Extra-EEA			Intra-EEA		
	Exports	Imports	Total	Exports	Imports	Total
2008	11	6	8	8	6	7
2009	11	6	9	8	6	7
2010	12	6	9	8	6	7
2011	12	7	9	9	6	8
2012	12	7	9	9	6	8
2013	12	7	9	9	6	7
2014	12	7	9	9	6	8

Source: Authors' calculation based on linked trade and CIP data.
Note: Products are classified at the CN-8 level.

Figure 5.15 shows the export diversification in terms of the average number of destinations per firm is more skewed in EU-owned firms in comparison to Irish and non-EU owned firms and the dispersion (measured as the ratio between the top and bottom quintile) has increased over time. Figure 5.16 shows in the case of import origins, the dispersion is larger in the case of Irish-owned firms.



Source: Authors' calculation based on linked trade and CIP data.



Source: Authors' calculation based on linked trade and CIP data.

Fig. 5.17: Average number of export destinations by industry, 2008 and 2014

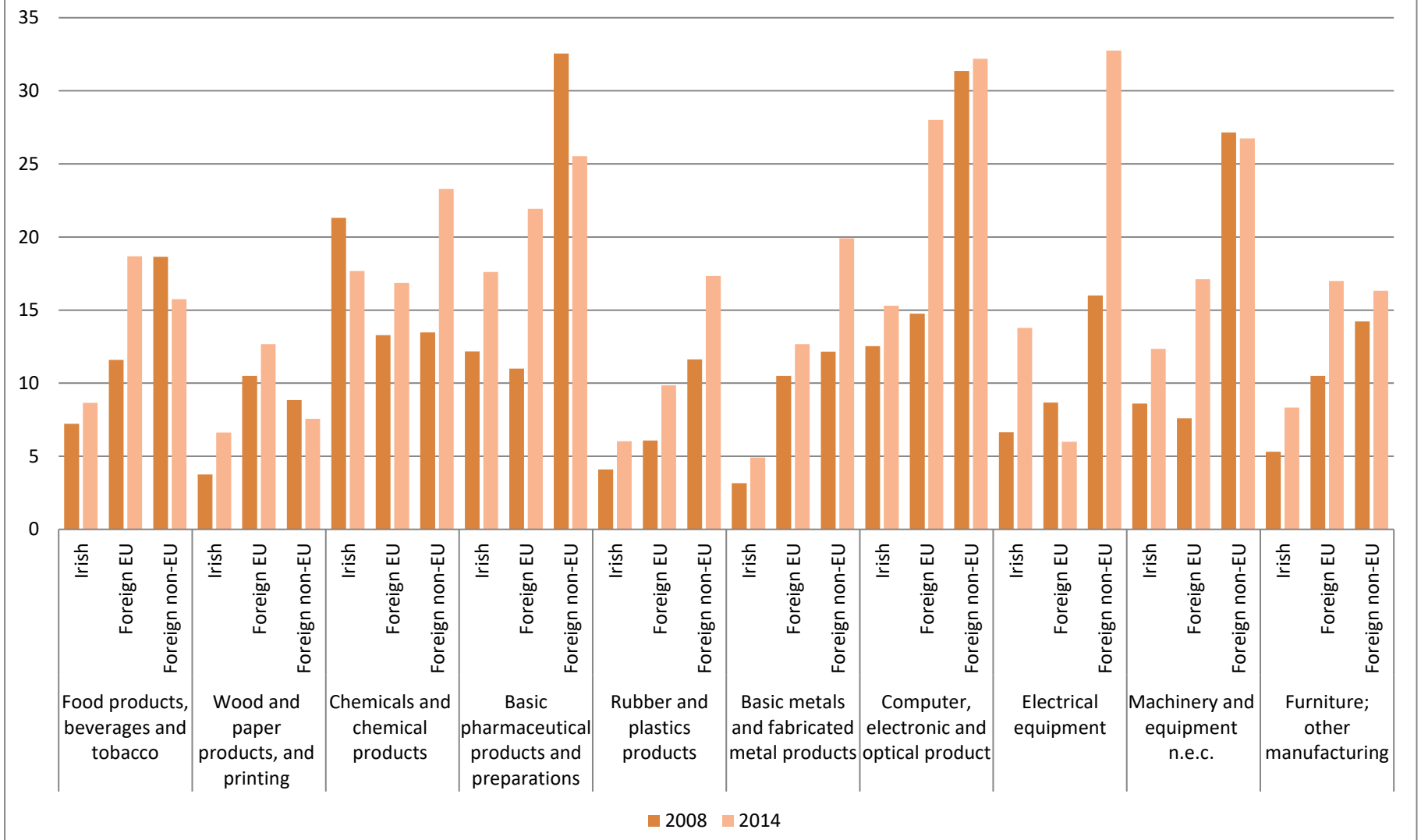


Fig. 5.18: Average number of export destinations by industry: 75th/25th quartiles, 2008 and 2014

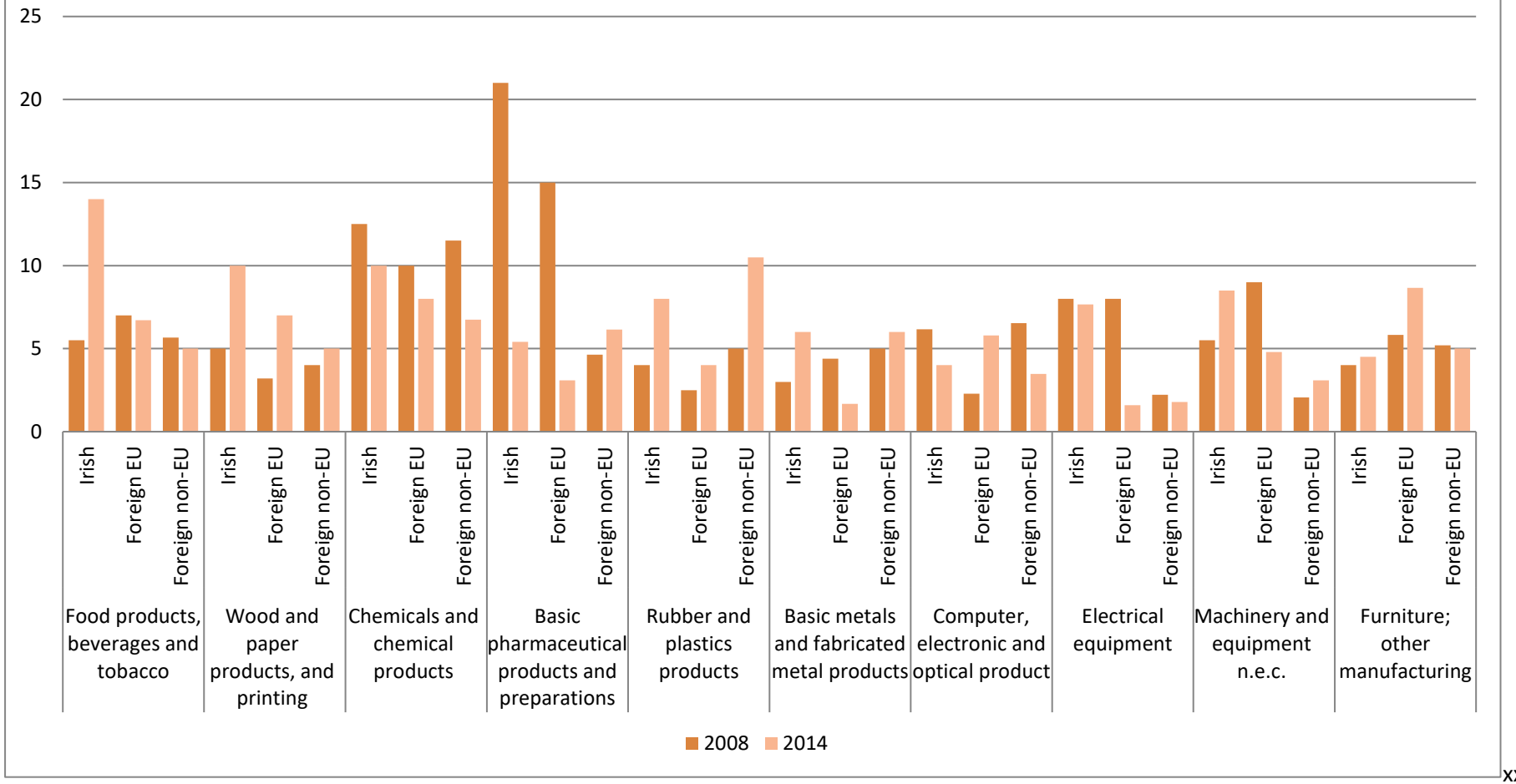


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Fig. 5.19: Average number of import origins by industry, 2008 and 2014

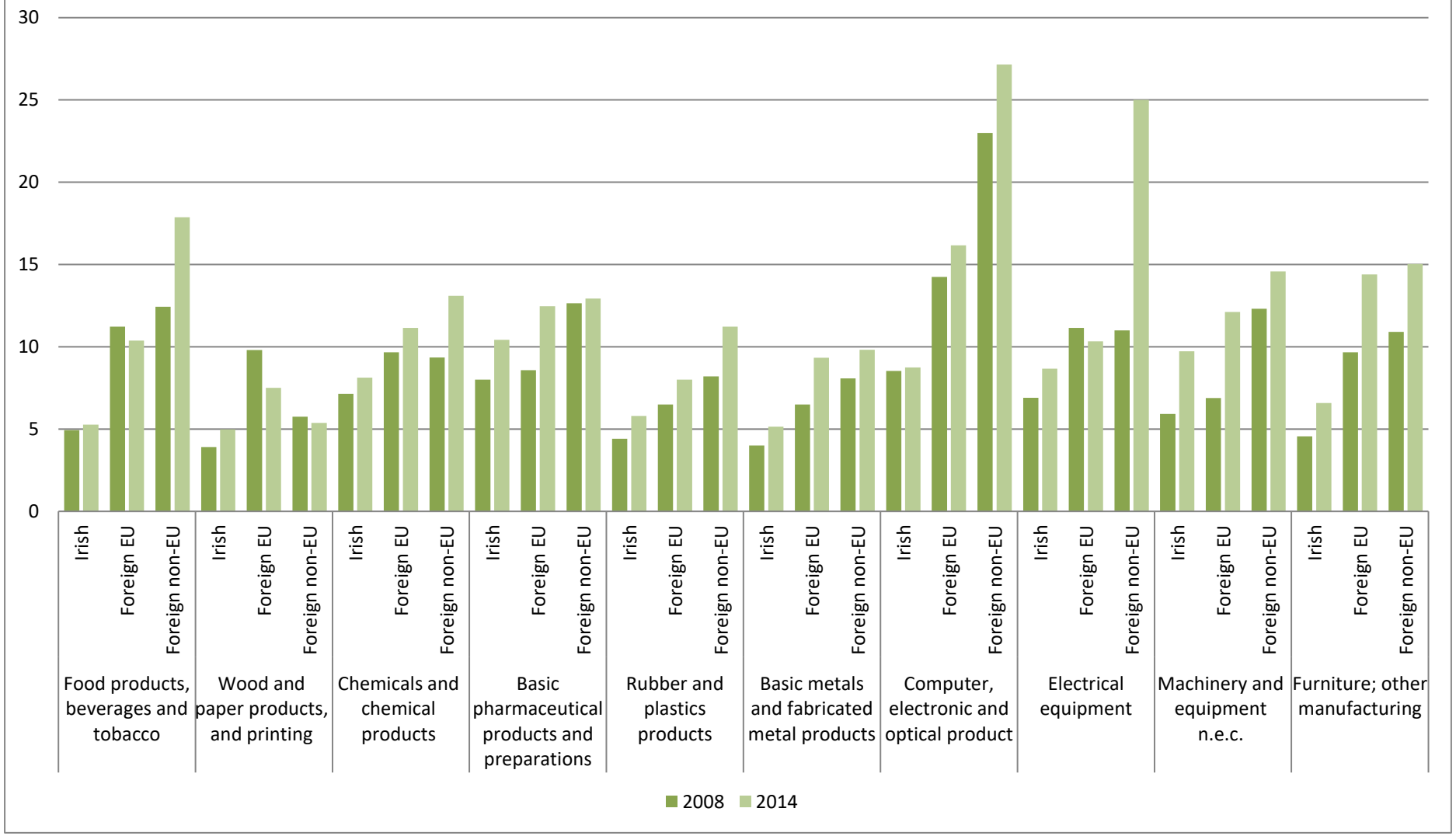
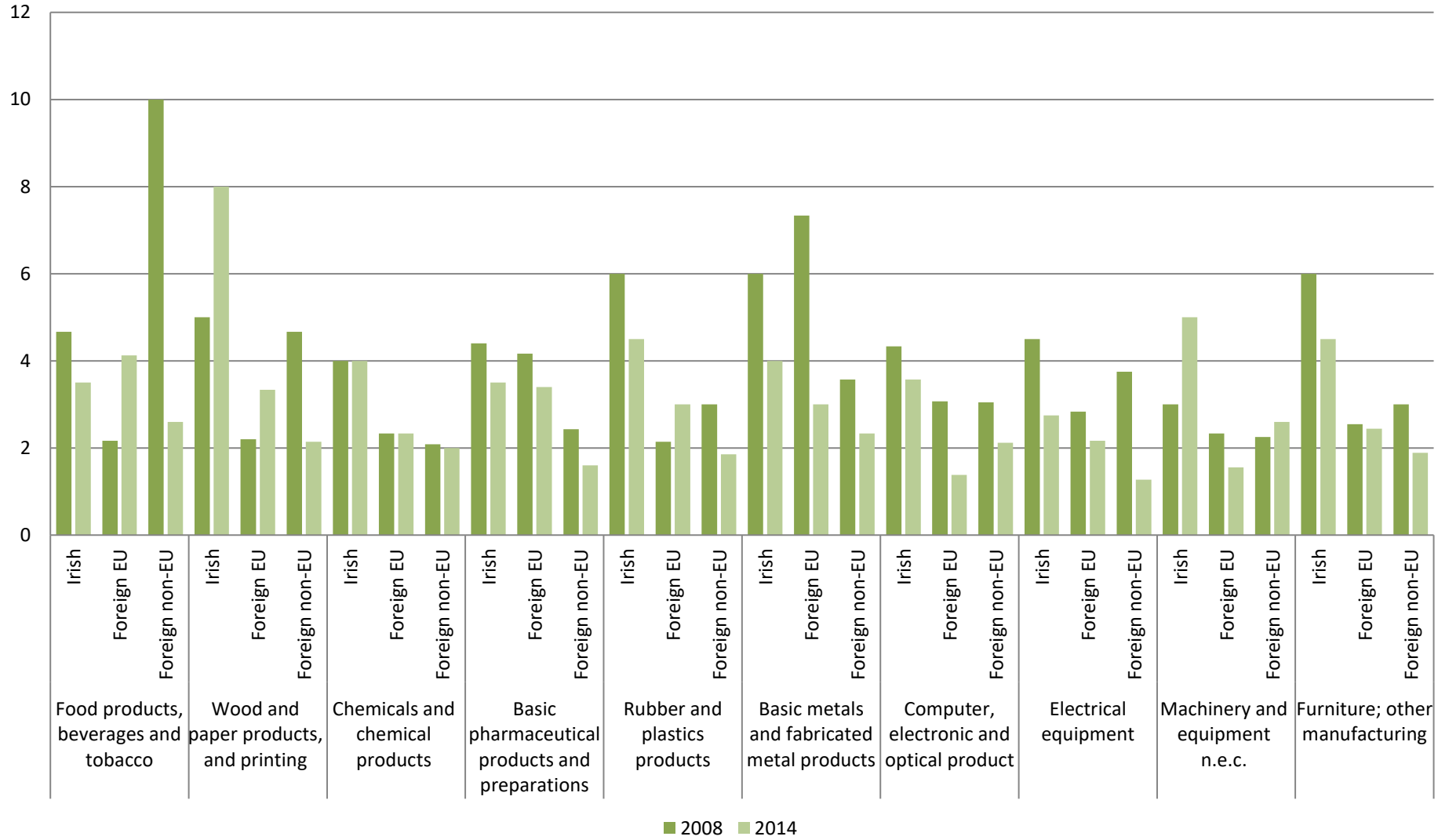


Fig. 5.20: Average number of import origins by industry : 75th/25th quartiles, 2008 and 2014



In terms of export market diversification by industry, Figure 5.17 shows foreign-owned firms export to a larger number of destinations in comparison to Irish owned firms, in any of the analysed industries. Over time the performance of Irish-owned firms has improved in this regard in all industries, with the exception of chemicals and chemical products. However, at the end of the period, the largest average number of destinations per Irish-owned firm remains in chemicals and chemical products (18 down from 21). Non-EU owned firms have the largest export market diversification, in particular in electrical equipment (33 up from 16); computer, electronic and optical products (32 up from 31); and pharmaceuticals (25 down from 32). The largest number of export destinations per EU-owned firm at the end of the period is in computer, electronic and optical products (28 up from 15 in 2008); and pharmaceuticals (22 up from 11).

Figure 5.18 shows the dispersion of export market diversification, measured as the ratio between the 75th and 25th quartiles, is the largest for Irish-owned firms in all industries, with the exception of furniture and other manufacturing, where the dispersion is larger for EU-owned firms.

Figure 5.19 shows the average number of import origins per firm is larger in foreign-owned firms in comparison to Irish-owned firms, in all industries. At the end of the period, the largest number of import origins per Irish-owned firm is in pharmaceuticals (10 up from 8 in 2008) and machinery and equipment n.e.c. (10 up from 6). The average number of import origins is larger in non-EU owned firms than in EU-owned firms, in all industries with the exception of woods, paper products and printing. At the end of the period, import markets diversification in non-EU owned firms was the largest in computer, electronic and optical products (27 up from 23 in 2008); and electrical equipment (25 up from 11).

Figure 5.20 shows the dispersion of import markets diversification, measured as the ratio between the 75th and the 25th quartiles, is the largest for Irish-owned firms in all industries with the exception of food, beverages and tobacco, where the dispersion is the largest in EU-owned firms.

5.2.3 Firm-product/country patterns

Table 5.3 brings together the product and the country information, presenting average figures of product-destination and product-origin combinations for Irish and foreign-owned exporters and importers.

For all the subgroups presented in Table 5.3, a time trend is noticeable: the number of product-country combinations rises over time, possibly a consequence of the expansion in the product-baskets of exports and imports shown above in Table 5.1.

Foreign-owned firms are again found to be involved in more complex trade and production networks, with the average number of product-country combinations exceeding that of Irish producers. Furthermore, also the distinction noted in Table 5.2, with foreign-owned firms being more involved in trade with extra-EEA countries and Irish firms being more involved in trade with intra-EEA countries, is again evident in Table 5.3.

Table 5.3: Average number of product-destinations (exports) and product-origin (imports) combinations, intra and extra EEA, by Irish ad foreign firms

IRISH FIRMS						
	Extra-EEA			Intra-EEA		
Year	Exports	Imports	Total	Exports	Imports	Total
2008	9	9	9	16	23	21
2009	12	11	11	17	23	21
2010	12	11	11	16	21	20
2011	13	13	13	15	23	20
2012	15	14	14	17	25	22
2013	15	15	15	18	25	22
2014	15	14	15	18	27	23
FOREIGN FIRMS						
	Extra-EEA			Intra-EEA		
	Exports	Imports	Total	Exports	Imports	Total
2008	35	48	42	26	41	34
2009	37	47	42	28	41	34
2010	40	50	45	27	40	34
2011	43	56	50	30	46	38
2012	46	57	52	31	49	40
2013	46	59	53	27	47	38
2014	47	59	53	29	51	40

Source: Authors' calculations based on trade, and CIP data.
Note: Products are classified at the CN8-digit level

The last table of this section, Table 5.4, presents the average amount traded, computed at the firm-product-destination level.

The first noticeable feature is the significantly larger amount of trade performed by foreign-owned firms with respect to Irish-owned firms. Trade by foreign firms is 5 to 10 larger than trade by Irish firms.

Across the various subgroups presented, the value of exports is consistently larger than the value of imports, probably signalling again that exports consists of products at a different point on the value chains with respect to imports.

Finally, focusing on the distinction between intra-EEA and extra-EEA trade, it is now found that both Irish and foreign-owned producers are shipping larger values of imports and exports to countries within the EEA area, than outside.

Table 5.4: Average value of exports and imports by firm-product-destination observation, in millions of Euro, intra and extra EEA, by Irish ad foreign firms

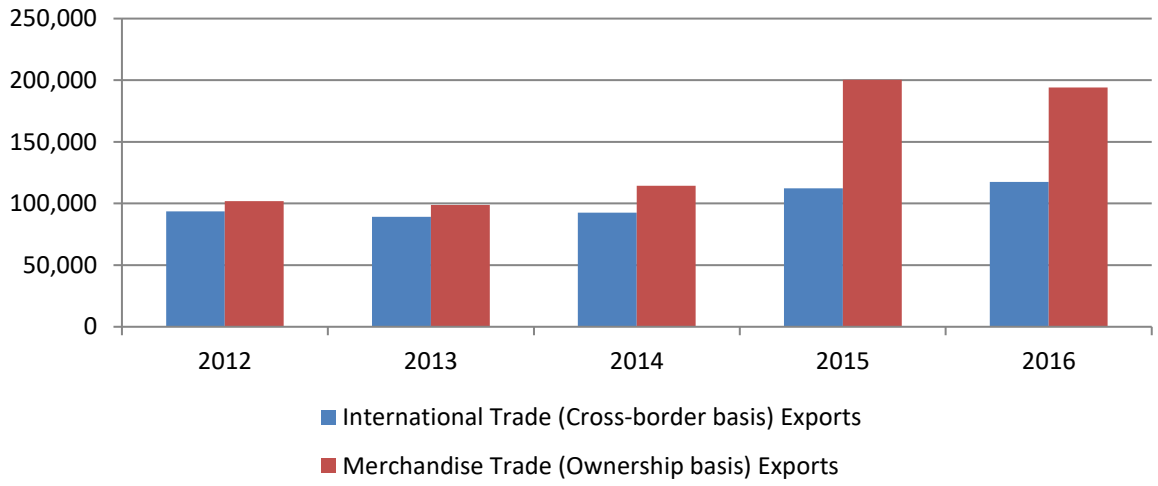
IRISH FIRMS						
	Extra-EEA			Intra-EEA		
Year	Exports	Imports	Total	Exports	Imports	Total
2008	143.27	78.21	98.59	525.75	224.70	304.93
2009	165.45	231.98	207.67	583.99	165.20	292.09
2010	167.52	54.91	99.75	569.5	177.14	300.73
2011	169.11	66.24	106.81	626.77	184.01	319.76
2012	157.52	69.37	105.69	596.53	202.72	322.25
2013	143.43	74.62	103.04	595.87	212.60	334.01
2014	139.43	65.56	96.91	615.88	184.61	315.01
FOREIGN FIRMS						
	Extra-EEA			Intra-EEA		
	Exports	Imports	Total	Exports	Imports	Total
2008	1675.65	570.84	990.34	3381.6	1025.49	1917.91
2009	1496.48	498.66	907.62	3549.52	683.07	1804.74
2010	1599.55	510.83	963.34	2849.01	1360.53	1940.02
2011	1287.60	737.42	967.92	2640.52	1139.54	1713.88
2012	1147.58	564.80	816.06	2789.14	945.62	1637.16
2013	1229.32	502.73	804.27	2364.35	570.21	1189.33
2014	1304.51	616.78	899.61	1707.59	568.78	960.11

Source: Authors' calculations based on trade and CIP data.
Note: Products are classified at the CN-8 level. Trade values are expressed in nominal terms.

5.3 Contract Manufacturing

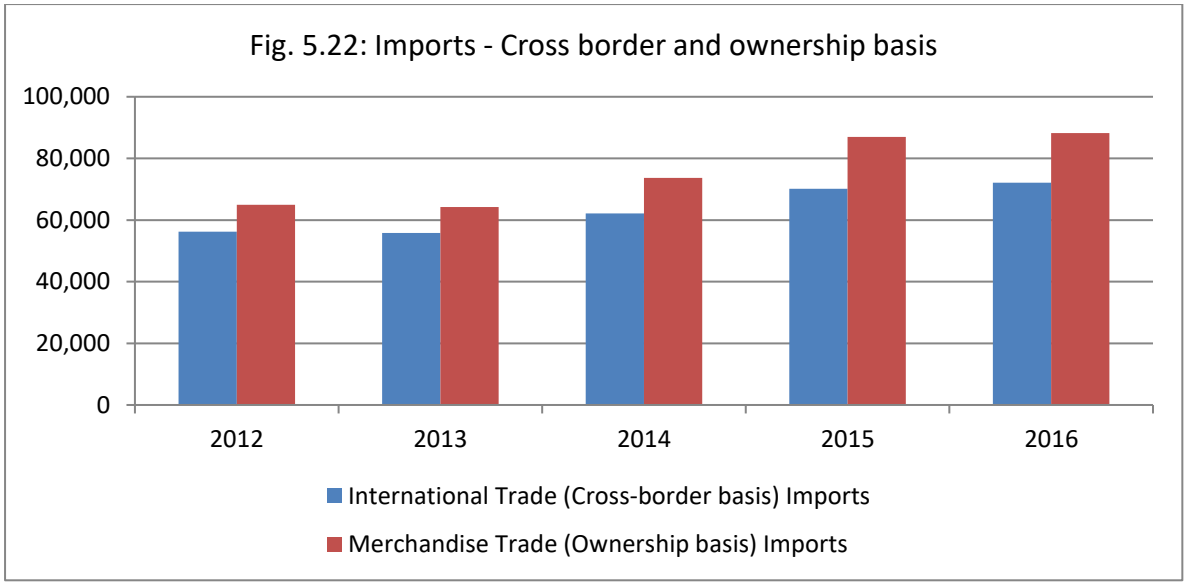
A key feature of production in recent years has been its fragmentation and internationalisation across borders. These patterns involve processing of goods across borders, known as "contract manufacturing" which includes: (a) goods sent abroad for processing; (b) goods received from abroad for processing in Ireland; (c) goods purchased abroad and further processed abroad. These arrangements are recorded as exports and imports in the Balance of Payments when change in ownership occurs, which takes place when the final good is sold. As shown in Figures 5.21 and 5.22, in Ireland, these exports and imports are substantial. According to the CSO (2017), until 2014, the trade balance of processed goods was offset by large amounts of royalties and management fees related to these processing operations. This was no longer the case in 2015 and 2016[12] which is reflected in significantly larger amounts of trade adjustment on the basis of ownership change.

Fig. 5.21: Exports - Cross-border and ownership basis

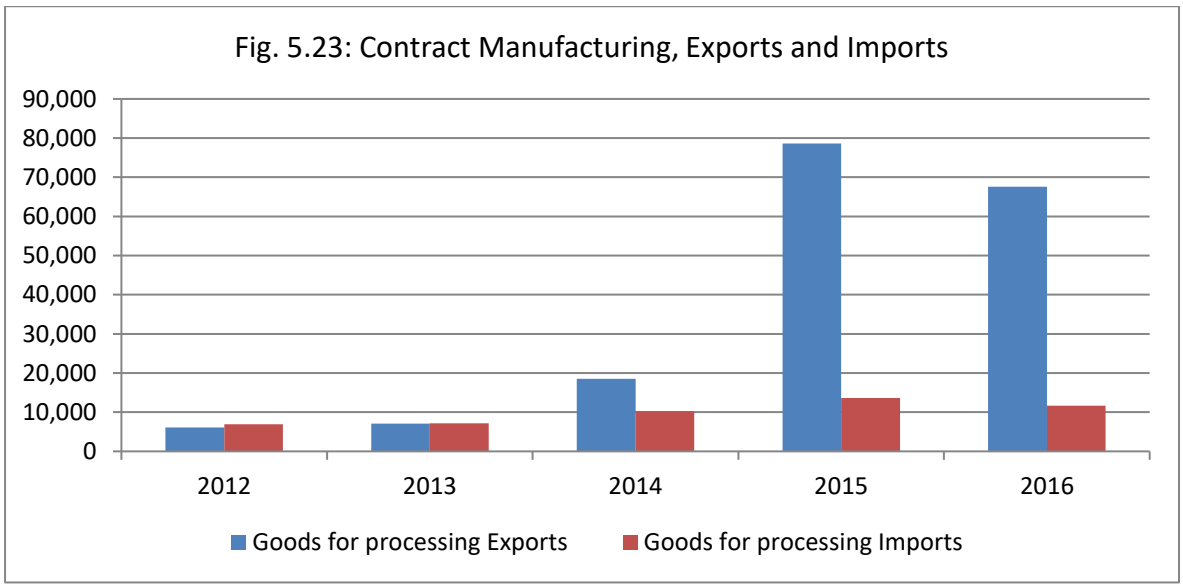


Source: Authors' elaboration based on data from the Central Statistics Office.

[12] Following from the new National Accounts Statistical System (ESA 2010) introduced in September 2014, expenditures on intellectual property assets are recorded as investment and are part of gross fixed capital formation rather than intermediate consumption.

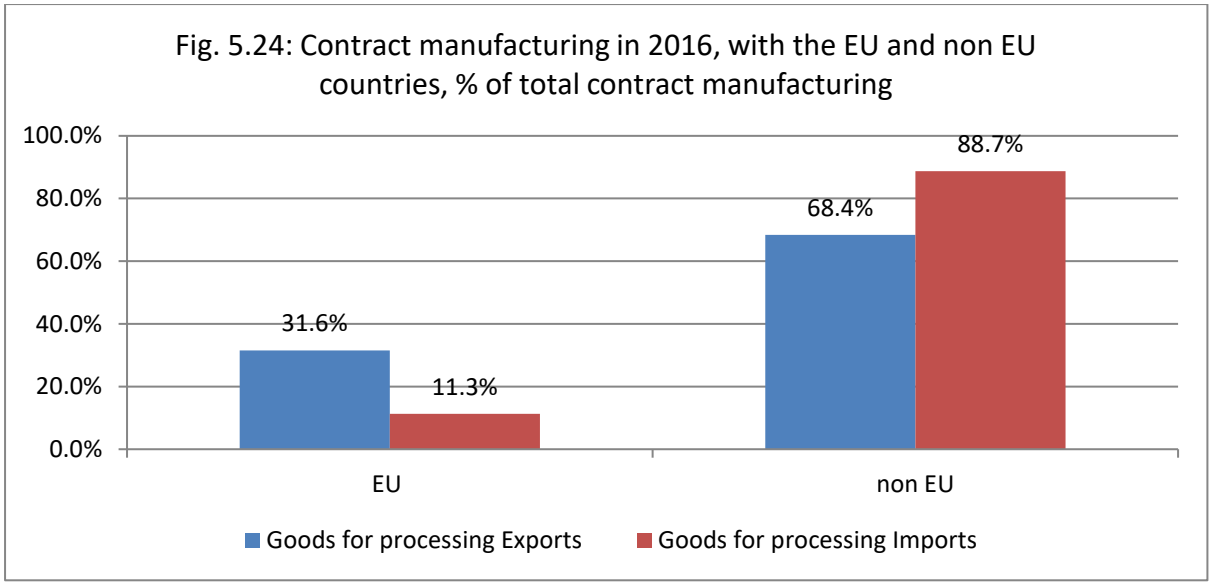


Source: Authors' elaboration based on data from the Central Statistics Office.



Source: Authors' elaboration based on data from the Central Statistics Office.

As shown in Figure 5.24, in 2016, the largest share of contract manufacturing was with non-EU countries which accounted for 68.4% of exports of goods for processing, and 88.7% of imports of goods for processing.



Source: Authors' elaboration based on data from the Central Statistics Office.

5.4 Spillovers from foreign-owned firms on the trading activities of indigenous firms

This section examines whether and to what extent the trade performance of Irish-owned firms is affected by the activity of foreign-owned affiliates. There are a number of channels through which such spillovers can take place.[13] Most studies have focused on competition or learning effects, as well as supply chain linkages, as channels for spillovers from foreign-owned firms to indigenous firms. While most of existing studies have focused on productivity spillovers[14], these spillover channels could also impact on the trade performance of indigenous firms.[15]

Competition or learning effects are linked to the presence of foreign-owned affiliates in the same industry or region. Indigenous firms might improve their innovation performance due to competitive pressure, or by adopting innovations employed by foreign competitors. Improved innovation performance in indigenous firms could lead to engagement in exporting and/or expansion and diversification of their export and import portfolio of products and markets.

Supply chain linkages between indigenous and foreign-owned firms take place in upstream and downstream industries. Higher quality or a larger number of intermediate inputs supplied by foreign-owned firms could result in productivity improvements in indigenous firms, which in turn could lead these latter to expanding and diversifying exports and imports. Moving towards the opposite end of the supply chain, higher quality standards demanded by foreign-owned firms in downstream industries could lead to product quality improvements of inputs supplied to foreign customers by indigenous firms in upstream industries. Supplying high quality inputs to foreign-owned firms could lead to expanding or shrinking the product portfolios of indigenous firms via complementarity or substitution effects.

To examine the extent to which FDI spillovers affect the trade performance of Irish-owned firms, we estimate an econometric model which links measures of indigenous firms' trade performance to indicators of horizontal (intra-industry and intra-region) and vertical (inter-industry via supply chain linkages) spillovers.

Spillover effects vary depending on the type of spillover (intra-industry, intra-region, via supply chain linkages), the origin of FDI (EU vs. non-EU based), and the type of trade performance measure (export/import intensity; number of products exported/imported; number of export destinations/import origins; number of products exported-export destinations; number of imported products-import origins).

The baseline econometric model is as follows:

[13] There is a large literature on FDI spillovers to indigeneous firms initiated by Caves (1974). Recent reviews of this literature include Görg and Strobl (2001), Görg and Greenaway (2004), Meyer and Sinani (2009), Havranek and Irsova (2011). Jude (2016) explores the intensity of the channels for FDI spillovers in Central and Eastern Europe.

[14] The empirical results of a recent analysis of productivity spillovers from foreign –owned to indigenous firms in Ireland are summarised in Appendix D.

[15] To the best of our knowledge only a small number of studies have examined trade spillovers. See for example Ciani and Imbruno (2017) on the export spillovers from FDI in Bulgaria, and Bajgar and Javorcik (2017) the FDI spillovers on the export quality of indigenous firms in Romania.

$$\ln Y_{ijrt}^{d} = \alpha_0 + \alpha_1 HOR_{j,t-k} + \alpha_2 HOR_{r,t-k} + \alpha_3 FOR_{j,t-k} + \alpha_4 BACK_{j,t-k} + \alpha_5 Z_{ijrt}^{d} + \\ + \alpha_6 \Delta SALES_{jt} + \mu_i + \eta_j + \rho_r + \lambda_t + \varepsilon_{ijrt} \quad (5.2)$$

Y_{ijrt}^{d} : trade performance measure for firm *i*, in industry *j*, region *r*, at time *t*; in constant prices;

Measures of trade performance used in this analysis include: export/import intensity; the number of products exported/imported per firm; the number of destinations/origins per firm; the number of product-destinations/origins per firm.

The key explanatory variables are four measures of spillovers:

Horizontal intra-industry spillovers

$\mathbf{HOR}_{\mathrm{j,t-k}} = \mathbf{Y}^{\mathrm{f}}_{\mathrm{j,t-k}} / \mathbf{Y}_{\mathrm{j,t-k}}$: the share of foreign affiliates' employment in total employment in industry j, at time t-k (k is the time lag= 0,…,T);

Horizontal intra-industry spillovers

$\mathbf{HOR}_{\mathrm{r,t-k}} = \mathbf{Y}^{\mathrm{f}}_{\mathrm{r,t-k}} / \mathbf{Y}_{\mathrm{r,t-k}}$: the share of foreign affiliates' employment in total employment in region r, at time t-k (k is the time lag = 0,…,T);

Forward spillovers from foreign-owned suppliers in upstream industries to indigenous firms in downstream industries

$\mathbf{FOR}_{\mathrm{j,t-k}} = \sum_{\mathrm{l}} \delta_{\mathrm{lj}} \mathbf{HOR}_{\mathrm{l,t-k}}, \mathbf{l} \neq \mathbf{j}$; where δ_{lj} denotes the share of inputs of industry j purchased from industry l;

Backward spillovers from indigenous firms in upstream industries to foreign-owned customers in downstream industries

$\mathbf{BAC}_{\mathrm{j,t-k}} = \sum_{\mathrm{l}} \gamma_{\mathrm{lj}} \mathbf{HOR}_{\mathrm{l,t-k}}, \mathbf{l} \neq \mathbf{j}$; where γ_{lj} denotes the share of output of industry j supplied to industry l;

In addition to these key explanatory variables, we control for a range of factors which are likely to affect the trade performance of indigenous firms including the following firm characteristics:

Z_{ijrt}^{d}*:* is a vector of *c*haracteristics of domestic firms including:

- Age
- Size (Emp)
- Industry concentration (Herfindahl-Hirschman index, HHI)
- Productivity (LP, real value added/employee)
- Wage/employee (Wemp)
- Investment in tangibles/employee (Kemp)

- Investment in R&D/employee (RDemp)

In addition we control for industry-specific shocks which might affect the measures of spillovers:

$\Delta SALES_{jt}$: output growth at industry level

$\mu_i, \eta_j, \rho_r, \lambda_t$: denote unobserved firm, industry, region and time specific effects and ε_{ijrt} is the remaining error term.

The empirical analysis identifies and quantifies spillovers from all foreign-owned affiliates and in addition from EU-owned and non-EU owned affiliates. This distinction is made using in the regression analysis the corresponding employment shares for the two groups of foreign affiliates.

The empirical results are presented in Tables 5.6-5.9. Overall, the estimates indicate that Irish-owned firms benefit to some extent from spillovers from foreign direct investment (FDI), mainly via supply chain linkages. There is also evidence suggesting that foreign-owned affiliates crowd out the trade performance of Irish-owned firms.

5.4.1 Intra-industry and intra-region FDI spillovers

The estimates indicate only very limited intra-industry and intra-region FDI spillovers on the trade performance of indigenous firms. This result is in line with the large literature on FDI spillovers which finds that most spillover effects come through supply chain linkages (for a review of this evidence see Havranek and Irsova 2011).

The export intensity of Irish-owned firms is positively linked to the presence of foreign-owned firms in the same industry. This positive effect is linked to the presence of multinationals with headquarter based outside the EU. An increase by one percentage point in the employment share of non-EU owned affiliates in the industry's total employment is linked to an increase by 5.3 per cent in the export intensity of Irish-owned firms in the same industry. Splitting the analysis by manufacturing and services firms, the results indicate only services firms appear to be affected by the presence of foreign affiliates. he export intensity of Irish-owned firms in services is negatively affected by the presence of EU-based multinatioanls, but positively affected by the presence of non-EU multinatioanls. An increase by one percentage point in the presence of non-EU-owned affiliates is associated with a 13.2 per cent higher export intensity of the indigenous firms in the same industry. These positive spillovers could come about through knowledge spillovers and learning effects from foreign-owned competitors in the same industry. No effect of intra-industry spillovers from foreign affiliates s are detected on the import intensity of Irish-owned firms.

the export intensity of Irish-owned firms appears to be affected negatively by the presence of foreign-owned firms in the same region. This negative effect is linked to the presence of affiliates of non-EU multinationals for all Irish-owned firms and for Irish-owned firms in services. For manufacturing firm the estimates indicate that it is the presence of affiliates owned by EU-owned affiliates that crowds out the export performance of Irish-owned firms. This negative effect is estimated with respect to both the extensive (number of products exported, and the number of product-export destinations) and intensive margins (export intensity, i.e. export sales as a share of turnover). In terms of the magnitude of the effects, an increase by one percentage point in the presence of EU-owned affiliates in the same region is associated with a 11 percent lower export intensity in Irish-owned manufacturing firms; an increase by one percentage point in the presence of

non-EU firms in the same region is associated with a 3.8 percent lower export intensity of Irish-owned service firms. These negative spillover effects are likely to come through the competition channel due to the stronger performance of foreign competitors in the same region.

5.4.2 FDI spillovers via forward linkages

The estimates indicate that supplies by foreign-owned affiliates to Irish-owned firms increase the import intensity of Irish-owned firms, as well as the number of products imported by Irish-owned manufacturing firms. A 10 percentage point increase in the presence of foreign-owned firms is associated with a 3.2 per cent higher import intensity of indigenous firms in downstream manufacturing industries. These effects are likely to be associated with the higher value of inputs supplied by foreign-owned firms and to the broader access to international markets facilitated by supply linkages with multinational firms. However, a 10 percentage point increase in the presence of foreign-owned firms is associated with a 2.7 per cent lower import intensity of indigenous firms in downstream services industries. This lower import intensity can be explained by the fact that multinationals supplies can substitute indigenous firms' imports from abroad.

Concerning exports, forward supply linkages with affiliates owned by EU-based multinationals are positively linked to the number of products exported and the number of combined export product-destinations of Irish-owned manufacturing firms. This result implies that higher quality inputs supplied by EU-owned affiliates can lead to expanding the product varieties and export markets. In contrast, forward supply linkages with affiliates owned by non-EU multinationals have the opposite effect on the same trade performance measures. This negative effect could come about through the competition channel.

Forward supply linkages with affiliates owned by EU-based multinationals are negatively linked to the export intensity of Irish-owned firms, while the same linkages with non-EU-based multinationals have a positive effect: it appears therefore that EU and non-EU multinationals can have opposite impacts, with the non-EU firms boosting the export performance of Irish firms downstream, and the EU owned affiliates reducing it. These effects can be explained in light of a different value-chains involvement of EU and non-EU multinationals in Ireland: being supplied by EU multinationals induces Irish firms to focus their activity domestically; being supplied by non-EU multinationals induces Irish firms to export a larger fraction of their turnover.

5.4.3 FDI spillovers via backward linkages

The estimates indicate that Irish-owned manufacturing firms benefit from supplying foreign-owned firms in terms of the number of their export destinations and the number of products exported-export destinations. These positive effects appear to be associated with supply linkages with affiliates owned by EU-based multinationals, and can be driven by positive knowledge and technology spillovers from multinationals, which allow Irish firms to expand their operations abroad.

Supply linkages with affiliates owned by non-EU multinationals have instead negative effects. The larger the presence of non-EU multinationals in downstream industries, the lower the number of products exported by indigenous firms in upstream industries. This crowding our effect can be explained by the competition exerted by these foreign-owned affiliates. Also the import intensity of Irish-owned firms, particularly those in services, is reduced by supply chain linkages with non-EU owned affiliates in downstream industries. Supplying foreign-owned firms appears negatively linked to the import intensity of Irish-owned firms in services.

Table 5.6: FDI spillovers on the export intensity of Irish-owned firms, 2008-2014

	All Firms		Manufacturing		Services	
Explanatory Variables	Ln Export intensity (1)	Ln Export intensity (2)	Ln Export intensity (3)	Ln Export intensity (4)	Ln Export intensity (5)	Ln Export intensity (6)
Intra-industry	0.0316		0.0491		0.0145	
	(0.0241)		(0.0338)		(0.0352)	
Intra-industry_EU		-0.00571		0.0509		-0.0749**
		(0.0361)		(0.0585)		(0.0325)
Intra-industry_nonEU		0.0533*		0.0264		0.132**
		(0.0291)		(0.0305)		(0.0642)
Intra-region	-0.0233		-0.0265		-0.0189	
	(0.0156)		(0.0313)		(0.0149)	
Intra-region_EU		-0.0145		-0.111*		0.0364
		(0.0335)		(0.0588)		(0.0362)
Intra-region_nonEU		-0.0345*		-0.0376		-0.0378**
		(0.0178)		(0.0382)		(0.0164)
Forward link	-0.152		-0.0320		0.0556	
	(0.202)		(0.418)		(0.188)	
Backward link	-0.000517		0.202		0.0373	
	(0.0393)		(0.156)		(0.0372)	
Forward link_EU		-0.553**		-0.462		-0.240
		(0.213)		(0.889)		(0.292)
Backward link_EU		0.0836		0.609*		-0.0292
		(0.104)		(0.358)		(0.0933)
Forward link_nonEU		0.805**		0.681		0.757
		(0.377)		(0.754)		(0.492)
Backward link_nonEU		-0.0413		0.108		-0.0279
		(0.0618)		(0.265)		(0.0329)
Δ Industry sales	0.0300***	0.0278***	0.0294***	0.0293***	0.00849	0.00790
	(0.00795)	(0.00781)	(0.00991)	(0.0102)	(0.00773)	(0.00742)
Ln Age	-0.253	-0.116	-0.252	0.135	-0.539*	-0.476
	(0.254)	(0.267)	(0.462)	(0.537)	(0.303)	(0.296)
Ln Age^2	0.121	0.0630	0.144	-0.0171	0.232*	0.205
	(0.107)	(0.113)	(0.198)	(0.230)	(0.127)	(0.125)
HHI	0.0790*	0.0740	0.0550	0.0586	0.0956	0.107
	(0.0423)	(0.0467)	(0.0665)	(0.0829)	(0.0664)	(0.0652)
Ln Emp	0.00352	0.00476	0.0119	0.0141	0.00739*	0.00720*
	(0.00368)	(0.00375)	(0.00894)	(0.00939)	(0.00392)	(0.00398)
Ln LP	0.00504	0.00488	0.00797	0.00833	0.00879	0.00820
	(0.00454)	(0.00476)	(0.00603)	(0.00644)	(0.00602)	(0.00622)
Ln Wemp	-0.0105***	-0.00874**	-0.258***	-0.250***	0.00123	0.00173
	(0.00382)	(0.00361)	(0.0450)	(0.0477)	(0.00210)	(0.00220)
L Kemp	0.000770	0.000791	0.00602	0.0203	0.000587	0.000529
	(0.000550)	(0.000565)	(0.0212)	(0.0227)	(0.000556)	(0.000568)
Ln RDemp	-0.00418	-0.00413	0.0192	0.0186	-0.00371	-0.00410
	(0.00427)	(0.00426)	(0.0339)	(0.0362)	(0.00423)	(0.00413)
Constant	0.0415	-0.0110	0.00982	-0.0718	0.260	0.228
	(0.139)	(0.154)	(0.231)	(0.282)	(0.171)	(0.173)
Firm FE	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
County FE	Y	Y	Y	Y	Y	Y
N	19301	18280	7136	6445	12165	11835

Source: Authors' estimates based on data from the CIS and ASI provided by Ireland's Central Statistics Office (CSO).
Notes: Standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table 5.7: FDI spillovers on the extensive margins of exports by Irish-owned firms, 2008-2014 – Manufacturing firms

Explanatory variables	Ln No. products exported	Ln No. products exported	Ln No. destinations Exports	Ln No. Destinations Exports	Ln No. product-destinations exports	Ln No. product-destination exports
	(1)	(2)	(3)	(4)	(5)	(6)
Intra-industry	-0.346		0.0564		-0.222	
	(0.286)		(0.200)		(0.258)	
Intra-industry_EU		-0.623**		0.202		-0.318
		(0.309)		(0.300)		(0.328)
Intra-industry_nonEU		-0.423		-0.0180		-0.389
		(0.303)		(0.230)		(0.280)
Intra-region	-0.255		0.0630		-0.0861	
	(0.278)		(0.292)		(0.309)	
Intra-region_EU		-0.958**		-0.535		-0.748*
		(0.406)		(0.324)		(0.407)
Intra-region_nonEU		-0.250		0.115		-0.0459
		(0.310)		(0.293)		(0.332)
Forward link	-2.209		-1.256		-3.612	
	(4.067)		(2.635)		(3.728)	
Backward link	-0.413		2.621**		1.610	
	(1.524)		(1.149)		(1.374)	
Forward link_EU		19.18***		8.657		24.35***
		(7.017)		(5.280)		(6.668)
Backward link_EU		4.071		6.317***		6.447**
		(2.785)		(2.236)		(2.516)
Forward link_nonEU		-13.15**		-3.819		-16.92***
		(5.909)		(3.721)		(5.715)
Backward link_nonEU		-3.934**		0.185		-2.265
		(1.899)		(1.477)		(1.540)
Δ Industry sales	-0.0806	-0.0569	-0.0268	0.00452	-0.101	-0.0688
	(0.0673)	(0.0628)	(0.0442)	(0.0465)	(0.0638)	(0.0644)
Ln Age	-5.775	-1.286	-10.20***	-6.579	-11.99**	-6.817
	(3.803)	(4.146)	(3.812)	(4.537)	(4.679)	(5.389)
Ln Age^2	2.516	0.608	4.470***	3.004	5.239***	3.079
	(1.612)	(1.762)	(1.629)	(1.949)	(1.990)	(2.303)
HHI	0.0962	0.0459	-0.0578	0.276	0.0693	0.137
	(0.558)	(0.513)	(0.364)	(0.372)	(0.546)	(0.525)
Ln Emp	0.266***	0.262***	0.399***	0.371***	0.432***	0.418***
	(0.0683)	(0.0781)	(0.0653)	(0.0684)	(0.0850)	(0.0934)
Ln LP	0.0848	0.0749	0.0960**	0.0698	0.126**	0.112
	(0.0534)	(0.0567)	(0.0443)	(0.0476)	(0.0634)	(0.0683)
Ln Wemp	0.385***	0.362**	0.183**	0.191**	0.371***	0.351***
	(0.132)	(0.138)	(0.0876)	(0.0898)	(0.121)	(0.125)
L Kemp	-0.0176	0.0649	-0.0226	-0.0585	-0.0548	-0.0166
	(0.102)	(0.0987)	(0.0923)	(0.103)	(0.110)	(0.110)
Ln RDemp	0.262	0.174	0.104	0.0745	0.301**	0.234
	(0.172)	(0.188)	(0.103)	(0.114)	(0.150)	(0.173)
Constant	2.784	0.673	3.588*	1.519	5.196**	2.646
	(2.115)	(2.154)	(1.929)	(2.205)	(2.474)	(2.658)
Firm FE	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
County FE	Y	Y	Y	Y	Y	Y
N	2824	2593	2815	2584	2824	2593

Source: Authors' estimates based on linked transaction level trade statistics and CIS data provided by Ireland's Central Statistics Office (CSO).
Notes: Standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table 5.8: FDI spillovers on the import intensity of Irish-owned firms, 2008-2014

	All Firms		Manufacturing		Services	
Explanatory variables	Ln Import intensity (1)	Ln Import intensity (2)	Ln Import intensity (3)	Ln Import intensity (4)	Ln Import intensity (5)	Ln Import intensity (6)
Intra-industry	0.00895		-0.00482		0.0183	
	(0.00951)		(0.00547)		(0.0237)	
Intra-industry_EU		0.0108		-0.00958		0.0490
		(0.0148)		(0.0115)		(0.0313)
Intra-industry_nonEU		0.00286		-0.0108*		-0.00715
		(0.0113)		(0.00607)		(0.0305)
Intra-region	-0.00490		-0.0114		-0.00218	
	(0.0114)		(0.0103)		(0.0177)	
Intra-region_EU		0.000438		-0.00595		0.00132
		(0.0163)		(0.0153)		(0.0244)
Intra-region_nonEU		-0.00477		-0.000570		-0.00858
		(0.0132)		(0.00960)		(0.0208)
Forward link	-0.0315		0.326**		-0.266*	
	(0.103)		(0.126)		(0.160)	
Backward link	-0.0268		0.0496		-0.0229	
	(0.0276)		(0.0495)		(0.0325)	
Forward link_EU		-0.0203		0.109		-0.224
		(0.0994)		(0.190)		(0.178)
Backward link_EU		0.0806		0.0610		0.138
		(0.0890)		(0.0832)		(0.115)
Forward link_nonEU		0.00746		0.555***		-0.242
		(0.215)		(0.160)		(0.436)
Backward link_nonEU		-0.0680**		0.0748		-0.0683*
		(0.0333)		(0.0632)		(0.0411)
Δ Industry sales	0.00597**	0.00458	0.00189	0.000675	0.00599	0.00442
	(0.00302)	(0.00285)	(0.00156)	(0.00177)	(0.00505)	(0.00453)
Ln Age	-0.0251	-0.0234	0.247**	0.241*	-0.172	-0.150
	(0.135)	(0.145)	(0.118)	(0.127)	(0.193)	(0.203)
Ln Age^2	0.0145	0.0139	-0.103**	-0.100*	0.0775	0.0682
	(0.0580)	(0.0621)	(0.0504)	(0.0543)	(0.0826)	(0.0868)
HHI	-0.00118	0.00425	-0.000923	0.000786	0.00761	0.0136
	(0.0155)	(0.0178)	(0.0108)	(0.0112)	(0.0288)	(0.0283)
Ln Emp	0.00577***	0.00631***	-0.00156	-0.00181*	0.00940***	0.00982***
	(0.00166)	(0.00178)	(0.00111)	(0.00109)	(0.00232)	(0.00244)
Ln LP	0.00344	0.00342	-0.00516*	-0.00535*	0.0137	0.0127
	(0.00530)	(0.00571)	(0.00278)	(0.00308)	(0.0108)	(0.0110)
Ln Wemp	-0.00462	-0.00506	0.00518	0.00327	-0.00549	-0.00575
	(0.00347)	(0.00364)	(0.00355)	(0.00379)	(0.00393)	(0.00411)
L Kemp	0.00181***	0.00196***	0.00237	0.00358	0.00174***	0.00192***
	(0.000590)	(0.000566)	(0.00478)	(0.00549)	(0.000577)	(0.000564)
Ln RDemp	-0.00295	-0.00301	0.00245	0.00242	-0.00291	-0.00291
	(0.00328)	(0.00337)	(0.0115)	(0.0122)	(0.00339)	(0.00346)
Constant	-0.00434	-0.00960	-0.151**	-0.149**	0.122	0.107
	(0.0696)	(0.0728)	(0.0634)	(0.0692)	(0.0997)	(0.105)
Firm FE	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
County FE	Y	Y	Y	Y	Y	Y
N	19301	18280	7136	6445	12165	11835

Source: Authors' estimates based on data from the CIS and ASI provided by Ireland's Central Statistics Office (CSO).
Notes: Standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table 5.9: FDI spillovers on the extensive margins of imports by Irish-owned firms, 2008-2014 – Manufacturing firms

Explanatory varaibles	Ln No. products imported	Ln No. products imported	Ln No. Import Origins	Ln No. Import Origins	Ln No. product-import origins	Ln No. product-import origins
	(1)	(2)	(3)	(4)	(5)	(6)
Intra-industry	-0.0599		-0.182*		-0.151	
	(0.158)		(0.104)		(0.163)	
Intra-industry_EU		0.186		0.196		0.240
		(0.255)		(0.186)		(0.265)
Intra-industry_nonEU		-0.0129		-0.278**		-0.206
		(0.185)		(0.121)		(0.192)
Intra-region	0.249		-0.133		0.142	
	(0.212)		(0.158)		(0.208)	
Intra-region_EU		0.563		0.711**		0.639*
		(0.355)		(0.294)		(0.384)
Intra-region_nonEU		0.0530		-0.295		-0.0304
		(0.240)		(0.185)		(0.248)
Forward link	3.599*		0.771		5.191**	
	(1.941)		(1.615)		(2.016)	
Backward link	0.586		0.936		0.634	
	(1.077)		(0.839)		(1.117)	
Forward link_EU		5.142		8.314***		8.544**
		(4.006)		(3.013)		(4.170)
Backward link_EU		0.873		1.546		1.571
		(1.397)		(1.147)		(1.541)
Forward link_nonEU		4.247		-3.530		5.783
		(3.640)		(3.229)		(4.086)
Backward link_nonEU		0.961		0.552		0.474
		(1.330)		(1.035)		(1.281)
Δ Industry sales	0.0133	0.0239	-0.0321	-0.0235	0.00949	0.00896
	(0.0397)	(0.0437)	(0.0363)	(0.0367)	(0.0461)	(0.0494)
Ln Age	-6.907	-5.137	-7.036**	-5.390	-6.220	-4.675
	(4.562)	(5.031)	(3.102)	(3.451)	(4.767)	(5.269)
Ln Age^2	2.939	2.165	2.994**	2.304	2.638	1.978
	(1.979)	(2.176)	(1.346)	(1.500)	(2.063)	(2.278)
HHI	-0.212	-0.193	-0.214	-0.187	-0.226	-0.146
	(0.200)	(0.265)	(0.189)	(0.223)	(0.228)	(0.304)
Ln Emp	0.553***	0.563***	0.406***	0.429***	0.617***	0.632***
	(0.0464)	(0.0508)	(0.0421)	(0.0445)	(0.0499)	(0.0540)
Ln LP	-0.00119	-0.0217	0.0568**	0.0515	0.0128	-0.00603
	(0.0330)	(0.0379)	(0.0278)	(0.0318)	(0.0336)	(0.0377)
Ln Wemp	0.0185	-0.0656	0.0387	0.0166	-0.0123	-0.0920
	(0.137)	(0.139)	(0.113)	(0.116)	(0.141)	(0.142)
L Kemp	-0.0257	-0.102	0.156**	0.146**	0.0116	-0.0564
	(0.0814)	(0.0832)	(0.0609)	(0.0697)	(0.0778)	(0.0803)
Ln RDemp	0.360***	0.358**	0.265**	0.237*	0.340**	0.344**
	(0.129)	(0.140)	(0.128)	(0.139)	(0.134)	(0.146)
Constant	3.500	2.471	3.472**	2.451	3.041	2.358
	(2.189)	(2.406)	(1.437)	(1.613)	(2.304)	(2.518)
Firm FE	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
County FE	Y	Y	Y	Y	Y	Y
N	4211	3824	4204	3819	4211	3824

Source: Authors' estimates based on linked transaction level trade statistics and CIS data provided by Ireland's Central Statistics Office (CSO).

Notes: Standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

6 Access to Finance and Firm Performance

This chapter examines the extent of financing constraints faced by enterprises in Ireland during the period between 2014 and the first semester of 2017, and how these affect their performance with respect to exporting, investment and innovation. The focus of this analysis is on small and medium-sized enterprises (SMEs) defined as enterprises with less than 250 employees. However, large firms are also analysed in areas where they are most relevant. Section 6.1 describes the dataset, the basic econometric model and the key variables used in the analysis. Section 6.2 presents a descriptive analysis of the dependent variables and main covariates of interest over time and across firm characteristics. Section 6.3 discusses the main empirical results.

Key Findings

- The evidence indicates a continuing decline of the share of firms facing actual financing constraints from 29% of applicants in 2011 (the highest share over the analysed period), to 11% in 2016. While also declining, the share of firms facing actual financing constraints is the largest for micro firms (17%), youngest (33%) and for indigenous firms (12%).
- The proportion of firms with higher debts relative to the previous period was lower in the first semester of 2017, 15%, compared to 19% in early 2014. While the share of SMEs reporting higher debts has declined, particularly for micro firms (9% in 2017H1 compared to 20% in 2014H1), the share of large firms reporting higher debts has increased from 11% in the first half of 2014 to 23% in the first semester of 2017.
- The proportion of firms reporting higher investment has decreased from 38% (the highest rate over the analysed period) to 34% in the first semester of 2017. Over the analysed period, the proportion of firms reporting higher investment has increased for small firms from 34% to 41%, while all it has decreased for the other size groups, particularly for micro firms from 27 % in the first semester of 2014 to 19% in the first semester of 2017.
- The empirical results indicate that export engagement and export entry are less likely for firms accumulating higher debts over assets. Further, continuous exporting is less likely if firms face higher interest expenses.
- The evidence also indicates that higher investment is less likely for firms facing higher interest expenses or with a deteriorated credit history.
- Process innovation is less likely if firms accumulate higher debts over assets while product innovation appears to be associated with higher financial needs by firms.

6.1 Data, Variables and Empirical Methodology

This research uses a rich dataset from the *Survey on the Access to Finance of Enterprises* (SAFE) undertaken by the European Commission and the European Central Bank. This survey is conducted on a biannual basis. Information on firm size in terms of number of employees, turnover, age, type of ownership, parent country, main activity, export status, as well as information on access to finance per firm, are collected in this survey. Firms based in European countries, both EU and non-EU, are surveyed with an average of 500 firms from Ireland included in each survey wave. The analysis in this chapter is based on a total of 3,512 firms based in Ireland covering seven survey waves over the period 2014-2017.

6.1.1 Basic Model and Main Variables

In order to empirically test the relationship between Irish firms' access to finance and different indicators of firm performance, we run the following econometric specification:

$$Y_{it} = \beta_0 + \beta_1 Financial\_constr_{it} + \beta_2 X_{it} + \beta_3 \varepsilon_t + \mu_{it} \quad (6.1)$$

Table 6.1 presents the list of the firm performance outcome variables of interest (Y_{it}). We are particularly interested in how financial constraints affect firms' decision to engage in exporting, increase their investment and introduce innovations.

As can be seen in Table 6.1, we analyse not only the decision to export *per se*, but also the sustainability of firms' export engagement over time. Moreover, we distinguish between various types of innovation and analyse their respective relationship with access to finance.

Table 6.1

Outcome variables	
Variable Name/Code	**Description**
Export_engage $_{it}$	Binary variable taking value 1 if firm *i* engaged into export activity in semester *t*, i.e. if part of its turnover in that period is accounted for by exports of goods and services.
New_exporter $_{it}$	Binary variable taking value 1 if firm *i* engaged into export activity in semester *t, but not in semester t-1.*
Continuous_exporter $_{it}$	Binary variable taking value 1 if firm *i* engaged into export activity in both semester *t and t-1.*
Export_exiter $_{it}$	Binary variable taking value 1 if firm *i* did not engage into export activity in semester t, after having engaged in t-1.
Higher_investment $_{it}$	Binary variable taking value 1 if firm *i* increased its investment in property, plant or equipment in semester t.
Innovation $_{it}$	Binary variable taking value 1 if firm *i* has undertaken any type of innovation in year t.
Product_innov $_{it}$	Binary variable taking value 1 if firm *i* has introduced a new or improved product or service in year t.
Product_innov $_{it}$	Binary variable taking value 1 if firm *i* has introduced a new or improved production process in year t.
Organ_innov $_{it}$	Binary variable taking value 1 if firm *i* has introduced a new organisation or management in year t.
Market_innov $_{it}$	Binary variable taking value 1 if firm *i* has introduced a new way of selling goods or services in year t.

financial_constr is the main variable of interest in this analysis. It takes value 1 if firm *i* reported to be financially constrained at time *t*. In this research, we have constructed a total of eleven alternative measures of firm financial constraint. These measures are described in Table 6.2 below. *X* is a vector of firm characteristics, some of which may vary over time, such as firm size in terms of

number of employees, main activity, ownership type, annual turnover, age and parent country. Finally, ε accounts for time fixed effects.

Table 6.2 presents the list of eleven alternative measures of firm financial constraint (*financial_constr*). Among the financial measures constructed using information from the SAFE data base, the closest to reflect the difficulties experienced by firms to gain access to external funds are: *actual_constr*, *higher_debt* and *higher_interest* are.

Table 6.2

Financial constraint variables	
Variable Name/Code	**Description**
$Actual\_constr_{it}$	Binary variable taking value 1 if firm *i* has applied for any financing in semester t and (1) has received below 75% of the funds required; (2) refused because the cost was too high; or (3) was rejected.
$Discouraged_{it}$	Binary variable taking value 1 if firm *i* in semester t decided not to apply for financing because of possible rejection.
$Perceived\_constr_{it}$	Binary variable taking value 1 if firm *i* reported that access to finance was an important problem in semester t.
$Higher\_interest_{it}$	Binary variable taking value 1 if firm *i* reported that in semester t its interest expenses have increased.
$Higher\_debt_{it}$	Binary variable taking value 1 if firm *i* reported that in semester t its debt has increased compared to assets.
$Higher\_needs_{it}$	Binary variable taking value 1 if firm *i* reported that in semester t its needs of external financing have increased.
$Refinancing_{it}$	Binary variable taking value 1 if firm *i* has used its financing in semester t to refinance or pay off obligations.
$Less\_available_{it}$	Binary variable taking value 1 if firm *i* considers that in semester t the availability of financing has deteriorated for it.
$Future\_constr_{it}$	Binary variable taking value 1 if firm *i* considers that in semester t+1 the availability of financing will deteriorate for it.
$Credit\_history_{it}$	Binary variable taking value 1 if firm *i*'s credit history has deteriorated in semester t.
$Willingness_{it}$	Binary variable taking value 1 if firm *i* considers that agents' willingness to finance it has deteriorated in semester t.

Equation 6.1 is estimated using three empirical approaches: (1) a panel data probit estimator in which the different financial constraint measures listed in Table 6.2 are instrumented by their lags; (2) a panel data probit with the covariate of actual financial constraint (*actual_constr*) instrumented by one of the other alternative measures of financial constraint; and (3) a panel data probit with random effects, capturing the separate effect of each of the eleven financial constraint measures. In approach (2), we also use as an instrument for the measure of financing constraint the variable *sector_constraint2*, accounting for the share of competitor firms actually constrained in firm *i*'s sector. All these estimations control for firm characteristics, such as industry, size, age and type of ownership, as well as wave fixed effects and whether the firm is owned or not by a foreign parent.

6.2 Descriptive Analysis

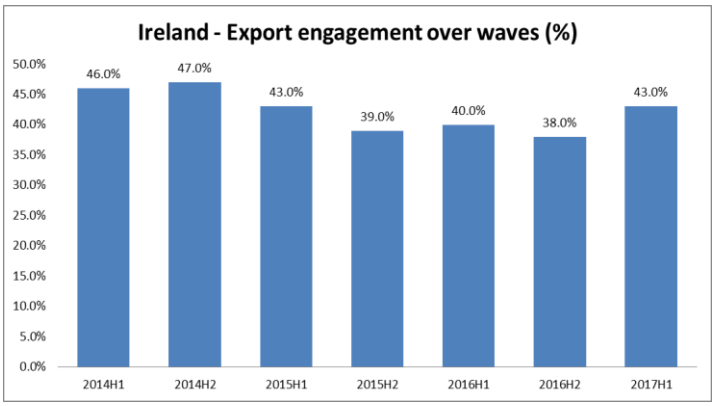
This section describes the most relevant outcome variables, as well as some of the main financing constraints measures, over time and according to the aforementioned firm features. This analysis considers the most recent available SAFE data, the first semester of 2017 (2017 H1). The analysed sample includes 3,512 firms located in Ireland.

6.2.1 Export engagement

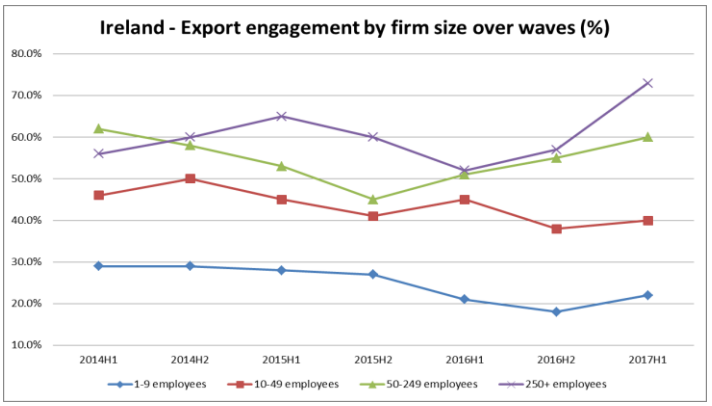
Figure 6.1 consists of a series of four graphs showing the evolution of firms' decision to engage in exporting over time, across firm size (number of employees), age and parent country. It can be observed in Figure 6.1(a) that there has been a slight decrease in the share of Irish firms engaging in export activity from 2014 to 2016, with a slight recovery in early 2017. While 46% of firms surveyed in early 2014 reported to have sold goods or services abroad, just 38% did it in late 2016, while the share in the first half of 2017 was 43%.

Figure 6.1

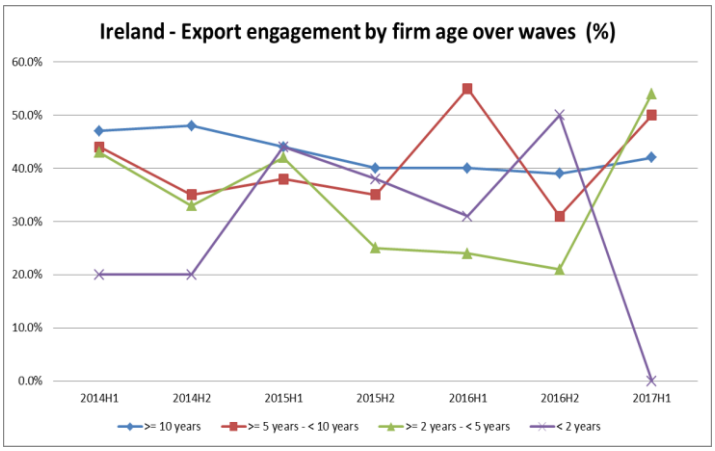
(a)



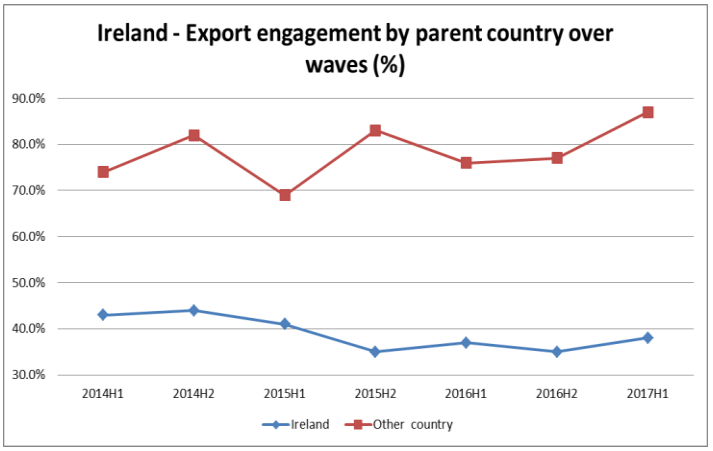
(b)



(c)



(d)



Source: Own elaboration based on data from the EC/ECB Survey on the Access to Finance of Enterprises (SAFE)

Figure 6.1(b) shows that the largest firms, with over 250 employees, tend to be more likely to engage into exporting. Indeed, 57% of large firms reported to have exported any good or service in the second half of 2016; whereas only 18% of micro enterprises engaged into that activity. The prevalence of large firms in the export activity is more evident in early 2017, as 73% of firms surveyed from that category reported to have exported, compared to only 22% of micro enterprises.

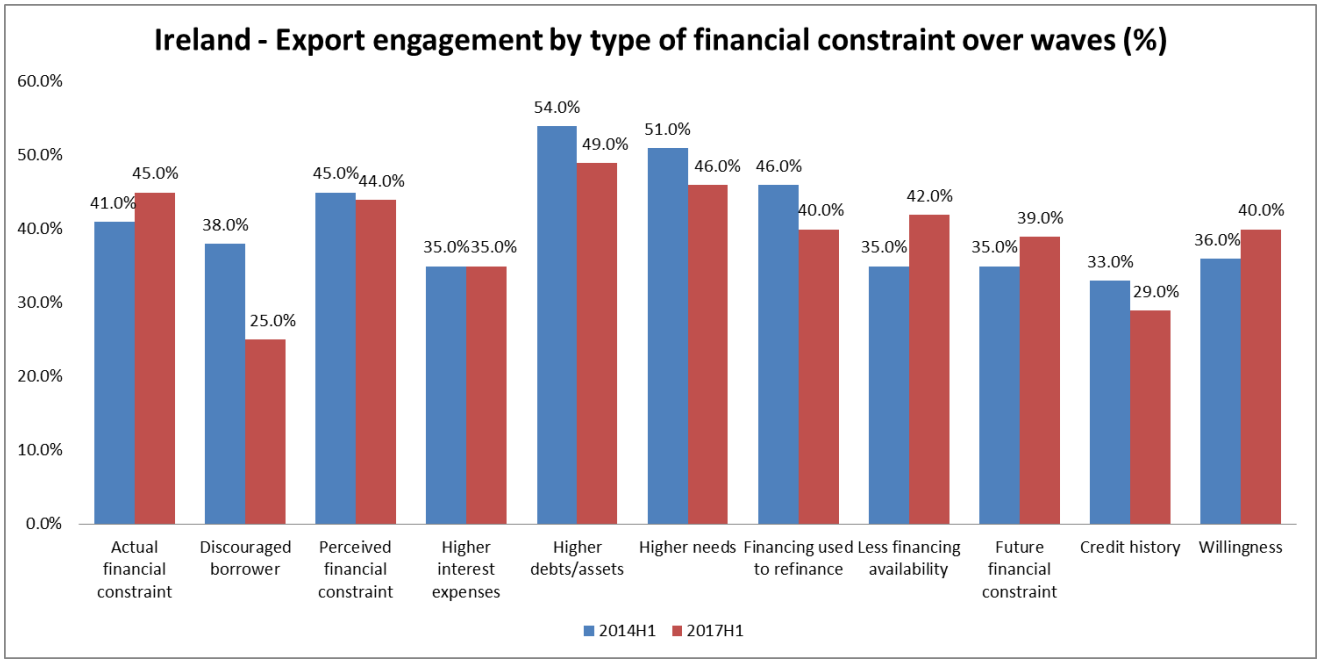
Mixed results are obtained when looking at firm age in Figure 6.1(c). Even though the oldest firms, with 10 years or more of life, tend to be the most likely to sell goods and services abroad, it is impressive to see a recent rise in export engagement by the youngest firms, below 2 years old. In

late 2016, 50% of the young enterprises surveyed reported to have participated in the foreign market. However, the volatility of the export decision by the youngest firms is evident, as in early 2017, none of the youngest firms surveyed sold any product abroad. Moreover, among firms in the second age group (between 2 and 5 years) 54% exported, turning that category into the most export intensive in late 2017.

The criterion in which the greatest differences between firms on their export engagement are identified is the firms' parent country, as shown in Figure 6.1(d). Here, we can observe that firms owned by a foreign parent are much more likely to export than Irish-owned firms. In 2017H1, the shares of exporting firms in each category are 87% and 38%, respectively.

We are also interested in investigating if there is a correlation between export engagement and access to finance across firms. Figure 6.2 shows the rates of export engagement across the eleven measures of financial constraint, only taking the first (2014H1) and last wave (2017H1) of the dataset. Two patterns can be identified. Firstly, the incidence of export engagement across types of financial constraint tends to be similar to the overall results shown in Figure 6.1(a). In fact, only for the higher debt and higher needs categories there is over 50% export likelihood in early 2014. Secondly, over time there is a downward trend of export engagement, since for most financial constraint types the probability to export has decreased. The exceptions to that trend are the firms with actual financial constraint, less financial availability, future financial constraint and agents' willingness to finance, in which the proportion of firms engaged in exporting has risen.

Figure 6.2



Source: Own elaboration based on data from the EC/ECB Survey on the Access to Finance of Enterprises (SAFE)

6.2.2 Access to Finance

The descriptive analysis made for the degree of export engagement is repeated for the most relevant, in our view, measures of financial constraints per firm: actual financial constraint (*actual_constr*) and the reported higher debts (*higher_debt*).

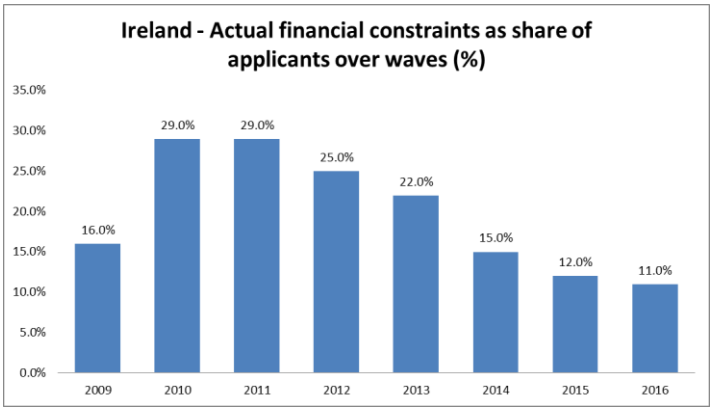
6.2.2.1 Actual Financial Constraint

For the first measure of interest, we restrict the analysis to small and micro enterprises (SMEs) reporting to have applied to financing. Given the data availability we examine the time period starting in with the first survey wave conducted in 2009. Figure 6.3 summarises the performance of SMEs for this financing constraint measure over time, according to the same categorisation utilised earlier.

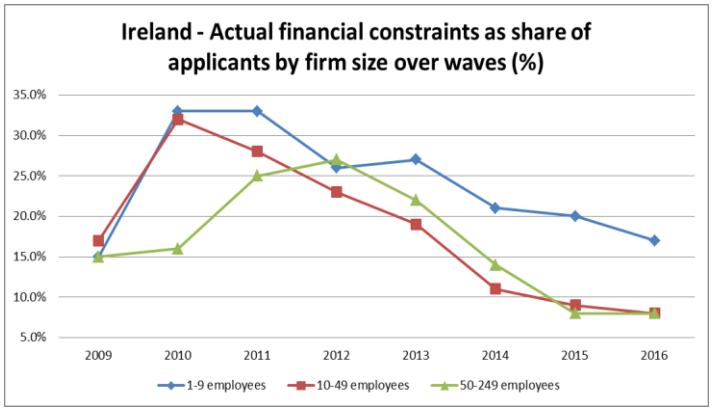
Figure 6.2(a) presents the overall statistics, where a clear rise of the degree of firm financial constraint is observed from 2009 to 2010, presumably as a consequence of the financial crisis in Ireland. Since 2011, the share of applicants facing actual financing constraints declined steadily from 299% to 11% in 2016.

Figure 6.3

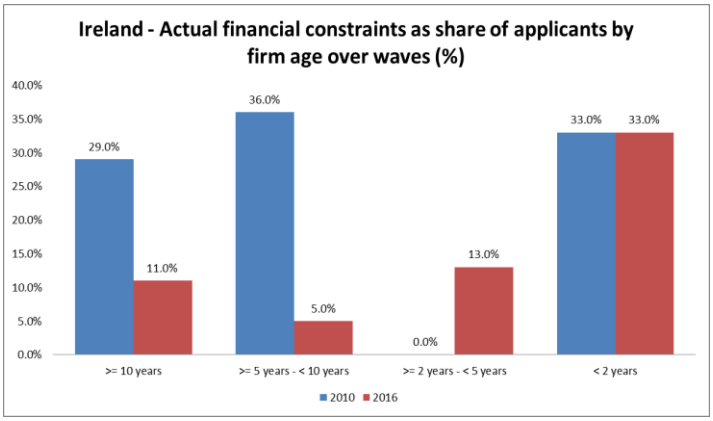
(a)



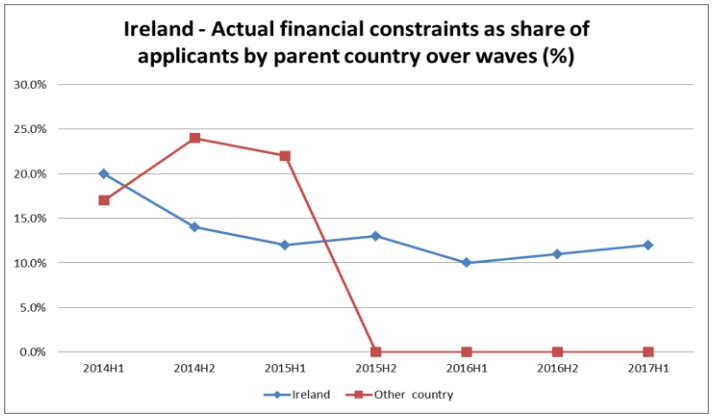
(b)



(c)



(d)



Source: Own elaboration based on data from the EC/ECB Survey on the Access to Finance of Enterprises (SAFE)

A similar pattern is observed across firm size in Figure 6.2(b). Indeed, the huge rise in financial constraints is more evident for the smallest firms, represented by the red and blue lines. A slight increase is observed one year later for medium-sized firms (green line). Then, the aforementioned sustained fall occurs for all types of firms until 2016. Even in that last year it is evident that micro enterprises which have applied for financing are the most financially constrained.

In order to illustrate the degree of access to finance across firm age in Figure 6.2(c) we take the first and last year of the span. Thus, a very evident pattern can be identified. Applicants with down to 5 years of existence have become more successful to get credit from 2009 to 2016. In fact, 5-10-year-old Irish firms, having a 36% rate of financial constraint in 2010, reported a sharp fall to 5% in 2016. In contrast, the youngest applicants have maintained a high degree of constraint over time (33%).

Finally, we examine the degree of access to finance for Irish-owned and foreign-owned firms in Figure 6.2(d). Like in the export engagement case, it is very straightforward to distinguish a pattern, in which foreign-owned firms are clearly less likely to report any financial constraint than the Irish-owned ones over time, especially in the last four waves of our sample, in which no foreign-owned firms report rejection of their application for external finance.

6.2.2.2 Higher Debts

We are particularly interested in the share of Irish firms reporting to have increased their debts with respect to their assets, as another proxy for financial constraints. The descriptive analysis presented in this subsection only considers the last seven waves of the SAFE survey, since the source question on debts over assets was first included in the survey in 2014.

The summary statistics of firms reporting higher debts are shown in Figure 6.4. The overall results in Figure 6.4(a) show quite a steady trend of this indicator, ranging from 19% in early 2014 to 15% in early 2017. It is worth noticing a considerable decline in the second semester of 2014 with just 13% of sampled firms reporting an increase in debts.

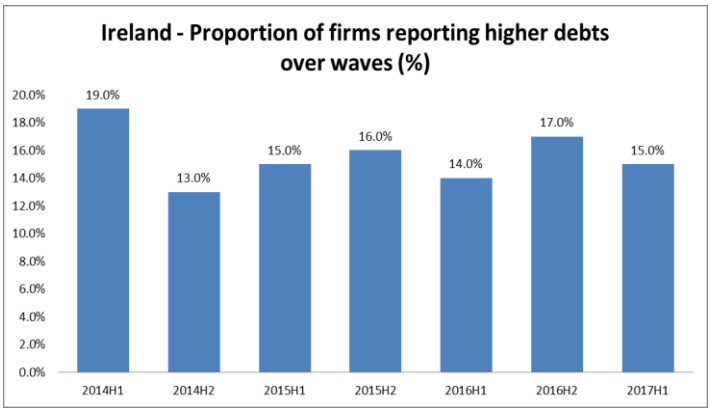
Although over time the share of firms reporting higher debts displays a volatile pattern when analysed by firm size, it can be distinguished in Figure 6.4(b) that the largest firms exhibit a positive tendency to raise their debts, especially in 2017H1, when 23% reported to have done so. As for the smallest firms, they used to have the largest frequency of higher indebtedness at the beginning of the sample; but, particularly in the case of micro enterprises, they show a huge drop in that degree, with only 9% reporting to have increased their debts over assets.

The statistics by firm age in Figure 6.4(c) reveal a substantial increase in the share of firms reporting higher debts among the youngest firms. It is impressive that in late 2016, nearly 70% of firms below 2 years old reported an increased degree of indebtedness, more than doubling the figure from the first semester of 2016. A large increase in that period is also evident for firms from the second youngest age group. It is true, though, that in early 2017, both age categories exhibit a drop in their figures; but the purple line for the youngest firms still gives the largest degree of higher indebtedness in that period. Much lower rates are obtained for the most experienced firms surveyed.

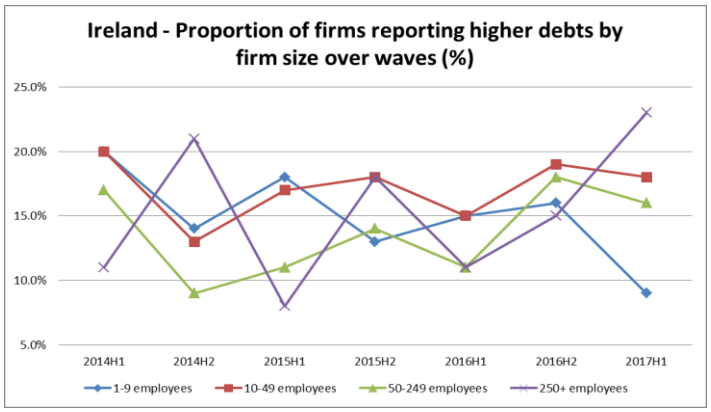
Finally, as observed in Figure 6.4(d), the degree of reported higher indebtedness is more volatile for foreign-owned firms than the indigenous ones. However, in early 2015 and late 2016, the proportion of firms with higher debts was the same for Irish-owned and foreign-owned firms.

Figure 6.4

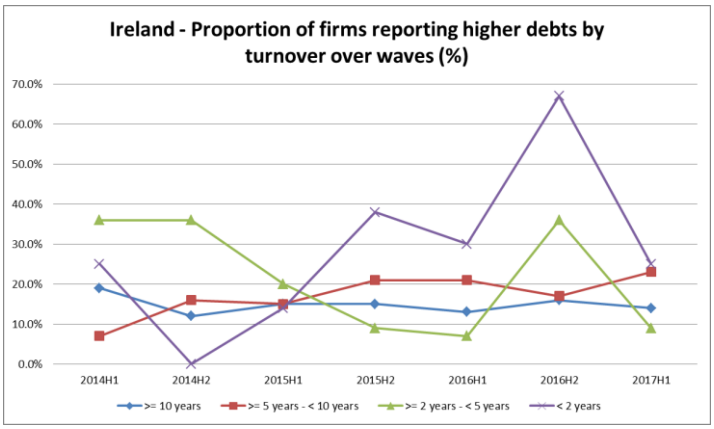
(a)



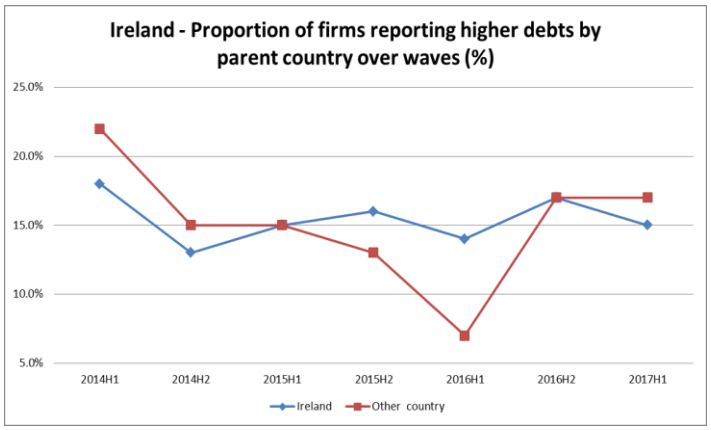
(b)



(c)



(d)



Source: Own elaboration based on data from the EC/ECB Survey on the Access to Finance of Enterprises (SAFE)

6.2.3 Investment

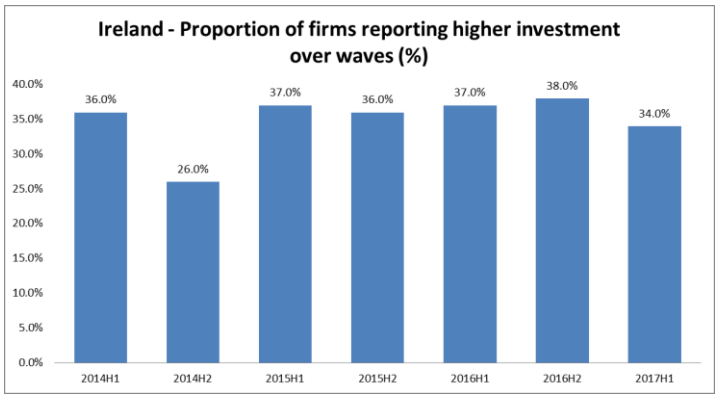
Another policy relevant issue in this section is whether financial constraints are correlated with Irish firms' degree of investment. In this descriptive analysis, we present how firms' decision to increase their investment has varied over time (our *higher_investment* binary variable). Figure 6.5 summarises the main findings for the last six semesters.

There has been a quite stable trend over time for the decision to raise investment, as shown in Figure 6.5(a). Indeed, while in early 2014, 36% of Irish firms sampled responded positively to the question, 34% did it in early 2017. It is evident however that a significant fall in that share occurred in late 2014. That outcome is reflected in the subsequent analyses in Figure 6.5.

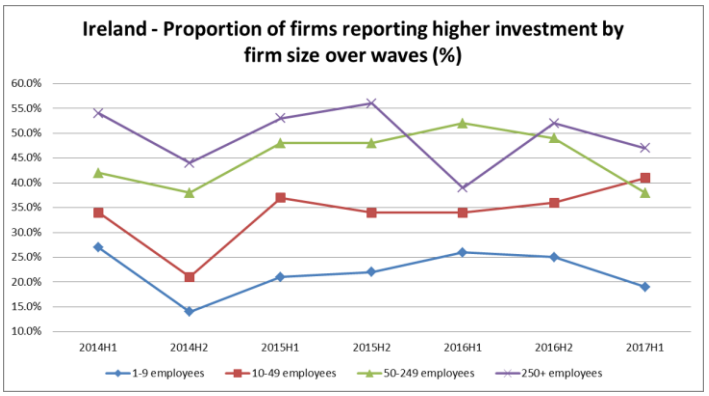
When comparing the decision to increase investment across firm size, we clearly obtain the largest figures for firms with more than 250 employees. More than 50% of the largest firms (purple line in Figure 6.5(b)) have reported they raised their degree of investment in most of the time span considered; whereas less than 30% of surveyed micro enterprises did so.

Figure 6.5

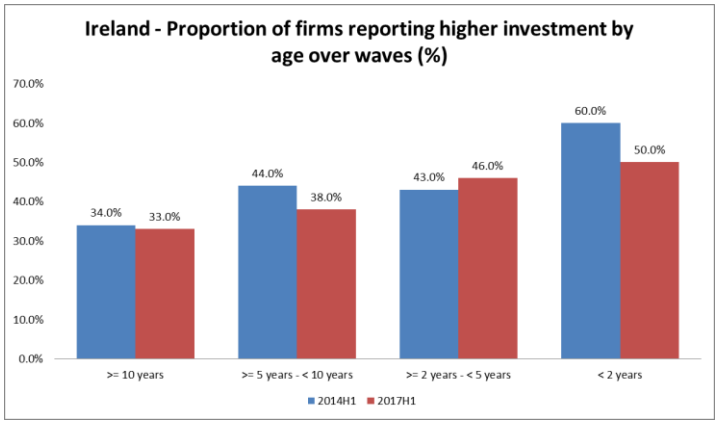
(a)



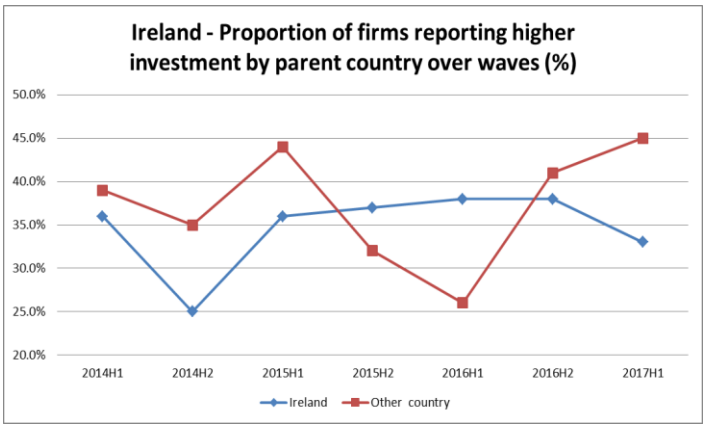
(b)



(c)



(d)



Source: Own elaboration based on data from the EC/ECB Survey on the Access to Finance of Enterprises (SAFE)

In Figure 6.5(c) we only show the results for the start and end of the time span in order to emphasise that the youngest firms are much more likely to raise their investment levels than more experienced firms. It is striking that in early 2014 over 60% of firms with less than 2 years of age have decided to invest in plants, property or equipment; while that is the case for slightly over 30% of over-10-year-old firms.

A less clear pattern is found in terms of parent country. Figure 6.5(d) shows that foreign-owned firms tend to be more prone to raise their investment degree than indigenous firms; but between late 2015 and early 2016, the former experienced a huge drop in the figures, whereas the latter maintained a slightly positive trend, which was reversed in the last period of the sample.

6.2.4 Innovation

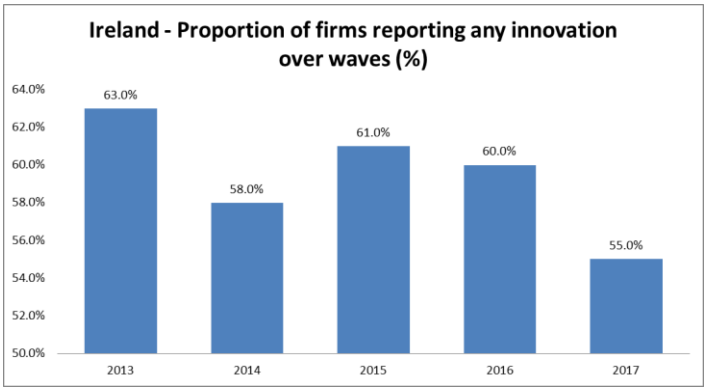
In this last section of the descriptive analysis, we work with the *innovation* binary variable, controlling for firms' decision to undertake any type of innovation (product, process, organisational or marketing). The source question of this variable is only available in the first survey of every year

since 2013. Hence, the graphs presented in Figure 6.6 encompass the 2013-2016 time period, on an annual basis.

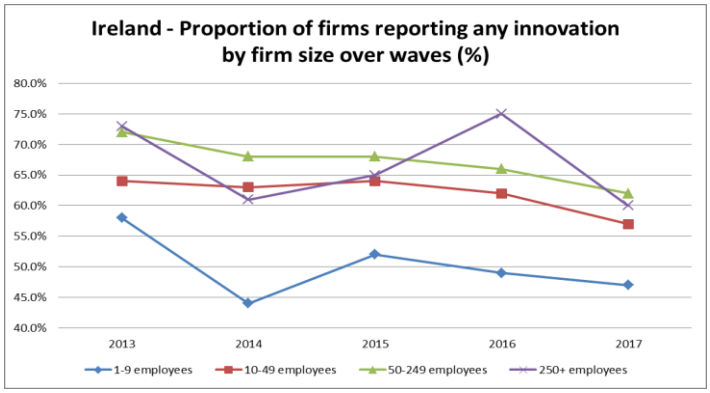
Even though the overall results in Figure 6.6(a) inform that, on average, around 60% of firms surveyed declared to have made at least one sort of innovation, it is interesting to see a fall in the innovation degree in 2014, decreasing from 63% to 58%. Moreover, in 2017 there is another fall, from 60% to 55%. In the next three graphs, the described outcome is confirmed.

Figure 6.6

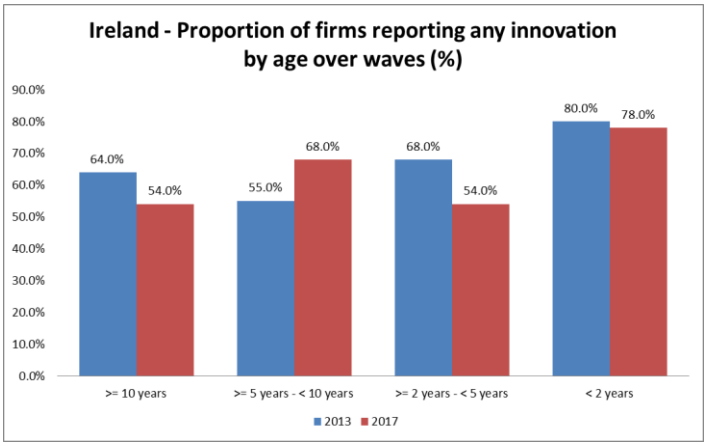
(a)



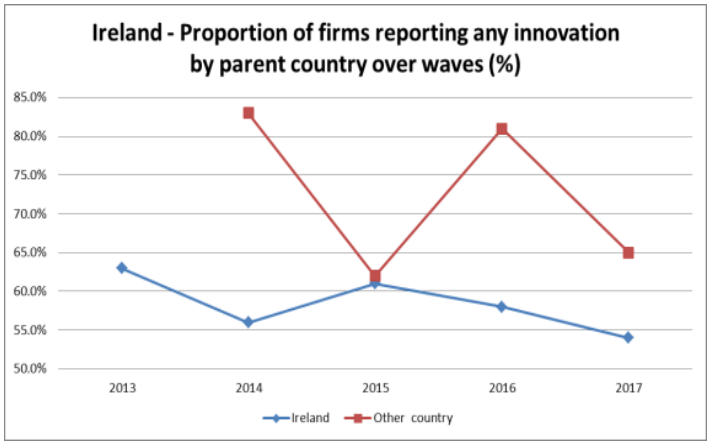
(b)



(c)



(d)



Source: Own elaboration based on data from the EC/ECB Survey on the Access to Finance of Enterprises (SAFE)

In Figure 6.6(b) on the analysis across firm size, we can notice that the drop observed in the decision to innovate in 2014 is particularly explained by micro enterprises and, to a lesser extent, the largest firms. It was the latter that, however, in 2017 most accounted for the fall in the likelihood to innovate. The intermediate firm size categories also exhibit a decreasing trend.

Over time, a huge volatility was observed in the degree of innovation across firm age. For that reason, Figure 6.6(c) only reports the first and last waves of the sample. There, it is clear that firms younger than 2 years present the largest probability to introduce any innovation. Nevertheless, most age categories show a fall in their figures over time, except the second oldest age group.

Finally, in Figure 6.6(d) we present the statistics by parent country. It is necessary to clarify that in 2013 all the firms surveyed reported to be indigenous. Indeed, in the subsequent years, the vast majority of firms are owned by an Irish agent or firm. But the minority comprising foreign-owned firms is the most likely to make any type of innovation. That pattern is particularly clear in 2014 and 2016, when over 80% firms owned by a foreign agent innovated, while slightly over 50% of indigenous firms made that decision.

6.3 Empirical Results

After analysing the behaviour of our main variables of interest over time, in this section we present the main findings from our econometric approaches to determine if restrictions for firms to have sufficient access to finance seriously affect their performance in aspects like export engagement, investment and innovation. Our preliminary expectation is a negative effect by financial constraints on Irish firms' performance. It is important to point out that for approaches (1) and (2) described earlier (probit estimations with instrumental variables) the observations are weighted, using the general weighting variable *wgtCommon* provided by the SAFE dataset, in order to make our empirical results more representative of the Irish industry.

6.3.1 Export Engagement

First, we investigate how firms' financial constraint may influence their decision to participate in the export activity in a particular period of time. Hence, the outcome variable in this exercise is *export_engage*, taking value 1 if firm *i* reported to have exported any good or service in semester *t*. Table 6.3 portrays the most relevant results from this process. Columns (1)-(4) correspond to approach (1), in which the covariate controlling for financial constraint is instrumented by up to its third lag, leading to a considerable loss of observations. Column (5) follows approach (2), in which the *actual_constr* regressor is instrumented by another financial constraint measure; in this case, *higher_debt*. Column (6) applies approach (3) with random effects. Some specifications also control for the lag of the dependent variable in order to assess a potential persistence effect.

Under approach (1) firm's export participation is negatively and significantly affected if it has accumulated higher debts (*higher_debt*) in the last six months. A firm is also less likely to export in semester *t* if its financing was used to pay back previous debts (*refinancing*). These results are robust to the inclusion of the lagged dependent variable.

Under approach (2), the only estimation giving the expected negative effect on export engagement is when we instrument the actual financial constraint variable (*actual_constr*) with *higher_debt*. However, in further estimations not reported in this document, its significance declines when adding more instruments, such as *sector_constraint2*, controlling for the share of firms actually constrained per sector, and especially the lag of the *actual_constr* regressor. In other results from approach (2), not reported here, the *actual_constr* variable obtains unexpected positive and significant coefficients when we instrument it with variables like *sector_constraint2*, *credit_history* and *willingness*. This may be interpreted as an intention by the firm to raise more revenues from exporting, given that it is more difficult for them to raise funds from credits.

Under approach (3), we can highlight that *higher_debt* is the only financial constraint measure that significantly prevents firms from engaging into the export activity, when controlling for the lag of export engagement. The other measures do not prove to be significant.

Table 6.3

Financial constraints and export status for Irish firms

Dependent Variable	export_engage					
Column	(1)	(2)	(3)	(4)	(5)	(6)
Estimation	IV Probit	IV Probit	IV Probit	IV Probit	IV Probit	RE Probit
higher_debt	-2.010**	-2.068**				-0.384**
	(1.008)	(0.986)				(0.190)
refinancing			-2.031***	-1.744**		
			(0.670)	(0.884)		
actual_constr					-4.246***	
					(0.900)	
L.export_engage		2.208***		2.218***	1.188**	2.168***
		(0.628)		(0.790)	(0.521)	(0.146)
L.higher_debt						0.135
						(0.194)
Instrument	L3.higher_debt	L3.higher_debt	L3.refinancing	L3.refinancing	higher_debt	
N	311	247	311	247	887	828
ll	-50.09	-20.75	-56.07	-25.76	-35.71	-300.3
chi2_exog	4.069	3.347	6.068	2.193	5.499	
p_exog	0.0437	0.0673	0.0138	0.139	0.0190	
rho						0.116
sigma_u						0.363
chi2						272.5

Robust standard errors adjusted for clusters in firms.
Columns (1)-(5): Observations weighted by the wgtCommon variable.
Estimations control for firm size, main activity, ownership type, age, parent country and wave fixed effects.
*Denotes statistical significance at the 10% level; **Denotes statistical significance at the 5% level; ***Denotes statistical significance at the 1% level.

Source: Own estimates based on data from the EC-ECB Survey on the Access to Finance of Enterprises (SAFE)

6.3.2 Export Entry

In the next stage of our econometric analysis, we go deeper into Irish firms' export dynamics: entry, permanence and exit from the export activity. As a proxy to the decision to start exporting, we consider the outcome variable *new_exporter*, taking value 1 if firm *i* exported in semester *t*, without exporting in *t-1*. Given the nature of this dependent variable, the specifications presented in Table 6.4 do not control for the lag of export engagement. Columns (1) and (2) present the main results from approach (1), instrumenting the financial constraint variable by its first lag. Columns (3) and (4) present results from approach (2), and the last three columns correspond to approach (3) with random effects.

Under approach (1), we obtain positive and significant coefficients for *higher_debt* and the variable controlling for firms' perception of future financial constraint (*future_constr*), implying that financial constraints, accounted for by these measures, boost firms to export for the first time or to re-enter the export activity. However, only in the case of *future_constr*, the Wald test statistic of exogeneity is significant, meaning that *future_constr* is well instrumented by its first three lags.

Under approach (2), we still get positive and significant coefficients, especially when *actual_constr* is instrumented by *higher_interest*. Nevertheless, the significance of the main covariate and the Wald test of exogeneity diminishes when adding further instruments, in particular the lag of *actual_constr*. We also obtain positive and significant values when using *willingness* or *credit_history* as instruments; but they do not prove to be appropriate instruments given the insignificant Wald test statistic.

Under approach (3), once again we obtain positive and significant coefficients for financial constraint measures like *actual_constr* and *refinancing*. However, when controlling for the lags of the financial constraint measures, we obtain a negative and significant figure for *higher_debt*, which is the only expected outcome achieved for export entry.

Table 6.4

Financial constraints and export entry for Irish firms

Dependent Variable	new_exporter						
Column	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Estimation	IV Probit	IV Probit	IV Probit	IV Probit	RE Probit	RE Probit	RE Probit
higher_debt	2.179**						-0.0689**
	(1.107)						(0.0349)
future_constr		1.719**					
		(0.679)					
actual_constr			4.519***	1.753**	0.0263**		
			(0.518)	(0.850)	(0.0125)		
refinancing						0.0162*	
						(0.00861)	
L.higher_debt							0.0168
							(0.0236)
Instrument	L.higher_debt	L.future_constr	higher_interest	willingness / L.actual_constr			
N	871	829	2497	863	2497	2509	871
ll	-114.5	-75.56	29.83	20.25	-336.4	-337.4	-180.5
chi2_exog	2.001	4.618	8.859	2.780			
p_exog	0.157	0.0316	0.00292	0.0955			
rho					0.0452	0.0496	0.271
sigma_u					0.218	0.229	0.609
chi2					42.18	31.53	19.94

Robust standard errors adjusted for clusters in firms.
Columns (1)-(4): Observations weighted by the wgtCommon variable.
Estimations control for firm size, main activity, ownership type, age, parent country and wave fixed effects.
*Denotes statistical significance at the 10% level; **Denotes statistical significance at the 5% level; ***Denotes statistical significance at the 1% level.

Source: Own estimates based on data from the EC-ECB Survey on the Access to Finance of Enterprises (SAFE)

6.3.3 Export Continuity

Now we illustrate the decision by Irish firms to keep exporting in the next period. For that purpose, our outcome variable *continuous_exporter* takes value 1 if firm *i* exported any good or service in semester *t* and *t-1*. Table 6.5 presents the most relevant findings. Columns (1)-(4) show results from approach (1), where the financial constraint measure is instrumented by its first lag. Column (5) presents one result from approach (2); while Columns (6)-(10) contain estimations from approach (3) with random effects. In some specifications, we control for the lag of the *new_exporter* dummy to evaluate if there is a persistence effect.

Under approach (1), we do not get any significant result for the several variables controlling for financial constraint. We can report, however, that most of them give negative coefficients, as expected. Moreover, in preliminary estimations not reported in this document, using only firm characteristics as instruments, we do obtain negative and significant values for most financial constraint measures, except for the *higher_needs* variable, always giving positive and significant coefficients. This might make sense, since a firm reporting that its external financing needs have increased in the last six months may be encouraged to keep on exporting to raise larger revenues, and compensate for a potential lack of funding.

Under approach (2), we get the expected negative effect on export continuity in Column (5) when *actual_constr* is instrumented by *higher_interest*. As in the export entry estimation, such significance vanishes when including the lag of *actual_constr* as instrument, not reported herein.

Under approach (3) with random effects, we obtain diverse results depending on the financial constraint covariate. The expected negative effect is achieved for measures like *actual_constr*, the perceived financial constraint (*perceived_constr*), *higher_interest* and *refinancing*. Surprisingly, we get positive and significant figures for *higher_debt*, especially when controlling for its first lag and the lag of *new_exporter*. The intuition behind this outcome may be similar to the one explained earlier for the positive coefficient of *higher_needs* in approach (1).

Table 6.5

Financial constraints and export continuity for Irish firms

Dependent Variable	continuous_exporter									
Column	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Estimation	IV Probit	IV Probit	IV Probit	IV Probit	IV Probit	RE Probit	RE Probit	RE Probit	RE Probit	RE Probit
higher_debt	-0.405	-0.387							0.0623**	
	(2.145)	(2.119)							(0.0242)	
higher_interest			-1.119	-1.106						
			(0.806)	(0.783)						
actual_constr					-4.805***	-0.151*				-0.170*
					(0.554)	(0.0795)				(0.0950)
perceived_constr							-0.0279**			
							(0.0135)			
refinancing								-0.0401**		
								(0.0198)		
L.new_exporter		0.0409		-0.0718	-0.0643	0.208***				
		(0.322)		(0.356)	(0.148)	(0.0654)				
L.higher_debt									0.0462*	
									(0.0246)	
L.actual_constr										0.0649
										(0.0404)
Instrument	L.higher_debt	L.higher_debt	L.higher_interest	L.higher_interest	higher_interest					
N	891	891	891	891	887	887	2509	2509	891	883
ll	-214.9	-214.8	-246.3	-245.9	-90.22	-366.3	-972.8	-972.7	-368.3	-363.8
chi2_exog	0.0139	0.0123	0.621	0.641	7.670					
p_exog	0.906	0.912	0.431	0.423	0.00561					
rho						0.974	0.809	0.815	0.973	0.976
sigma_u						6.127	2.061	2.101	6.043	6.429
chi2						51.68	75.97	69.31	54.47	43.42

Robust standard errors adjusted for clusters in firms.

Columns (1)-(5): Observations weighted by the wgtCommon variable.

Estimations control for firm size, main activity, ownership type, age, parent country and wave fixed effects.

*Denotes statistical significance at the 10% level; **Denotes statistical significance at the 5% level; ***Denotes statistical significance at the 1% level.

Source: Own estimates based on data from the EC-ECB Survey on the Access to Finance of Enterprises (SAFE)

6.3.4 Export Exit

In this last stage of the analysis of export dynamics, we aim to find any relation between Irish firms' access to finance and their decision to abandon the export activity in a particular period. Hence, the dependent variable utilised, *export_exiter*, takes value 1 if the firm did not export in semester *t*, after having done so in *t-1*. Unlike the previous models, our expectation is to get positive coefficients for the financial constraint controllers, as a sign of hampering firms' export engagement. Table 6.6 portrays the most relevant results, some of them including the lag of *new_exporter* to control for persistence. Columns (1)-(3) correspond to approach (1), with the financial constraint measure instrumented by their first lag. Columns (4) and (5) give results from approach (2), while Columns (6)-(10) provide estimations from approach (3) with random effects.

Under approach (1), when not controlling for the lag of *new_exporter*, we obtain the expected positive and significant coefficients for *higher_interest* and *refinancing*, even though the Wald test for exogeneity is slightly insignificant in both cases. When adding the lag of *new_exporter* into the main regression, the reported significance of those covariates vanishes. Moreover, the addition of that lag leads to an interesting negative and significant coefficient for *perceived_constr*, with a very significant Wald test. In other words, a firm perceiving to be financially constrained is associated to its decision to remain exporting in *t*.

Under approach (2), when instrumenting *actual_constr* with other financial constraint measures we do not obtain any significant result. As for the sign, most of the specifications provide a negative coefficient for *actual_constr* in the main regression.

Under approach (3) with random effects, we get very interesting results depending on the covariates included and excluded. When not controlling for any lags, the dummy for discouraged borrowers (*discouraged*) and *refinancing* get the expected positive and significant effect, leading firms to stop exporting in *t*. When adding the lag of the financial constraint covariates, we still get the same outcome for *refinancing*. For *perceived_constr*, we interestingly get a positive and significant value for the level, but a negative and significant one for the lag. Finally, when adding the lag of *new_exporter*, all the reported significances get lost.

Table 6.6

Financial constraints and export exit for Irish firms

Dependent Variable	export_exiter									
Column	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Estimation	IV Probit	IV Probit	IV Probit	IV Probit	IV Probit	RE Probit	RE Probit	RE Probit	RE Probit	RE Probit
higher_interest	1.469*									
	(0.794)									
refinancing		1.524**				0.0234**		0.0481*		
		(0.671)				(0.0101)		(0.0248)		
perceived_constr			-0.602**						0.0411**	0.0333
			(0.291)						(0.0201)	(6.705)
actual_constr				-1.116	-0.906					
				(1.098)	(1.071)					
discouraged							0.0281**			
							(0.0112)			
L.new_exporter			1.912***	1.851***	1.873***					1.835***
			(0.301)	(0.301)	(0.295)					(0.372)
L.refinancing								0.0286		
								(0.0248)		
L.perceived_constr									-0.0445**	-0.0414
									(0.0203)	(8.394)
Instrument	L.higher_interest	L.refinancing	L.perceived_constr	higher_interest / L.actual_constr	higher_debt / L.actual_constr					
N	891	891	891	883	883	2509	2365	891	891	891
ll	-168.1	-132.7	-199.6	6.068	6.818	-406.5	-373.0	-231.3	-231.6	-207.5
chi2_exog	1.743	2.015	7.041	1.527	1.228					
p_exog	0.187	0.156	0.00797	0.217	0.268					
rho						0.0529	0.128	0.250	0.295	0.0000343
sigma_u						0.236	0.382	0.577	0.646	0.00586
chi2						16.81	20.35	22.10	19.77	31.95

Robust standard errors adjusted for clusters in firms.

Columns (1)-(5): Observations weighted by the wgtCommon variable.

Estimations control for firm size, main activity, ownership type, age, parent country and wave fixed effects.

*Denotes statistical significance at the 10% level; **Denotes statistical significance at the 5% level; ***Denotes statistical significance at the 1% level.

Source: Own estimates based on data from the EC-ECB Survey on the Access to Finance of Enterprises (SAFE)

6.3.5 Investment

For the following exercises on investment and innovation, we opted for focusing on approaches (2) and (3), since the first stage regressions of the IV Probit estimations prove that factors like accumulating higher interests, debts or a deteriorated credit history significantly explain firms' actual impossibility to get sufficient financing. Moreover, estimations from approach (1) tend to be redundant with results from approach (3) with random effects.

In this section we investigate the relation between Irish firms' difficulties to access to finance and their decision to increase their investment in plants, property and equipment. For that purpose, our dependent variable *higher_investment* represents that decision in semester *t*. Our initial expectation is to obtain negative coefficients for the financial constraint covariates. Table 6.7 presents the most relevant results, some of which control for the lag of the dependent variable to evaluate a persistence effect. Columns (1)-(4) correspond to approach (2), with *actual_constr* instrumented by other financial constraint measures; whereas Columns (5)-(10) account for approach (3) with random effects.

We find varied and interesting results under approach (2). The expected negative and significant effect on investment is observed when *actual_constr* is instrumented by *higher_interest* and, to a lesser extent, by *credit_history*. Both results lose significance when including further instruments like *sector_constraint2* and the lag of *actual_constr*.

On the other hand, we obtain a positive and significant effect when the instrument is *higher_needs*. Moreover, according to the Wald test of exogeneity, this covariate is found to be the best instrument. We can interpret this as, if a firm perceives its external financing needs have increased, it may be encouraged to increase its investment levels, so that in the future it would be more capable of paying back that further financing. Again, that significance vanishes when adding the lag of *actual_constr*.

Under approach (3), we confirm the positive and significant effect of *higher_needs* on the decision to increase investment by Irish firms. When using *higher_debt* instead, we surprisingly get a positive and significant effect; but that significance is lost when including the lag of the dependent variable. We obtain a negative and significant effect when the covariate is *perceived_constr*, with a slight loss of significance when adding the lag of *higher_investment*.

Table 6.7

Financial constraints and investment for Irish firms

Dependent Variable	higher_investment									
Column	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Estimation	IV Probit	IV Probit	IV Probit	IV Probit	RE Probit	RE Probit	RE Probit	RE Probit	RE Probit	RE Probit
actual_constr	-4.545***	-3.972***	-0.323	3.689***						
	(0.796)	(1.418)	(1.025)	(0.907)						
higher_needs					0.393***	0.363***				
					(0.062)	(0.108)				
higher_debt							0.252***	0.114		
							(0.086)	(0.174)		
perceived_constr									-0.131**	-0.145
									(0.065)	(0.112)
L.higher_investment	0.291	0.445	0.815***	0.613***		0.754***		0.815***		0.802***
	(0.223)	(0.301)	(0.153)	(0.177)		(0.118)		(0.118)		(0.119)
Instrument	higher_interest	higher_interest / sector_constraint2	credit_history / sector_constraint2 / L.actual_constr	higher_needs / sector_constraint2						
N	887	887	883	848	2832	849	3009	891	3009	891
ll	-78.84	-78.49	-67.35	-77.54	-1622.21	-431.99	-1727.5	-456.16	-1729.77	-455.57
chi2_exog	5.663	2.709	0.353	7.118						
p_exog	0.0173	0.0998	0.553	0.00763						
rho					0.3203	0.133	0.338	0.149	0.3405	0.159
sigma_u					0.686	0.391	0.716	0.418	0.718	0.435
chi2					178.16	127.93	171.03	130.87	165.56	128.56

Robust standard errors adjusted for clusters in firms.

Columns (1)-(4): Observations weighted by the wgtCommon variable.

Estimations control for firm size, main activity, ownership type, age, parent country and wave fixed effects.

*Denotes statistical significance at the 10% level; **Denotes statistical significance at the 5% level; ***Denotes statistical significance at the 1% level.

Source: Own estimates based on data from the EC-ECB Survey on the Access to Finance of Enterprises (SAFE)

6.3.6 Innovation

As mentioned in the descriptive analysis, for the research on access to finance and innovation, we only count on the odd waves of the SAFE dataset, dating back to 2013. Hence, for the following estimations we employ an annual panel covering the 2013-2016 time span. These odd waves contain questions on specific types of innovation that we can exploit to distinguish the relation between financial constraints and each of these innovation modes.

In that sense, as previously explained in Table 6.1, we created five dependent variables accounting for innovation. The first one, *innovation*, takes value 1 if the firm reported to have undertaken at least one type of innovation. The other four control for each particular sort of innovation: product (*product_innov*), process (*process_innov*), organisational (*organ_innov*) and marketing innovation (*market_innov*). Table 6.8 summarises the main outcome from this exercise. Columns (1)-(4) show the results for the overall innovation dependent variable; Columns (5)-(8) focus on product innovation; Columns (9)-(12) correspond to process innovation; Columns (13) and (14) show two estimations for organisational innovation; and the last two columns, for marketing innovation.

When analysing the effect of financial constraint on overall innovation, we get a positive and significant effect when *actual_constr* is instrumented by *higher_needs*. That significance is lost when adding further instruments. The regressions run under approach (3) with random effects confirm the result for *higher_needs*, but the effect loses significance when controlling for the lag of innovation. We also ran an additional estimation using *perceived_constr* instead, achieving again a positive and significant value, losing relevance when adding the lag of the dependent variable.

As for product innovation, we obtain again a positive and significant effect with *higher_needs* as an instrument for *actual_constr*; but a negative and significant coefficient when the instrument is willingness. Given the definition of both covariates, these results appear to make sense. We should have in mind, however, that only in the case of *higher_needs*, the Wald test of exogeneity gives a significant result. The probit estimations with random effects confirm the outcome for *higher_needs*, but the significance is lost when adding the lag of the dependent variable. We did separate random effects estimations for willingness and *perceived_constr*, both giving positive and significant values vanished when adding the lag of *product_innov*.

When looking at the estimates for process innovation, we obtain the expected negative and significant values when *actual_constr* is instrumented by either *higher_interest* or *higher_debt*, although the former does not prove to be a significant instrument, according to the Wald test statistic. These results lose significance when the lag of *actual_constr* is added as an instrument. The approach (3) estimations only confirm the described effect for *higher_debt*. Furthermore, the random effects regressions show a positive and significant effect for *higher_needs* and *perceived_constr*; but, as usual, when adding the lag of the dependent variable, that significance fades away.

For organisational innovation, the only significant result from approach (2) is given by *higher_interest*, making *actual_*constr positive but only significant at 10%. Moreover, those estimations do not pass the Wald test of exogeneity. We ran some approach (3) regressions for *higher_interest*, but no significant results are obtained. When using the *perceived_constr* dummy in approach (3), we get a positive and significant effect for it, but not significant when adding the lag of *organ_innov*.

Table 6.8

Financial constraints and innovation for Irish firms

Dependent Variable	innovation				product_innov				process_innov				organ_innov		market_innov	
Column	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Estimation	IV Probit	IV Probit	RE Probit	RE Probit	IV Probit	IV Probit	RE Probit	RE Probit	IV Probit	IV Probit	RE Probit	RE Probit	IV Probit	RE Probit	IV Probit	RE Probit
actual_constr	1.748**	0.613			1.818***	-1.116**			-2.662***	-1.850**			2.237*		0.887	
	(0.882)	(0.415)			(0.681)	(0.531)			(0.597)	(0.741)			(1.232)		(0.618)	
higher_needs			0.471***				0.385***									
			(0.093)				(0.092)									
perceived_constr				0.008							0.123			0.342***		0.318***
				(0.140)							(0.264)			(0.087)		(0.082)
willingness								-0.182								
								(0.953)								
higher_debt												-0.382*				
												(0.205)				
L.innovation	0.687	1.115***		1.155***												
	(0.451)	(0.210)		(0.427)												
L.product_innov					0.508	1.239***		1.000								
					(0.352)	(0.163)		(0.685)								
L.process_innov									0.460	0.702***	0.737***	0.845***				
									(0.286)	(0.214)	(0.266)	(0.181)				
L.organ_innov													0.537			
													(0.405)			
L.market_innov															0.691***	
															(0.224)	
Instrument	higher_needs	higher_needs / L.actual_constr			higher_needs	willingness			higher_interest	higher_debt			higher_interest		less_available	
N	400	399	1916	439	409	436	1916	439	436	436	439	439	436	2006	408	2006
ll	-87.32	-70.28	-1177.95	-240.26	-88.80	-87.89	-1148.14	-242.05	-84.54	-82.58	-189.45	-185.19	-95.65	-1110.44	-87.31	-1196.76
chi2_exog	2.631	3.400			4.571	1.414			2.519	2.278			0.958		1.463	
p_exog	0.105	0.0652			0.0325	0.234			0.112	0.131			0.328		0.227	
rho			0.565	0.00001			0.533	3.00E-06			0.598	0.147		0.437		0.405
sigma_u			1.141	0.00358			1.067	0.0017			1.221	0.415		0.881		0.825
chi2			69.72	76.89			68.28	57.71			21.5	48.12		78.98		56.63

Robust standard errors adjusted for clusters in firms.

Columns (1)-(4): Observations weighted by the wgtCommon variable.

Estimations control for firm size, main activity, ownership type, age, parent country and wave fixed effects.

*Denotes statistical significance at the 10% level; **Denotes statistical significance at the 5% level; ***Denotes statistical significance at the 1% level.

Source: Own estimates based on data from the EC-ECB Survey on the Access to Finance of Enterprises (SAFE)

Finally, when evaluating the effects on marketing innovation, we do not get any significant result under approach (2). We additionally tried approach (3) for *perceived_constr*, which is found to be positive and significant when we do not include the lag of the dependent variable, *market_innov*.

These empirical results provide interesting insights on the effect of insufficient access to finance on firms' decisions in different activity areas. Given the data availability from SAFE for more European countries, the analysis could be extended to the European level. Additionally, subject to data availability, it would be interesting to evaluate the effect of financial constraints on firms' growth performance with respect to export and investment.

7 Summary and Policy Implications

This study examine the performance of indigenous and foreign-owned firms operating in Ireland over the period based a range of micro data available for the period from 2008 until 2014 (the most recent available data). The empirical evidence covers the following policy relevant areas:

- Employment and productivity performance including aggregate, sectoral and regional patterns;
- Investment in R&D, innovation and its effects on productivity;
- Trade performance and spillovers from foreign-owned firms on the trade performance of indigenous firms;
- SMEs' access to finance and how financing constraints impact on their export, investment and innovation performance

The key findings of this comparative analysis are summarised below.

Ireland is one of the most globalised economies in the world with a large share of foreign-owned firms. Among all EU countries, Ireland stands out with respect to the contribution of affiliates of multinational firms to economic performance and competitiveness including value-added, productivity and high-tech exports. Ireland's attractiveness to foreign direct investment (FDI) is linked to a range of factors including membership of the European Single Market Area, skilled and flexible labour force, business-friendly environment, competitive statutory and effective tax rates.

Foreign-owned firms are concentrated in high-productivity sectors including manufacture of computers, electronic and optical products; pharmaceuticals; chemicals; telecommunications; office support and other business support activities and computer programming, consultancy and related services. Breaking down the foreign-owned firms in EU-owned and non-EU owned affiliates, while in terms of the number of firms the two groups of foreign affiliates account for similar proportions, the non-EU owned affiliates account for larger shares in employment, as well as gross output and gross value added. *A key feature of the foreign-owned firms is their significantly larger scale* relative to the size of Irish-owned firms.

In terms of regional patterns, *foreign-owned firms are concentrated geographically* around Dublin and other major cities including Limerick, Cork and Sligo. The analysis also shows that EU-owned affiliates appear to be concentrated around Dublin, while affiliates owned by parent companies with headquarters in non-EU countries are more spread geographically with higher employment concentrations around Sligo, Limerick and Cork.

The productivity gap between foreign-owned firms and Irish-owned firms has increased over time and is larger in services in comparison to manufacturing. The analysis of productivity distributions indicates that most of the *productivity differentials between Irish-owned and foreign-owned firms are concentrated in the distributions tails*, while the central parts of the distributions are rather similar for the two groups of firms and appear to be stable over time. Regardless ownership, *productivity growth has been concentrated in the top percentile of firms* while the productivity performance of the rest of the first has been lagging behind. This pattern of productivity divergence

is present in both manufacturing and services for Irish-owned and non-EU owned affiliates, and for EU-owned affiliates in manufacturing. In contrast, productivity growth in EU-owned affiliates in services appears to be on a convergence path.

The estimated foreign-ownership *premia* controlling for unobserved industry, region and time specific effects indicate *significant differentials in the performance of the two groups of firms*. Relative to Irish-owned firms, foreign-owned firms are more productive, pay higher wages, invest more in tangible and intangible assets. On average, relative to Irish-owned firms, foreign-owned firms export a larger proportion of their output and import more relative to their output.

Overall, a larger proportion of foreign-owned firms invest in innovation in comparison to Irish-owned firms. However, it is worth noticing that the performance of Irish-owned firms in this respect has improved in recent years. A similar patterns is found for the propensity of firms to introduce innovation outputs, again with Irish-owned firms' performance improving while the share of foreign-owned firms with innovation outputs remaining unchanged.

In terms of investment in innovation and its impact on innovation outputs and productivity, the results of *this analysis uncover both similarities and differences in the behaviour and performance of Irish-owned and foreign-owned firms*. For both Irish-owned and foreign-owned firms, the propensity to invest in R&D appears to be higher for larger firms, firms operating in international markets, and firms with higher investment in fixed tangible assets in the previous year (a proxy for collateral). Irish-owned firms which received operating subsidies are more likely to invest in R&D while competition in the Irish market increases the foreign-owned firms' propensity to invest in R&D. Further, younger Irish-owned firms are more likely to invest in R&D.

Conditional on investing in R&D, *the intensity of R&D investment is driven by different factors in Irish-owned and foreign-owned firms*. In Irish-owned firms R&D intensity is positively linked to the amount of operating subsidies received in the previous year, as well as the skills intensity, and competition. In contrast, in foreign-owned firms, higher competition in the Irish market is associated with a lower R&D intensity. The propensity to invest in non-R&D assets in both Irish-owned and foreign-owned is positively associated with firm size and higher collateral, with the effect of the latter factor being larger for Irish-owned firms. The propensity to invest in non-R&D assets is positively associated with exporting in Irish-owned firms and with past operating subsidies in foreign-owned firms. In both Irish-owned and foreign-owned firms, the intensity of investment in non-R&D assets is negatively linked with competition in the Irish market.

Higher R&D intensity is positively associated with the propensity of Irish-owned firms to introduce product innovations, while foreign-owned with a high R&D intensity appear less likely to introduce product innovations. Investing in non-R&D assets is a significant determinant for the probability of introducing marketing innovations in foreign owned firms. The probability to introduce innovations in both Irish-owned and foreign-owned firms is positively associated with firm size and engagement in co-operation for innovation. In addition, the propensity of Irish owned firms to introduce innovations is positively associated with their export intensity and past investment in tangible fixed assets. With the exception of marketing innovations, younger Irish-owned firms are more likely to introduce innovations.

Over and above other factors, all four types of innovations are linked to productivity gains in Irish-owned firms. The largest productivity elasticity is for marketing innovations (0.21) and the lowest for process innovations (0.18). In foreign-owned firms, only process and organisational innovations are positively and significantly linked to productivity with the largest productivity gains in the case of organisational innovations (0.42).

Foreign-owned firms export and import a significantly large number of products in comparison to Irish-owned firms, 2 to 3 times more in recent years. Foreign-owned firms export to a larger number of destinations and import from more countries both EEA and extra-EEA countries. The analysis also shows that foreign-owned firms are integrated in more complex production and trade networks with a higher number of product - country combinations per firm. An interesting feature is the more important integration of foreign-owned firms in extra-EEA trade while Irish-owned firms tend to trade predominantly with EEA countries (mainly the UK). In terms of trade volumes, on average foreign-owned firms trade volumes 5 to 10 times larger than Irish-owned firms. The average value of exports per firm is larger than the imports per firm for both Irish-owned and foreign-owned firms. In terms of destinations/origins, the average value of exports and imports per firm-product are larger in with other EEA countries in comparison to extra-EEA countries.

Irish-owned firms benefit to some extent from spillovers from foreign direct investment (FDI) mainly via supply chain linkages. There is also evidence suggesting that foreign-owned affiliates crowd-out the trade performance of Irish-owned firms. Spillovers vary depending on the type of spillover (*intra-industry*, *intra-region*, via *supply chain linkages*), the origin of FDI (*EU* vs. *non-EU based*), *the type of trade performance measure* (export/import intensity; number of products exported/imported; number of export destinations/import origins; number of products exported-export destinations; number of imported products-import origins).

The evidence indicates only very limited intra-industry and intra-region FDI spillovers. It appears that Irish-owned firms benefit in terms of their export intensity from the presence in the same industry of affiliates of multinationals based outside the EU. However, the presence of multinationals crowd-out the export performance of Irish-owned firms within the same region. While the presence in the same region of affiliates of multinationals based in other EU countries affect negatively the export performance of Irish-owned firms in manufacturing, the presence of affiliates of non-EU multinationals have a negative effect of the export performance of Irish-owned firms in services.

Irish-owned firms benefit in terms of diversification of their merchandise exports from supplies by affiliates owned by EU multinationals. In contrast, supplies by affiliates owned by non-EU multinationals have the opposite effect on the export diversification of indigenous firms. Irish-owned firms benefit from supplying affiliates of EU based multinationals in terms of the diversification of export markets and product-export market combinations. In contrast, supply linkages with affiliates of non-EU multinationals are associated with a lower number of products exported.

The evidence indicates a *continuing decline of the share of firms facing actual financing constraints* from 29% of applicants in 2011 (the highest share over the analysed period), to 11% in 2016. While

also declining, *the share of firms facing actual financing constraints is the largest for micro firms (17%), youngest (33%) and for indigenous firms (12%).*

The proportion of firms with higher debts relative to the previous period was lower in the first semester of 2017, 15%, compared to 19% in early 2014. While the share of SMEs reporting higher debts has declined, particularly for micro firms (9% in 2017H1 compared to 20% in 2014H1), the share of large firms reporting higher debts has increased from 11% in the first half of 2014 to 23% in the first semester of 2017.

The proportion of firms reporting higher investment has decreased from 38% (the highest rate over the analysed period) to 34% in the first semester of 2017. Over the analysed period, the proportion of firms reporting higher investment has increased for small firms from 38% to 38%, while all it has decreased for the other size groups, particularly for micro firms from 27 % in the first semester of 2014 to 19% in the first semester of 2017.

The empirical results indicate that financing constraints are negatively associated with the SMEs export, investment and innovation performance. The empirical evidence indicates that export engagement and export entry are less likely for firms accumulating higher debts over assets. Further, continuous exporting is less likely if firms face higher interest expenses. The evidence also indicates that higher investment is less likely for firms facing higher interest *expenses* or with a deteriorated credit history. Process innovation is less likely if firms accumulate higher debts over assets while product innovation appears to be associated with higher financial needs by firms.

The evidence provided in this study suggests a number of policy implications to be considered in the context of the European Semester.

Fostering the diffusion of productivity gains from top performers to the rest of firms could be beneficial for aggregate productivity.

Enabling production linkages between indigenous and foreign-owned firms could be beneficial for expanding and diversifying exports and imports. Enhancing the absorptive capacity of indigenous firms is key in order to ensure they can internalise the positive externalities from advanced knowledge and technologies.

Improving access to finance particularly for small and young indigenous firms could enhance investment, exporting, and innovation.

8 Further Proposed Research

This study has uncovered a number of similarities and differentials with respect to the behaviour and performance of Irish-owned and foreign-owned firms operating in Ireland. To provide further evidence which could be useful in the context of the European Semester we propose to deepen the empirical analysis in the following directions:

The impact of investment in R&D and other innovation expenditures on the exporting performance of Irish- and foreign-owned firms. In particular, this research would identify the extent to which product and export destination portfolios are adjusted as a result of investment in R&D and innovation.

The effects of R&D tax credits and other innovation policies on the exporting performance of Irish- and foreign-owned firms. This research would examine the effects of innovation policies on the extensive and intensive margins of exports by indigenous and foreign-owned firms.

The effects of engagement in international production on the productivity of indigenous and foreign-owned firms. This research would analyse whether and the extent to which structural and regulatory characteristics of the countries of origin for imported inputs affect the productivity of indigenous and foreign-owned firms.

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Appendix A Additional Tables

Table A1: The share of foreign-owned firms in employment by sector, manufacturing 2008

	2008
Manufacture of other transport equipment	0.9438
Other manufacturing	0.9384
Manufacture of basic pharmaceutical products and pharmaceutical preparations	0.9149
Manufacture of computer, electronic and optical products	0.8727
Manufacture of chemicals and chemical products	0.7808
Repair and installation of machinery and equipment	0.7301
Manufacture of tobacco products	0.7162
Manufacture of textiles	0.5893
Manufacture of motor vehicles, trailers and semi-trailers	0.5847
Manufacture of electrical equipment	0.5601
Manufacture of machinery and equipment n.e.c.	0.5362
Manufacture of rubber and plastic products	0.4426
Manufacture of beverages	0.4082
Printing and reproduction of recorded media	0.3914
Manufacture of paper and paper products	0.3032
Manufacture of fabricated metal products, except machinery and equipment	0.2199
Manufacture of food products	0.2103
Manufacture of other non-metallic mineral products	0.1989
Manufacture of wearing apparel	0.1565
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	0.1224
Manufacture of furniture	0.0513
Manufacture of basic metals	0.0377
Manufacture of leather and related products	0.0000

Source: Authors' calculations based on data from the CIP.

Table A2: The share of foreign-owned firms in employment by sector, manufacturing 2014

	All foreign	Foreign EU	Foreign non-EU
Manufacture of basic pharmaceutical products and pharmaceutical preparations	0.8864	0.2169	0.6695
Other manufacturing	0.8820	0.0740	0.8081
Manufacture of computer, electronic and optical products	0.8658	0.0626	0.8032
Manufacture of beverages	0.7355	0.7355	0.0000
Manufacture of tobacco products	0.7206		
Manufacture of motor vehicles, trailers and semi-trailers	0.6216		
Manufacture of chemicals and chemical products	0.6064	0.2400	0.3665
Manufacture of electrical equipment	0.5454	0.1299	0.4155
Manufacture of machinery and equipment n.e.c.	0.4868	0.1018	0.3850
Manufacture of textiles	0.4850		
Repair and installation of machinery and equipment	0.4271	0.2462	0.1809
Manufacture of rubber and plastic products	0.3938	0.1512	0.2426
Manufacture of basic metals	0.3691		
Manufacture of paper and paper products	0.3559	0.2431	0.1128
Manufacture of other transport equipment	0.2689		
Printing and reproduction of recorded media	0.2370	0.1286	0.1084
Manufacture of fabricated metal products, except machinery and equipment	0.2105	0.0757	0.1348
Manufacture of food products	0.1522	0.0764	0.0758
Manufacture of other non-metallic mineral products	0.1510	0.1127	0.0383
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	0.1257		
Manufacture of leather and related products	0.1042		
Manufacture of furniture	0.0809		
Manufacture of wearing apparel	0.0000		

Note: For some industries it was not possible to provide a separate share for affiliates of EU and non-EU firms because of a too small number of firms, which cannot be reported for confidentiality purposes. *Source*: Authors' calculations based on data from the CIP.

Table A3: The share of foreign-owned firms in employment by sector, services 2008

	2008
Telecommunications	0.9198
Office administrative, office support and other business support activities	0.6833
Computer programming, consultancy and related activities	0.6166
Activities of head offices; management consultancy activities	0.5630
Publishing activities	0.5616
Travel agency, tour operator and other reservation service and related activities	0.5190
Security and investigation activities	0.4929
Services to buildings and landscape activities	0.4894
Repair of computers and personal and household goods	0.4835
Information service activities	0.3871
Retail trade, except of motor vehicles and motorcycles	0.3731
Scientific research and development	0.3610
Employment activities	0.3138
Rental and leasing activities	0.3056
Advertising and market research	0.2846
Wholesale trade, except of motor vehicles and motorcycles	0.2775
Architectural and engineering activities; technical testing and analysis	0.2574
Gambling and betting activities	0.2338
Water transport	0.1894
Warehousing and support activities for transportation	0.1660
Food and beverage service activities	0.1531
Other professional, scientific and technical activities	0.1479
Postal and courier activities	0.1220
Real estate activities	0.1091
Programming and broadcasting activities	0.1027
Wholesale and retail trade and repair of motor vehicles and motorcycles	0.1012
Other personal service activities	0.0843
Motion picture, video and television programme production, sound recording and music publishing activities	0.0705
Land transport and transport via pipelines	0.0462
Sports activities and amusement and recreation activities	0.0347
Accommodation	0.0263
Legal and accounting activities	0.0170
Veterinary activities	0.0086
Air transport	0.0081

Source: Authors' calculations based on data from the ASI.

Table A4: The share of foreign-owned firms in employment by sector, services 2014

	All foreign	Foreign EU	Foreign non-EU
Wholesale and retail trade and repair of motor vehicles and motorcycles	0.2374	0.2086	0.0288
Wholesale trade, except of motor vehicles and motorcycles	0.4091	0.1147	0.2944
Retail trade, except of motor vehicles and motorcycles	0.4909	0.4051	0.0858
Land transport and transport via pipelines	1.0460	0.0531	0.9929
Water transport	0.2981	0.0398	0.2583
Air transport	0.0848	0.0194	0.0655
Warehousing and support activities for transportation	0.3026	0.2036	0.0989
Postal and courier activities	0.0349		
Accommodation	0.0586	0.0132	0.0454
Food and beverage service activities	0.3358	0.1781	0.1577
Publishing activities	0.5136	0.2502	0.2633
Motion picture, video and television programme production, sound recording and music publishing activities	0.1120	0.0000	0.1120
Programming and broadcasting activities	0.0582	0.0582	0.0000
Telecommunications	0.8456	0.3283	0.5173
Computer programming, consultancy and related activities	0.6817	0.1179	0.5638
Information service activities	0.8538	0.1308	0.7230
Real estate activities	0.4436	0.1740	0.2696
Legal and accounting activities	0.0151	0.0065	0.0087
Activities of head offices; management consultancy activities	0.3028	0.0727	0.2301
Architectural and engineering activities; technical testing and analysis	0.3780	0.3197	0.0583
Scientific research and development	0.2798	0.0598	0.2199
Advertising and market research	0.5182	0.3066	0.2116
Other professional, scientific and technical activities	0.2127	0.0867	0.1260
Veterinary activities	0.1197		
Rental and leasing activities	0.3616	0.2551	0.1065
Employment activities	0.3017	0.1946	0.1071
Travel agency, tour operator and other reservation service and related activities	0.6499	0.0935	0.5564
Security and investigation activities	0.2804	0.1806	0.0998
Services to buildings and landscape activities	0.0153		
Office administrative, office support and other business support activities	0.3971	0.0883	0.3088
Gambling and betting activities	0.2623		
Sports activities and amusement and recreation activities	0.0238		
Repair of computers and personal and household goods	0.4018	0.0439	0.3579
Other personal service activities	0.1438	0.1156	0.0282

Note: For some industries it was not possible to provide a separate share for affiliates of EU and non-EU firms because of a too small number of firms, which cannot be reported for confidentiality purposes.

Source: Authors' calculations based on data from the CIP.

Table A5: The share of foreign-owned firms in employment by counties

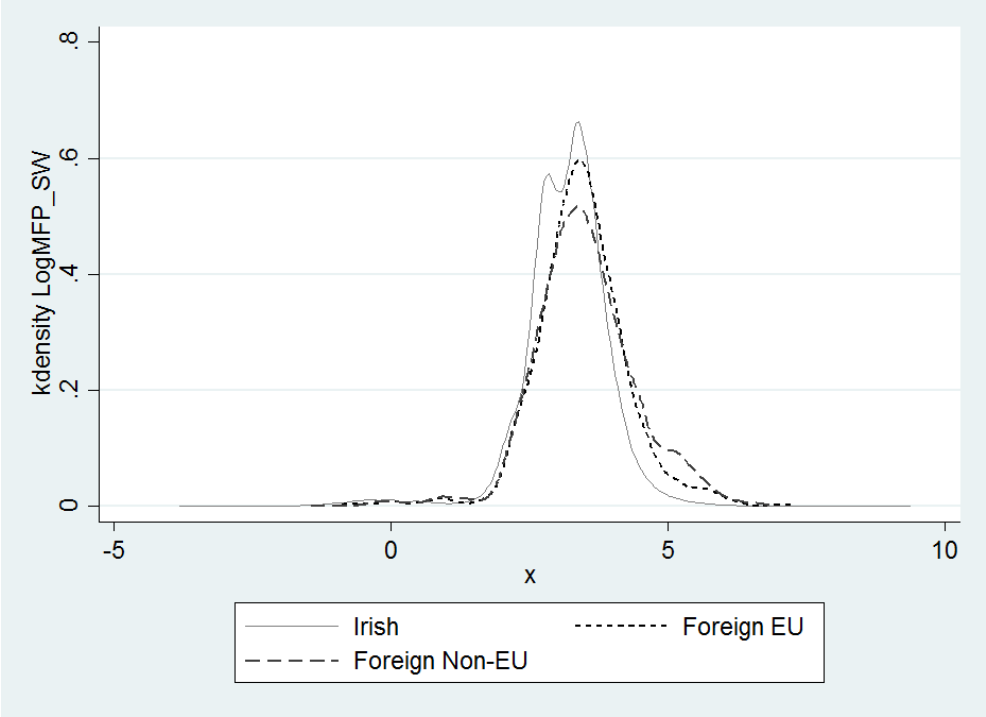
2008		2014			
			All foreign	Foreign EU	Foreign non-EU
South Dublin	0.6350	South Dublin	0.6839	0.5685	0.1154
Sligo	0.4970	Dublin-Fingal	0.5793	0.0903	0.4890
Limerick County	0.4735	Cork City	0.5451	0.0679	0.4772
Waterford City	0.4670	Sligo	0.5331	0.1267	0.4064
Galway City	0.4557	Limerick	0.5281	0.0092	0.5189
Clare	0.4553	Limerick County	0.5131	0.1134	0.3997
Kildare	0.4139	Clare	0.4457	0.1887	0.2570
Leitrim	0.4004	Dublin city	0.3927	0.2090	0.1837
Dun Laoghaire-Rathdown	0.3669	Kildare	0.3894	0.1199	0.2694
Dublin-Fingal	0.3617	Cork County	0.3879	0.0553	0.3327
Westmeath	0.3474	Galway	0.3647	0.0968	0.2680
Dublin City	0.3336	Tipperary	0.3514	0.0585	0.2929
Cork City	0.3098	Mayo	0.3316	0.0813	0.2503
Cork County	0.3016	Waterford	0.3200	0.1631	0.1568
Waterford County	0.2749	Kerry	0.2783	0.0857	0.1926
Wicklow	0.2677	Carlow	0.2642		
Mayo	0.2621	Dublin	0.2611	0.1860	0.0751
Offaly	0.2272	Wexford	0.2608	0.1567	0.1042
Galway County	0.2055	Louth	0.2511	0.0634	0.1878
Kerry	0.1721	Wicklow	0.2510	0.0882	0.1628
Donegal	0.1636	Donegal	0.2304	0.0786	0.1517
Tipperary North	0.1564	Westmeath	0.2235	0.1035	0.1200
Louth	0.1433	Roscommon	0.1968		
Tipperary South	0.1344	Leitrim	0.1856		
Carlow	0.1327	Cavan	0.1511	0.0481	0.1031
Cavan	0.1321	Meath	0.1415	0.0847	0.0568
Limerick City	0.1279	Galway	0.1375	0.0500	0.0874
Wexford	0.1276	Offaly	0.1119	0.0716	0.0403
Kilkenny	0.1082	Tipperary	0.1111		
Longford	0.0939	Monaghan	0.0746	0.0403	0.0343
Meath	0.0808	Lacis	0.0423		
Roscommon	0.0733	Kilkenny	0.0372		
Laois	0.0615	Longford	0.0314		
Monaghan	0.0589	Waterford	0.0142		

Note: For some industries it was not possible to provide a separate share for affiliates of EU and non-EU firms because of a too small number of firms, which cannot be reported for confidentiality purposes.

Source: Authors' calculations based on data from the CIP.

Appendix B: Productivity Patterns: Total Factor Productivity[16]

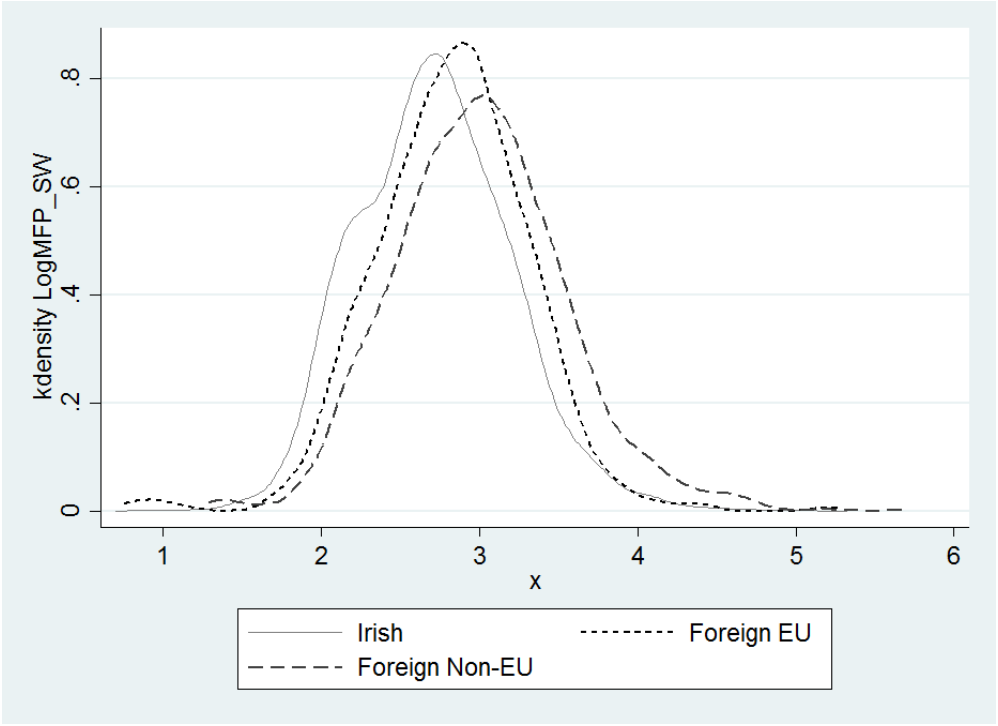
Figure B-1: Productivity distribution by firm ownership, all sectors



Source: "Productivity Spillovers from Multinational Activity to Indigenous Firms in Ireland", by Mattia Di Ubaldo, Martina Lawless and Iulia Siedschlag, forthcoming.

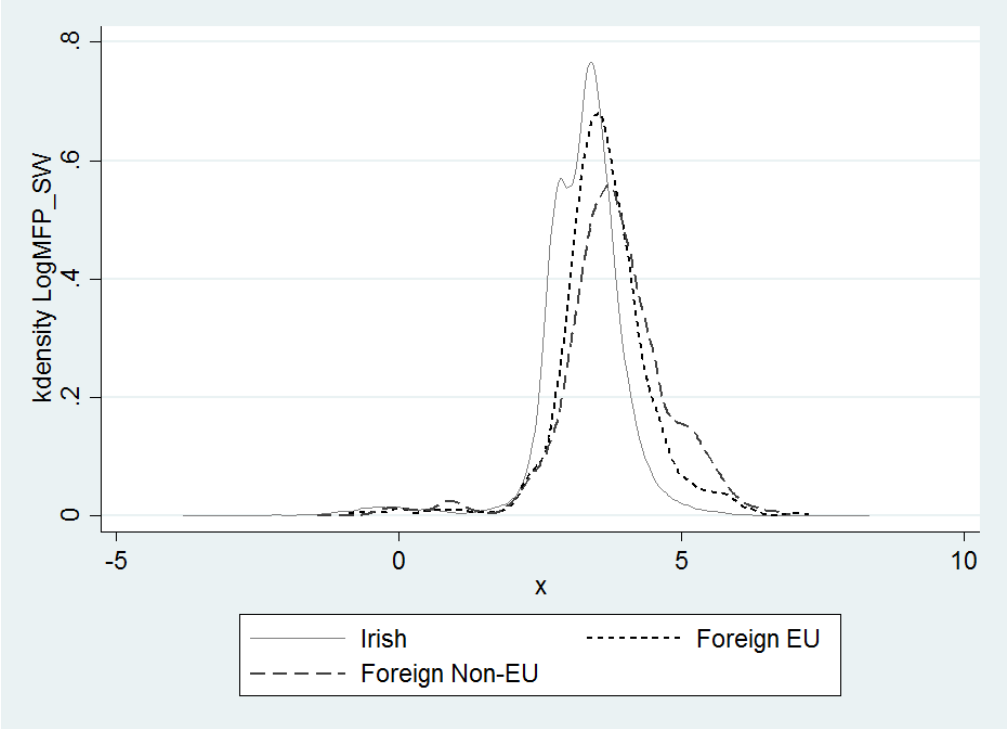
[16] These summary statistics are taken from the research paper "Productivity Spillovers from Multinational Activity to Indigenous Firms in Ireland", by Mattia Di Ubaldo, Martina Lawless and Iulia Siedschlag, prepared as background empirical analysis for the *OECD Ireland Economic Survey 2018*. This research is part of the joint ESRI and the Department of Finance Research Programme on the Macro-economy and Taxation. The views expressed in this paper are those of the authors and they should not be regarded as an official position of the Department of Finance. This research uses statistical data from the Central Statistics Office (CSO) of Ireland. The permission for controlled access to confidential micro data sets has been granted in line with the Statistics Act, 1993. The use of these statistical data does not imply the endorsement of the CSO in relation to the analysis or interpretation of the statistical data. We would like to thank Gerard Doolan, Andrew Murray, Barry Kelleher, Ben Berstock and Alan Corcoran in the CSO for valuable support with data access and clearance. We thank Brendan O'Connor, Javier Papa, and Luke Rehill from the Department of Finance for useful discussions and for sharing with us relevant output of the *MultiProd* project. We also thank Ben Westmore and Yosuke Jin from the OECD for useful comments and suggestions.

Figure B-2: Productivity distribution by firm ownership, manufacturing

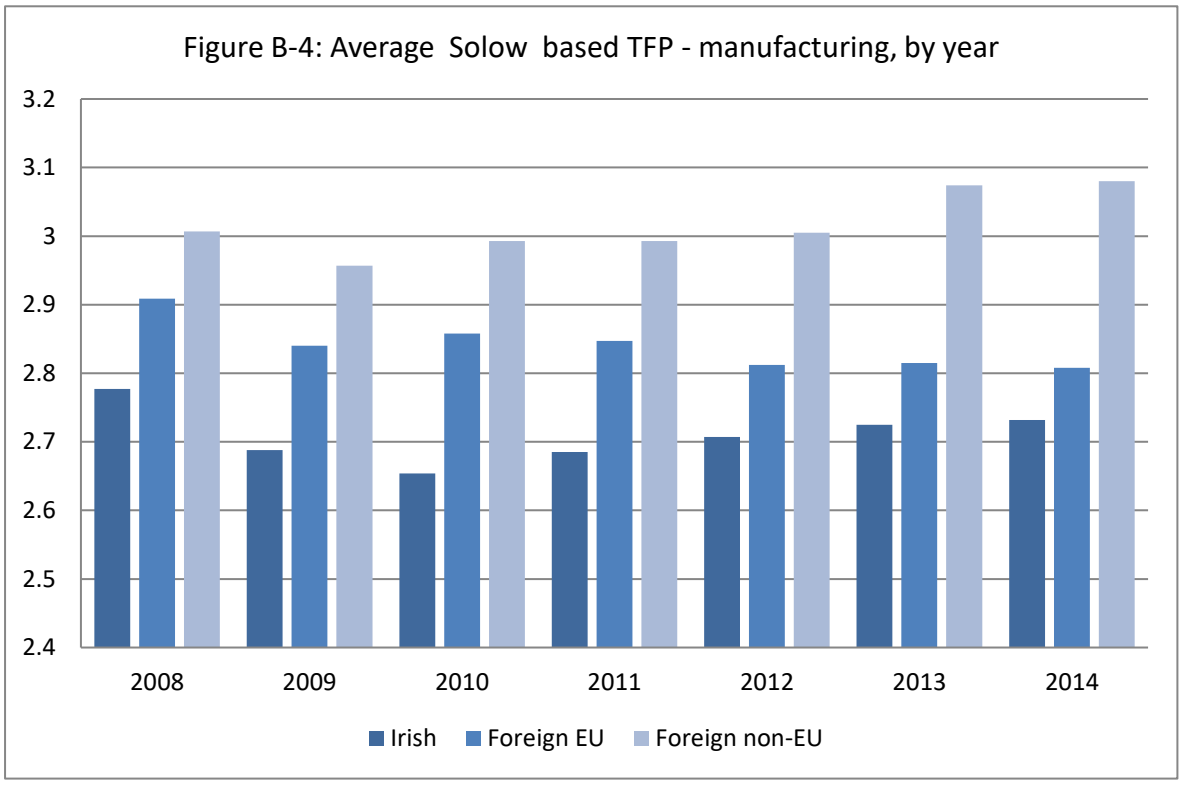


Source: "Productivity Spillovers from Multinational Activity to Indigenous Firms in Ireland", by Mattia Di Ubaldo, Martina Lawless and Iulia Siedschlag, forthcoming.

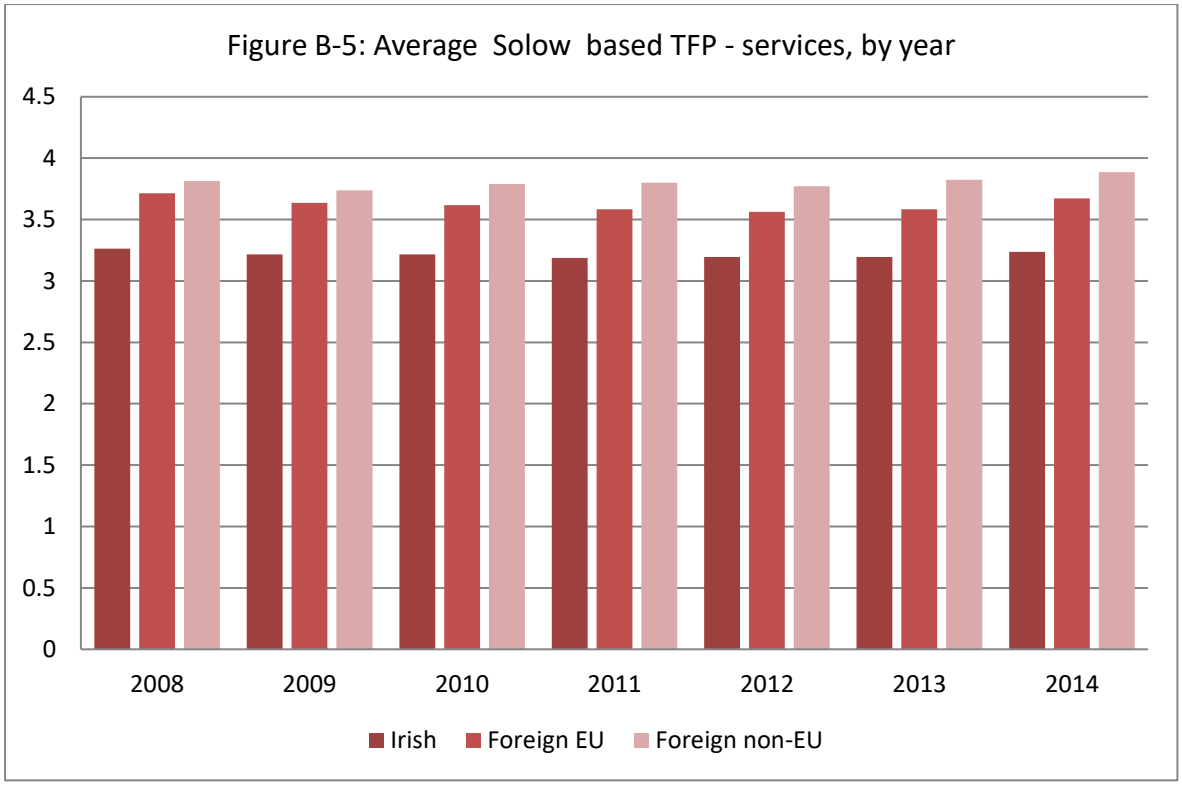
Figure B-3: Productivity distribution by firm ownership, services



Source: "Productivity Spillovers from Multinational Activity to Indigenous Firms in Ireland", by Mattia Di Ubaldo, Martina Lawless and Iulia Siedschlag, forthcoming.

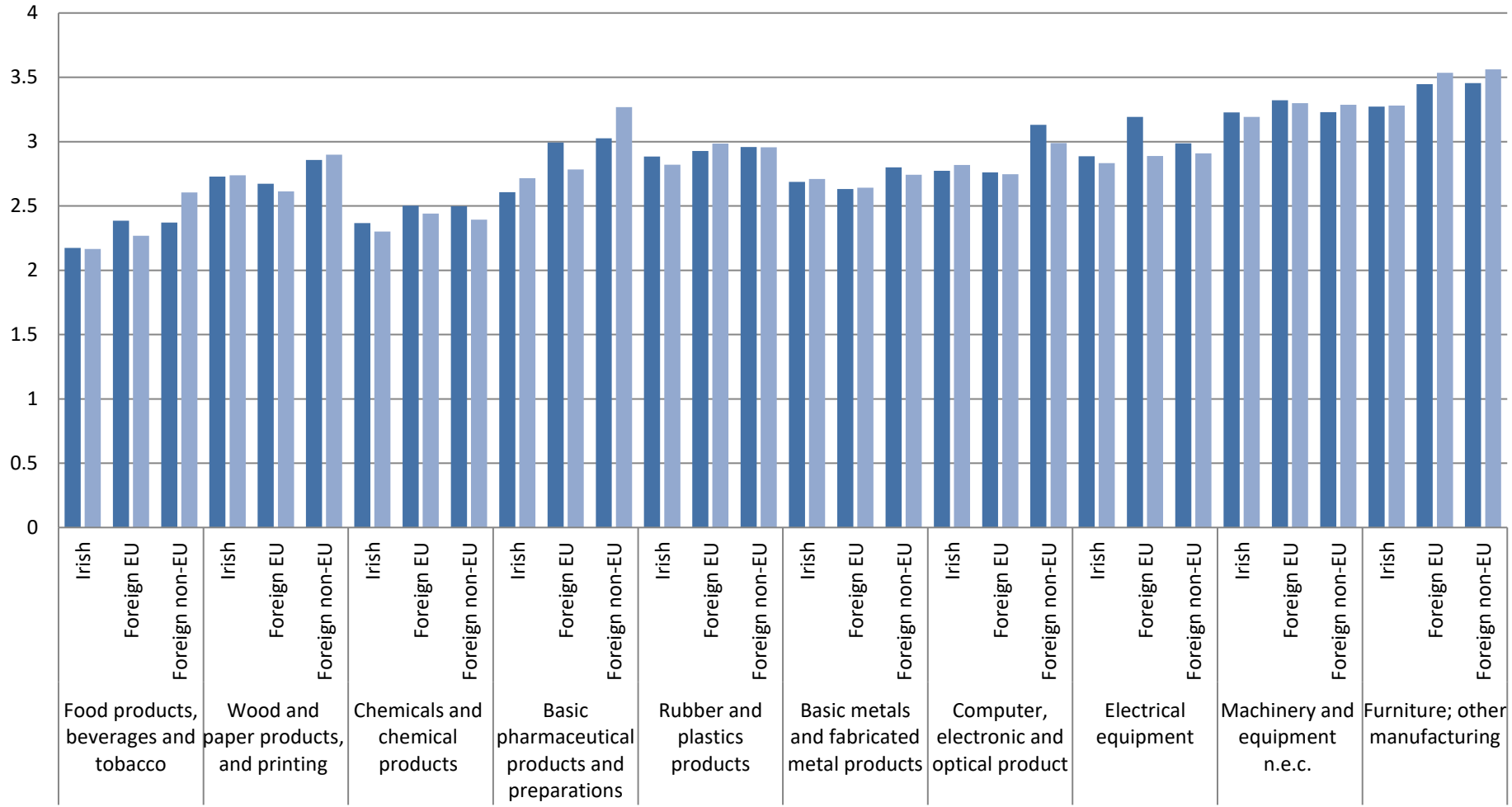


Source: "Productivity Spillovers from Multinational Activity to Indigenous Firms in Ireland", by Mattia Di Ubaldo, Martina Lawless and Iulia Siedschlag, forthcoming.



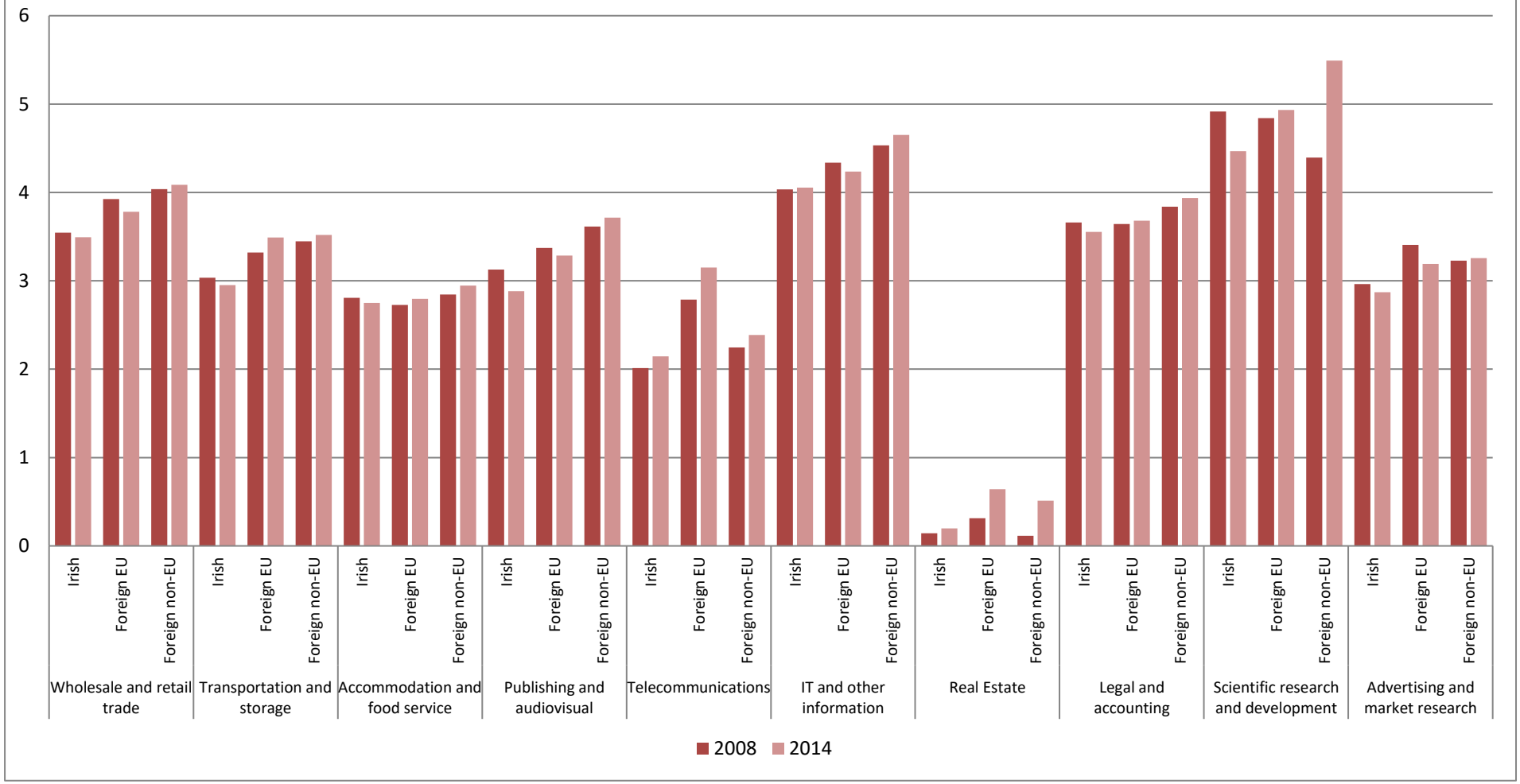
Source: "Productivity Spillovers from Multinational Activity to Indigenous Firms in Ireland", by Mattia Di Ubaldo, Martina Lawless and Iulia Siedschlag, forthcoming.

Figure B-6: Average Solow based TFP - manufacturing - 2008-2014

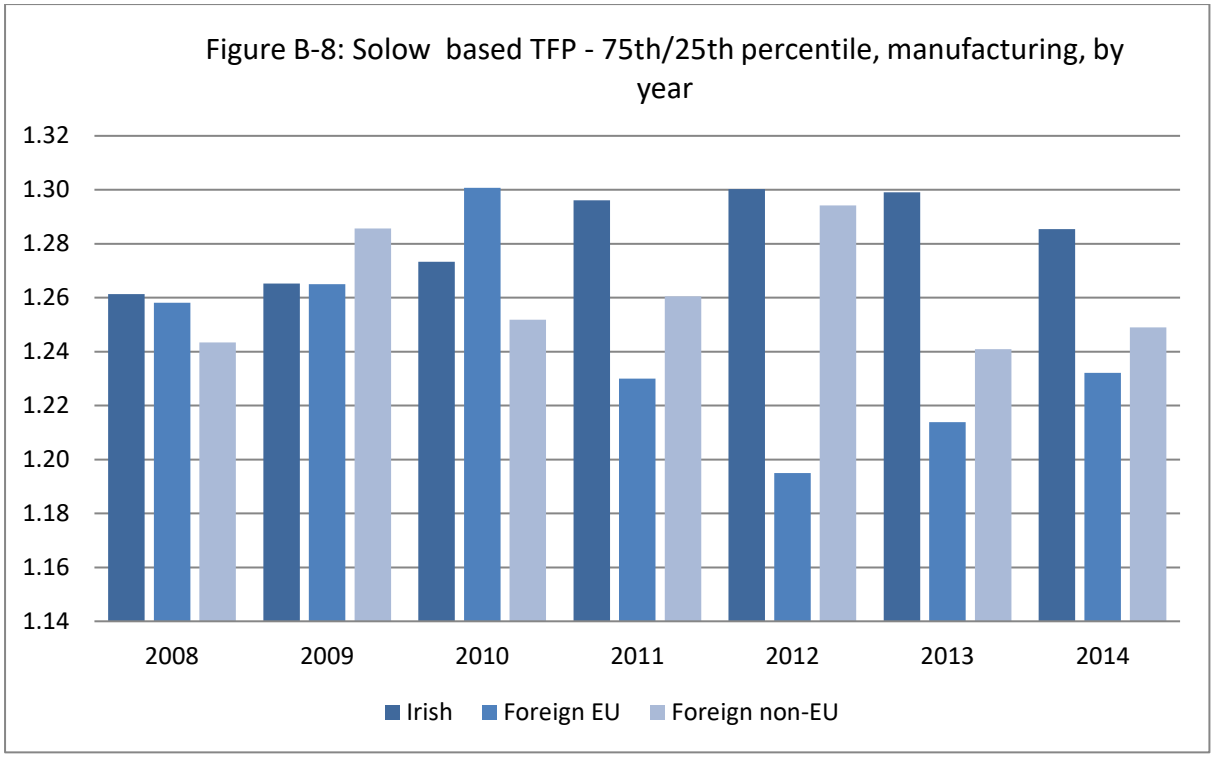


Source: "Productivity Spillovers from Multinational Activity to Indigenous Firms in Ireland", by Mattia Di Ubaldo, Martina Lawless and Iulia Siedschlag, forthcoming.

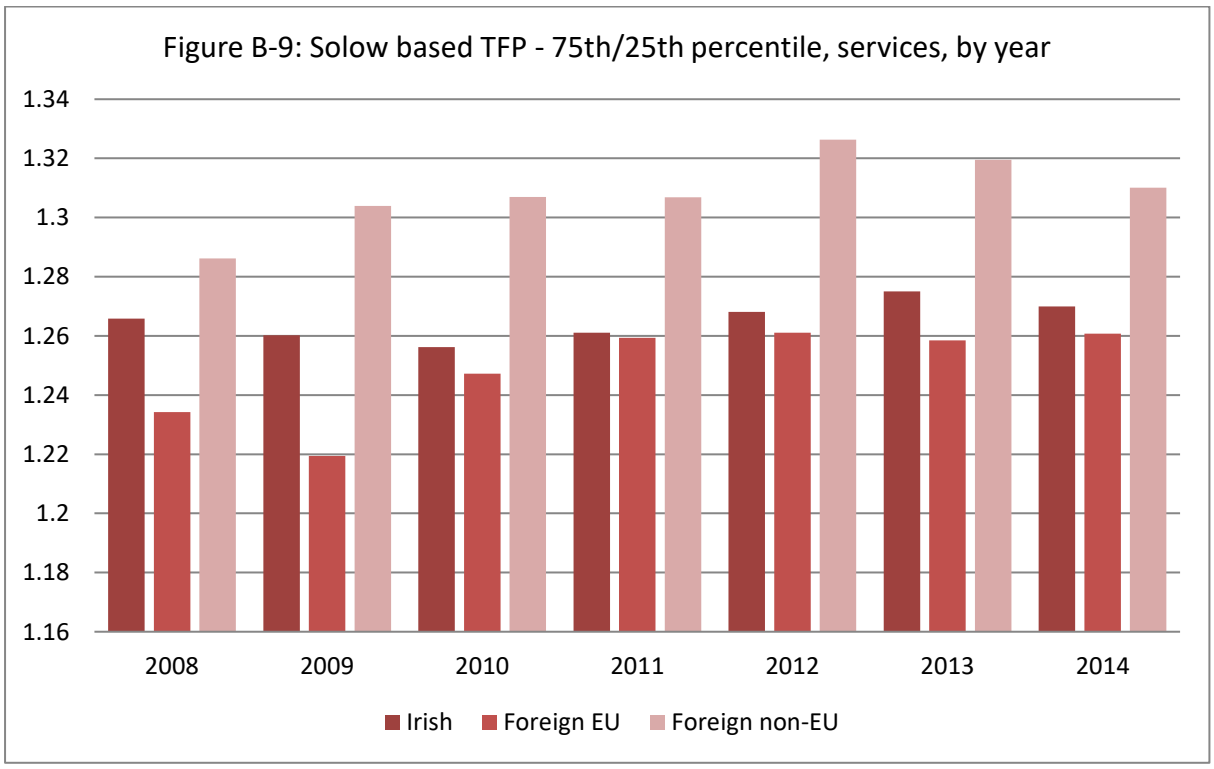
Figure B-7: Average Solow based TFP - services - 2008-2014



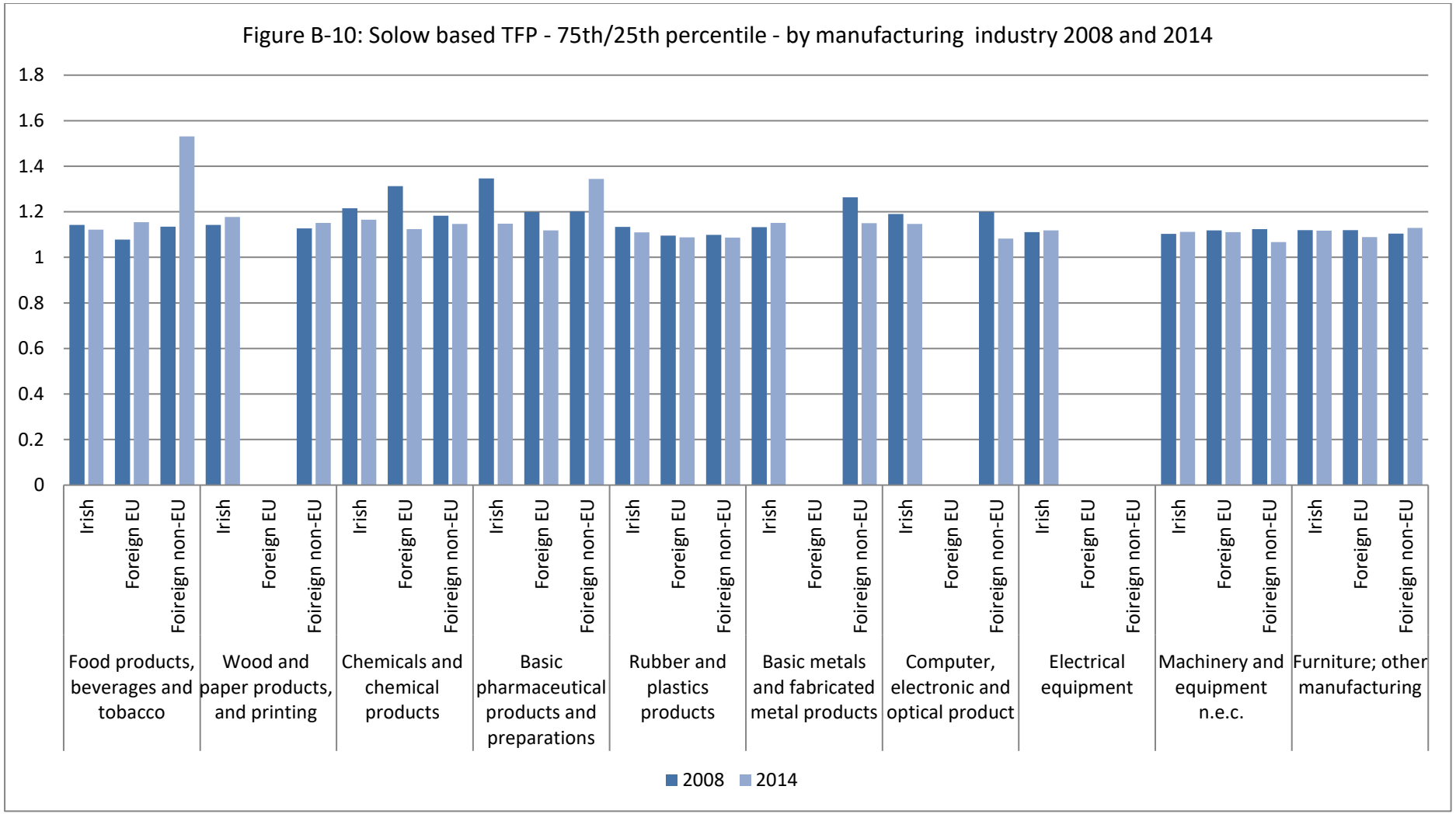
Source: "Productivity Spillovers from Multinational Activity to Indigenous Firms in Ireland", by Mattia Di Ubaldo, Martina Lawless and Iulia Siedschlag, forthcoming.



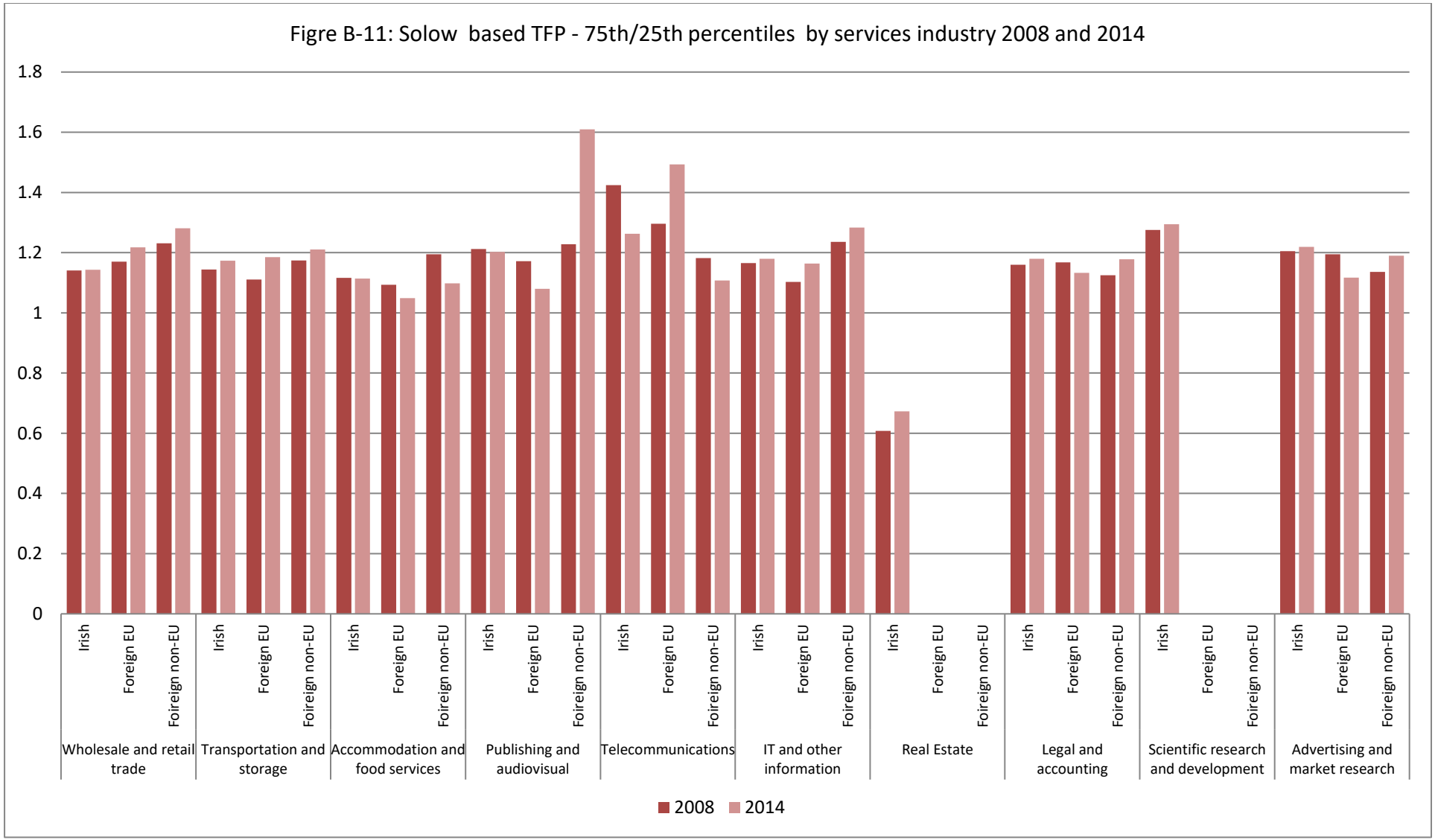
Source: "Productivity Spillovers from Multinational Activity to Indigenous Firms in Ireland", by Mattia Di Ubaldo, Martina Lawless and Iulia Siedschlag, forthcoming.



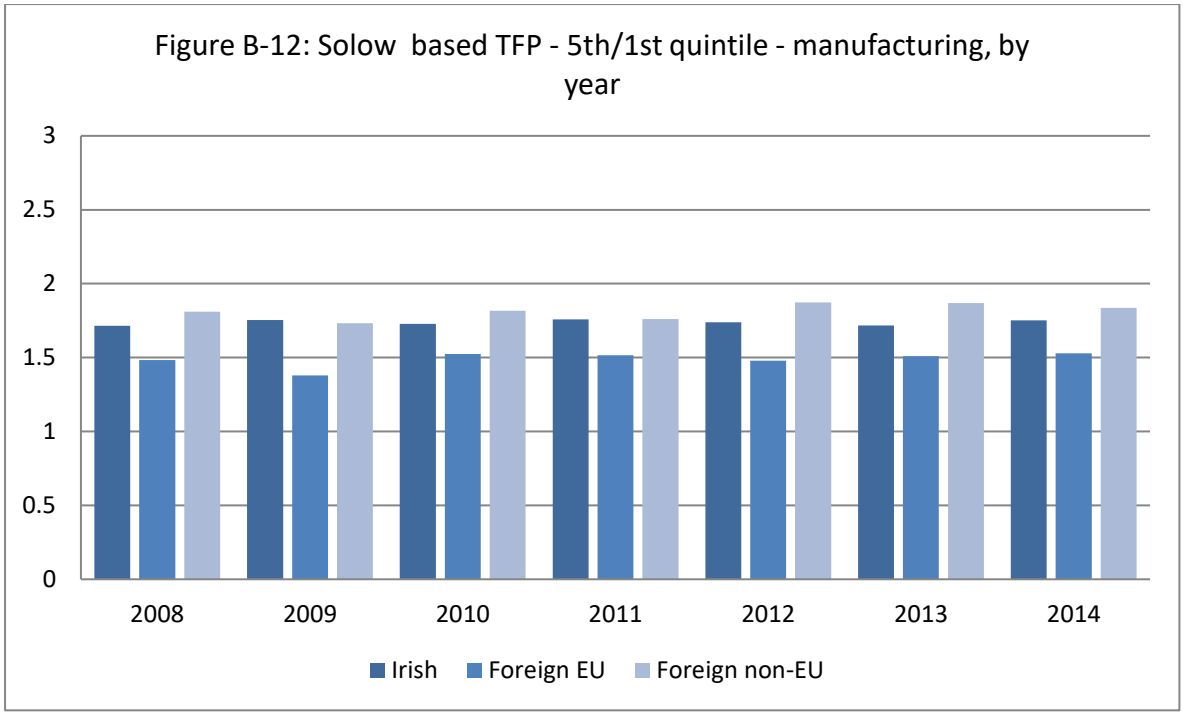
Source: "Productivity Spillovers from Multinational Activity to Indigenous Firms in Ireland", by Mattia Di Ubaldo, Martina Lawless and Iulia Siedschlag, forthcoming.



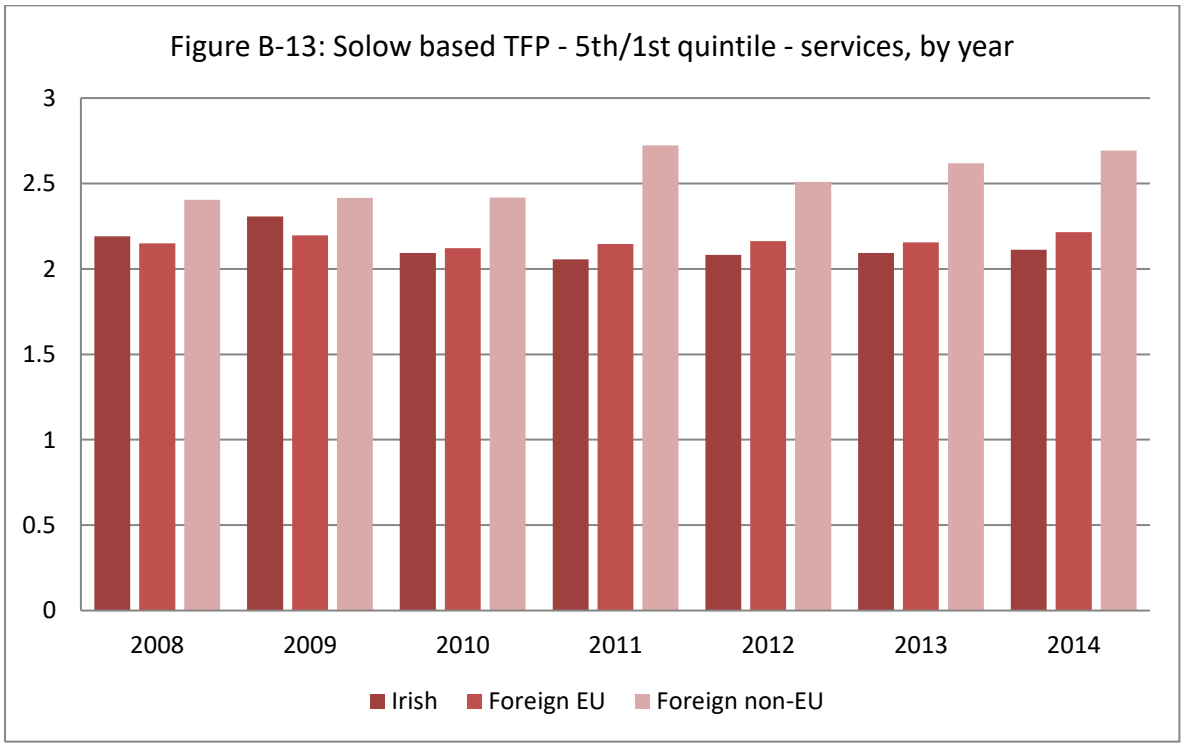
Source: "Productivity Spillovers from Multinational Activity to Indigenous Firms in Ireland", by Mattia Di Ubaldo, Martina Lawless and Iulia Siedschlag, forthcoming.



Source: "Productivity Spillovers from Multinational Activity to Indigenous Firms in Ireland", by Mattia Di Ubaldo, Martina Lawless and Iulia Siedschlag, forthcoming.



Source: "Productivity Spillovers from Multinational Activity to Indigenous Firms in Ireland", by Mattia Di Ubaldo, Martina Lawless and Iulia Siedschlag, forthcoming.



Source: "Productivity Spillovers from Multinational Activity to Indigenous Firms in Ireland", by Mattia Di Ubaldo, Martina Lawless and Iulia Siedschlag, forthcoming.

Appendix C The CDM Model

The CDM model estimates three sets of relationships. The first set consists of two equations relating to the investment phase, namely the propensity of enterprises to invest in innovation and the innovation expenditure intensity conditional on spending on innovation. The second set relates the various types of innovation outcomes to innovation expenditure intensity (innovation expenditure per employee) and other enterprise and industry characteristics. The third set links output/productivity to innovation outcomes and other enterprise characteristics.

The econometric model is described below. Detailed definitions of the variables used in the analysis are given in Table B1.

The Innovation Investment Equations

This stage of the model comprises two equations which explain in turn the firms' decision to invest/not invest in innovation and, if investing, the amount of innovation expenditure per employee. We only observe the innovation expenditure reported by firms. To the extent that this group of firms is not random, this implies a possible selection bias. To account for this potential bias, the propensity of firms to invest in innovation is given by the following selection equation:

$$y_i = \begin{cases} 1 \;\; if \;\; y_i^* = x_i\gamma + u_i > \tau \\ 0 \;\; if \;\; y_i^* = x_i\gamma + u_i \le \tau \end{cases}$$

y_i is an observed binary variable which equals one for firms engaged in innovation investment and zero for the rest of the firms. Firms engage in innovation and/or report innovation expenditure if y_i^* is above a certain threshold level τ . x_i is a vector of variables explaining the innovation decision, γ is the vector of parameters and u_i is the error term.

Conditional on investing in innovation, the amount of innovation expenditure per employee (w_i) is given by the following equation:

$$w_i = \begin{cases} w_i^* = z_i\beta + \omega_i, \;\; if \;\; y_i = 1 \\ 0 \;\; if \;\; y_i = 0 \end{cases}$$

w_i^* is an unobserved latent variable, z_i is a vector of firm characteristics and ω_i is an error term.

The Innovation Output Equations

This second stage of the model explains the innovation outcomes given by the following innovation production function:

$$g_i = w_i^*\alpha + h_i\delta + e_i$$

where g_i is innovation output proxied by product, process, and organisational innovation indicators. w_i^* is the predicted innovation expenditure per employee estimated from the selection model. These values are predicted for all firms and not just the sample reporting innovation expenditure. By using the predicted values of this variable to instrument the innovation effort w_i, we account for the possibility that innovation expenditure per employee and the innovation outputs could be simultaneously determined. The selection and innovation expenditure intensity equations thus correct for this endogeneity. h_i is a vector of other determinants of innovation output, α and δ are the parameter vectors and e_i is the error term.

The Output Production Equation

The last stage of the model explains the output production as a function of labour, capital, and innovation outcomes as follows:

$$p_i = k_i\lambda + g_i\mu + \nu_i$$

p_i is labour productivity (log of output per employee), k_i is the log of physical capital per worker and g_i denotes innovation outcomes (product, process, organisational innovation), ν_i is the error term and λ and μ are vectors of parameters. To correct for the fact that productivity and innovation output could be simultaneously determined, g_i are the predicted innovation output probabilities estimated in the previous stage.

Table C1: Description of Variables – Linked CIS/CIP/ASI data

Model stage	Variable	Type of variable	Description	Data Source
Propensity to invest and intensity of investment	Pr. (R&D)	Dependent variable - selection equation	A binary indicator taking value 1 if the firm reported positive expenditure on internal R&D and/or external (purchased) R&D during the survey year. Over the survey period (the survey year and the two preceding years), and 0 otherwise.	CIS data, 2006-2014.
	R&D/Empl.	Dependent variable - intensity equation	The amount spent on internal and/or external R&D per employee, during the survey year.	CIS data, 2006-2012.
	Pr. (Non-R&D)	Dependent variable - selection equation	A binary indicator taking value 1 if the firm reported positive expenditure on non-R&D innovation activities over the survey period (acquisition of machinery, equipment, software buildings and other), and 0 otherwise.	CIS data, 2006-2014.
	Non-R&D/Empl.	Dependent variable - intensity equation	The amount spent on non-R&D innovation activities (acquisition of machinery, equipment, software buildings and other) per employee, during the survey year.	CIS data, 2006-2014.
	Pr. (Inn. Exp.)	Dependent variable - selection equation	A binary indicator taking value 1 if the firm reported positive expenditure on either R&D or non-R&D innovation activities over the survey period, and 0 otherwise.	CIS data, 2006-2014.
	Foreign ownership	Independent variable	A binary variable identifying whether the firms has a domestic or foreign headquarter.	CIS data, 2006-2014.
	Export Intensity	Independent variable	The fraction of turnover from exports in total firm turnover.	CIP and ASI data, 2005-2014.
	Wage per employee	Independent variable	The value of expenditure on wages reported by a firm, divided by the number of employees	CIP and ASI data, 2005-2014.
	Market Share	Independent variable	The ratio of a firm's (grossed) turnover over the total NACE 2-dig. sector (grossed) turnover, in each year.	CIP and ASI data, 2005-2014.
	Average perceived market risk (3-dig sect)	Independent variable	The 3-dig. sector level average of the qualitative indicator (0, 1, 2, 3) representing firms' perceived constraint to innovation arising from uncertain demand.	CIS data, 2006-2010.
	Value Added per Employee	Independent variable	The value of sales, net of the cost of materials and services, divided by the number of employees.	CIP and ASI data, 2005-2014.
	Age	Independent variable	The number of years a firm has been active, since it was first surveyed in the CIP or the ASI questionnaires. Gap years are counted towards the total age.	CIP and ASI data, 1991-2012.
	Employees	Independent variable	The number of employees reported by a firm.	CIP and ASI data, 2006-2014.

	Cooperation	Independent variable	A binary indicator taking value 1 if the firm reported to have cooperated with other enterprises or institutions on its innovation activities.	CIS data, 2006-2014.
Knowledge production -innovation output	Product Innovation	Dependent variable	A binary indicator taking value 1 if the firm reports to have introduced a new product over the survey period (survey year and preceding 2 years).	CIS data, 2006-2014.
	Process Innovation	Dependent variable	A binary indicator taking value 1 if the firm reports to have introduced a process innovation over the survey period (survey year and preceding 2 years).	CIS data, 2006-2014.
	Organizational Innovation	Dependent variable	A binary indicator taking value 1 if the firm reports to have introduced an organizational innovation over the survey period (survey year and preceding 2 years).	CIS data, 2006-2014.
	Marketing Innovation	Dependent variable	A binary indicator taking value 1 if the firm reports to have introduced a marketing innovation over the survey period (survey year and preceding 2 years).	CIS data, 2006-2014.
	Predicted R&D per employee	Independent variable	The predicted amount of R&D (internal and external) expenditure per employee from the 1st stage	1st stage of model.
	Predicted Non-R&D per employee	Independent variable	The predicted amount of non-R&D expenditure per employee from the 1st stage	1st stage of model.
	Predicted Innovation Expenditure per employee	Independent variable	The predicted amount of total innovation expenditure per employee from the 1st stage	1st stage of model.
	Import intensity	Independent variable	The ratio of purchases from abroad over total firm turnover	CIP and ASI data, 2005-2014.
	Tangibles per Employee	Independent variable	The value of investment in tangible capital, obtained by subtracting the investment in intangibles from the total investment, divided by the number of employees.	CIP and ASI data, 2006-2014.
Productivity	Value Added per Employee	Dependent variable	The value of sales, net of the cost of materials and services, divided by the number of employees	CIP and ASI data, 2006-2014.
	Predicted prob. of Product Innovation	Independent variable	The predicted probability that a firms reports to have introduced a new product over the survey period (survey year and preceding 2 years).	2nd stage of model
	Predicted prob. of Process Innovation	Independent variable	The predicted probability that a firms reports to have introduced a new process over the survey period (survey year and preceding 2 years).	2nd stage of model
	Predicted prob. of Organizational Innovation	Independent variable	The predicted probability that a firms reports to have introduced an organizational innovation over the survey period (survey year and preceding 2 years).	2nd stage of model
	Predicted prob. of Marketing Innovation	Independent variable	The predicted probability that a firms reports to have introduced a marketing innovation over the survey period (survey year and preceding 2 years).	

	Exporter	Independent variable	A binary variable identifying whether the firm reported sales from exporting.	CIP and ASI data, 2006-2014.
	Importer	Independent variable	A binary variable identifying whether the firm reported to have imported goods and services.	CIP and ASI data, 2006-2014.

Notes: All monetary variables are deflated by the 2-digit NACE producer price index (CIP data) or the Consumer Price Index (ASI data), with base year 2010. Variables entering more than 1 stage are described only once.

Appendix D: Productivity Spillovers from Foreign-Owned to Indigenous Firms: Key Findings and Policy Implications[17]

Key Findings

- On average, the productivity of domestic firms does not appear to be linked to the presence of foreign-owned firms in the same industry.
- When manufacturing and service firms are analysed separately, the estimates indicate intra-industry productivity spillovers on domestic firms in services.
- Allowing for different effects for affiliates owned by EU and non-EU multinationals, we find the average productivity of domestic firms is negatively linked to the presence of non-EU based multinationals.
- Looking at manufacturing and services separately, the estimates indicate the productivity of domestic firms in manufacturing is negatively linked with the presence of both EU and non-EU based multinationals in the same industry. In contrast, the productivity of domestic firms in services is positively linked to the presence of EU-based multinationals in the same service industry. There is no evidence of differential intra-industry productivity spillovers for domestic firms with more absorptive capacity.
- No evidence is found for intra-region productivity spillovers.
- On average, the productivity of domestic firms appear to be negatively related to supplies by foreign-owned firms. However, domestic firms in manufacturing which invest in R&D appear to be successful in internalising spillovers from supplies by foreign-owned firms. While the productivity of domestic firms in manufacturing is negatively linked to supplies by affiliates owned by non-EU multinationals, the productivity of domestic firms in services is enhanced by purchases from EU-based multinationals.
- On average, the productivity of all domestic firms is negatively linked to purchases by foreign-owned firms. The same result is found for manufacturing firms while there is no spillover effect for services firms. The negative effect appear to be linked to supplies by domestic firms to EU-based multinationals. However, domestic firms investing in R&D are able to internalise spillovers from purchases by affiliates owned by non-EU multinationals.
- Allowing for the input sourcing behaviour of foreign-owned firms to be specific to the home country of their parent company, on average the productivity of all domestic firms appear to be linked negatively supplies by domestic firms to foreign-owned firms. However, domestic firms in manufacturing which invest in R&D appear to benefit from supplying foreign-owned firms.

[17] This summary is based on the research paper "Productivity Spillovers from Multinational Activity to Indigeneous Firms in Ireland", by Mattia Di Ubaldo, Martina Lawless and Iulia Siedschlag, forthcoming ESRI Working Paper. This research is part of the joint ESRI and the Department of Finance Research Programme on the Macro-economy and Taxation. The views expressed in this paper are those of the authors and they should not be regarded as an official position of the Department of Finance. This research uses statistical data from the Central Statistics Office (CSO) of Ireland. The permission for controlled access to confidential micro data sets has been granted in line with the Statistics Act, 1993. The use of these statistical data does not imply the endorsement of the CSO in relation to the analysis or interpretation of the statistical data. We would like to thank Gerard Doolan, Andrew Murray, Barry Kelleher, Ben Berstock and Alan Corcoran in the CSO for valuable support with data access and clearance. We thank Brendan O'Connor, Javier Papa, and Luke Rehill from the Department of Finance for useful discussions and for sharing with us relevant output of the MultiProd project. We also thank Ben Westmore and Yosuke Jin from the OECD for useful comments and suggestions.

Policy Implications

- The evidence provided by this analysis indicates that attracting foreign direct investment is not sufficient to generate benefits to indigenous firms via involuntary knowledge spillovers and demonstration effects.
- Since productivity spillovers are not automatic, enhancing the absorptive capacity of indigenous firms is key in order to ensure they can internalise the positive externalities from advanced knowledge and technologies.
- Since most productivity spillovers appear to come about through supply chain linkages, enabling production linkages between indigenous and multinational firms could be beneficial for aggregate productivity.