UK EU EXIT – AN EXPOSURE ANALYSIS OF SECTORS OF THE IRISH ECONOMY

March 2017

An Roinn Airgeadais
Department of Finance

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Note: This paper is an update of a previous version of the paper that was published with Budget 2017 on 11 October 2016.

Following publication of the October 2016 version, the CSO released 2013 and 2014 data from the Census of Industrial Production and the Annual Services Inquiry under a revised methodology that also covered years 2008-2012. This paper now uses the 2014 data from both of these releases, whereas the original version relied on 2012 data, the most up to date data available at that time.

This paper also uses 2015 data from the Balance of Payments, External Trade (Goods and Services) and Tourism Statistics releases, compared with 2014 data used in the original version of this paper.

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Contents

The authors ***Donal Smith, Mike Fahy, Brian Corcoran and Brendan O'Connor*** are economists in the Department of Finance and members of the Irish Government Economic and Evaluation Service ("IGEES"). This document is part of ongoing Brexit analysis and scenario planning for input into larger Government deliberative processes. Unless explicitly referenced by Government decision, any proposal contained in this document does not represent Government policy and should not be represented as such. The analysis and views set out in this paper are those of the authors only and do not necessarily reflect the views of the Department of Finance or the Minister for Finance. The authors would like to thank the Central Statistics Office and Revenue Commissioners for provision of data. In particular in the Revenue Commissioners, the authors acknowledge Gerard McGuinness for analytical support and other members in the Revenue Commissioners Economic Research Unit for comments. In the Central Statistics Office, we recognise, in particular, Gerard Doolan, Annette Hayes, Maurice Mulcahy, Patrick Kilduff and Mark Manto. The authors would also like to thank Edgar Morgenroth (ESRI), Shane Enright (European Court of Auditors), Ian Power (Department of Finance), David Hegarty (Department of Finance), Sinead McPhillips (Department of Agriculture) the Department of Finance Brexit Unit and members of the Department of Finance Policy and EU Strategy Committees for comments and suggestions.

Executive Summary

This paper examines the trade exposures of sectors of the Irish economy to the UK in light of the United Kingdom's (UK's) decision to exit the European Union (EU). The nature and the size of any economic consequences on Ireland arising from this decision will depend on the eventual terms of the UK's withdrawal and its future relations with the EU, involving a range of potential outcomes. However, most assessments indicate that it is likely that the Irish economy will be adversely affected by the consequences of the UK's exit from the EU, with particular sectors being more vulnerable than others.

Key Findings

- With annual trade in exports of goods and services of around €39bn,[1] or about 17 per cent of total Irish exports in 2015, the UK is a very important trading partner for Ireland. That year the UK was just marginally ahead of the United States of America (USA) as the largest overall country destination for Irish exports, though its importance as an export trade destination for Ireland has declined over time. For instance, in the early 1970's the UK accounted for over 50 per cent of Irish exports.

- Decomposing Ireland's export trade into goods and services, it is found that the UK accounts for just under €15.5bn, or 14 per cent, of Ireland's goods exports in 2015, and €23.5bn, or 19 per cent, of Ireland's services exports in 2015.

- According to the trade statistics the top five commodity groups, in terms of share of total Irish exports to the UK, taken in this paper as a measure of the '*size exposure*' to the UK, are:
  I. Computer Services
  II. Food and Live Animals
  III. Chemicals
  IV. Insurance/Financial Services
  V. Transport

- Exports to the UK from these five groups alone account for just over 11 per cent of Ireland's total global exports in 2015. Exports to the UK from the remaining commodity groups account for a further six per cent of global Irish exports.

- However, the commodity groups with the highest shares of exports to the UK as a percentage of their total exports, taken in this paper as a measure of the '*proportional exposure*' to the UK, are:[2]
  I. Transport Services
  II. Minerals
  III. Manufactured Goods
  IV. Food and Live Animals

[1] These figures are based on the External Trade Statistics and the Balance of Payments statistics for 2015. Merchandise, Merchandise exports and Merchandise sector are defined in this paper as Goods, Goods exports and Goods sector.
[2] An additional category "Commodities not elsewhere stated" ranks first by proportional exposure but is omitted above as this is an extremely small sector and its size distorts the measure. Commodities not elsewhere stated includes unclassified postal packages, non-legal tender coin, gold (non-monetary), gold coin and monetary gold. A ranking including this micro category is contained in the main body of this paper.

- The UK is also important to Ireland as a source of imports, with 26 per cent of merchandise imports, and 14 per cent of overall imports originating from the UK. Significantly, in terms of manufacturing, the UK is a major source of intermediate goods used in production by exporters.

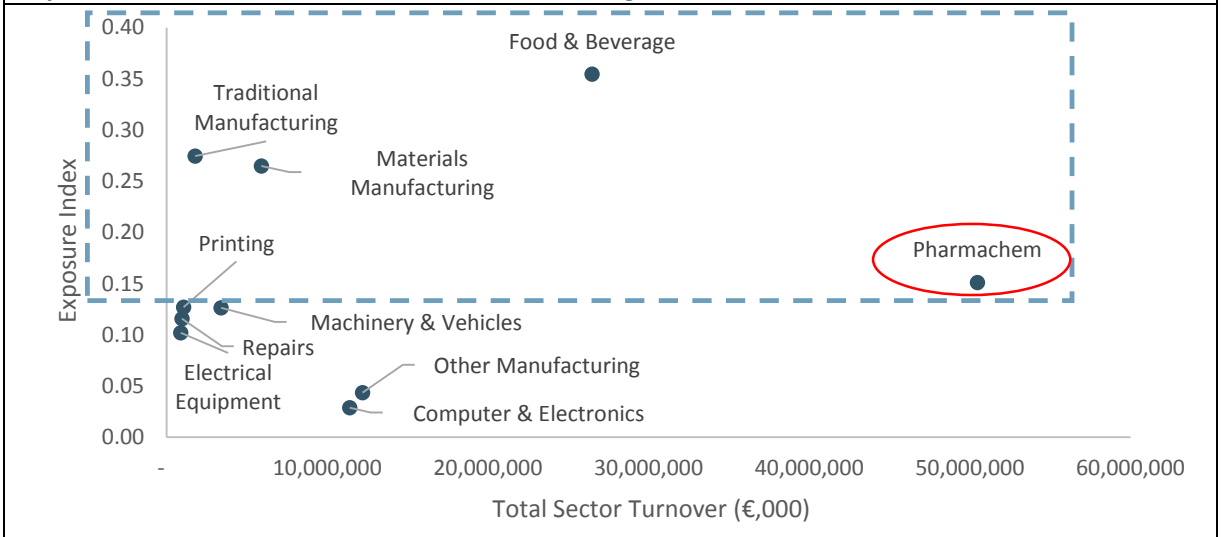
- To account for the importance of a sector in total Irish exports to the UK (the size exposure) and the importance of the UK in that sector's overall exports (the proportional exposure), an exposure index is constructed that equally weights both of these measures in one composite measure. Four out of the top five sectors were found to be goods (manufacturing) sectors.

- An in-depth analysis of the goods and services sectors was undertaken using the Census of Industrial Production 2014 (CIP 2014) and the Annual Services Inquiry (ASI 2014). This change of data source results in a change in sectoral categorisation. This is detailed extensively in the text. As of the date of publication of this paper, the most recently available vintages of both of these data sources are from 2014.

- Using the exposure index methodology this in-depth sectoral analysis identified the most exposed manufacturing sectors. The top five sectors, which collectively accounted for 75 per cent of manufacturing GVA and 112,562 employees according to CIP 2014, were:
  I. Food & Beverage
  II. Traditional Manufacturing
  III. Materials Manufacturing
  IV. Pharmachem, and
  V. Printing[3]

The economic importance of these sectors can be understood with reference to their overall economic size, as measured by turnover and employment. The Pharmachem sector is the largest of the exposed manufacturing sectors in turnover terms, with Food & Beverage the largest in terms of employment.[4]

Exposure Index versus Turnover for Manufacturing Subsectors

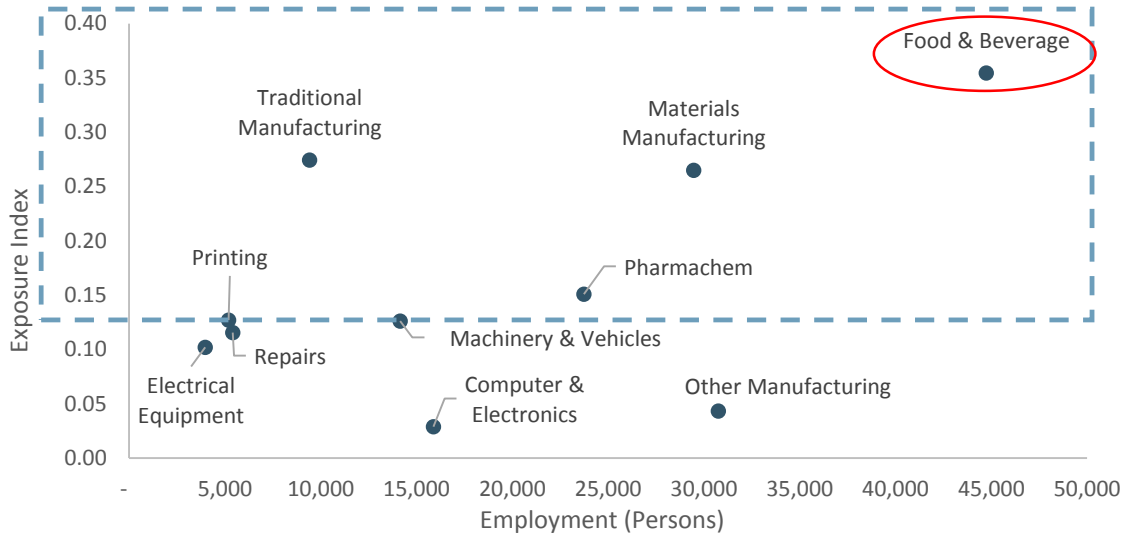


Source: CSO Census of Industrial Production 2014 data. Department of Finance Analysis.

[3] In the original version of this paper, published with Budget 2017, Electrical Equipment was the fifth most exposed manufacturing sector based on data from the 2012 release of the Census of Industrial production. However based on the 2014 release it has now been marginal replaced by the Printing sector.

[4] The same picture emerges if gross value added is used instead of turnover.

Exposure Index versus Employment for Manufacturing Subsectors



Source: CSO Census of Industrial Production 2014 data. Department of Finance Analysis.

- The capacity of a sector to absorb UK-related shocks can be assessed by analysing the share of a sector's turnover that is derived from UK exports. The top five exposed manufacturing sectors rely on the UK for between 9.5 and 20 per cent of total sectoral turnover (see table below). Further, in the Traditional, Materials and Electrical Equipment manufacturing sectors over a quarter of exports go to the UK, indicating the concentrated nature of these sectors' export markets.

- A sector could also face shocks to the cost of inputs into its production process, for instance through (tariff or non-tariff) trade barriers or customs procedures. The share of a sector's production inputs that is accounted for by UK-sourced imports is a measure of the exposure of a sector to a UK-related input shock. The importance of the UK as a production input source varies by sector, with Pharmachem showing a relatively low reliance. Others depend on the UK for close to 20 per cent of their production inputs (Traditional Manufacturing, and Materials Manufacturing). This shows a lack of diversity in input sourcing.

Manufacturing Sectoral Exposure Characteristics: Exports, Turnover, Inputs and Imports

	Exports and Turnover	Inputs and Imports	
Manufacturing Sector	**UK Exports as Share of Sector Turnover**	**Share of Intermediate Goods Sourced from UK**	**Share of Imported Intermediate Goods that come from UK**
Food and Beverage	15.4%	10.6%	49.5%
Traditional Manufacturing	20.4%	17.1%	63.4%
Materials	15.9%	19.4%	54.6%
Printing	9.5%	6.9%	43.3%

Source: Census of Industrial Production 2014, Department of Finance Analysis

- With the exception of the Pharmachem sector, each of the most exposed manufacturing sectors has a high domestic ownership share (in terms of turnover) and a relatively high

domestic linkage in terms of output multipliers. Overall, spillover effects from a UK-related shock or a change in trading relationships are, therefore, likely to be more pronounced in these sectors.

- In terms of regional impacts, the most exposed manufacturing sectors have a comparatively large share of employment outside of Dublin. Almost 80 per cent of employment in Food and Beverage is located outside Dublin. The highest share of total employment in the exposed sectors in a particular region is found in the Border region.

Turnover, Gross Value Added, Multipliers and Regional Employment of the Exposed Manufacturing Sectors

NACE Sector	Turnover from indigenous enterprises as per cent of Total Sector Turnover	Gross Value Added as per cent of Total Manufacturing Gross Value Added	Output multipliers	Employment Share – Dublin	Employment Share – Outside Dublin
Food & Beverage (Sector C NACE 10-12)*	49.1	24.6	1.5	18	82
Traditional Manufacturing (Sector C NACE 13-17)*	75.8	1.6	1.4	29	71
Materials Manufacturing (Sector C NACE 22-25)*	67.3	6.0	1.4	13	87
Pharmachem (Sector C NACE 20, 21)*	6.1	42.1	1.1	23	77
Printing (Sector C NACE 18)	58.0	1.1	1.2	54	46

Source: CSO Census of Industrial Production 2014, Input-Output Table 12 for Ireland 2011. Department of Finance Analysis.
Note: Average output multiplier for combined sectors (*) based on authors' calculations.

- On the services side, the sectors which show the highest overall exposure, based on the exposure index approach, are Transport, Insurance/Financial Services and Computer Services. While Tourism does not exhibit a high exposure under this measure, approximately 40 per cent of trips to Ireland are undertaken by UK residents and this sector is sensitive to exchange rate changes.

- Utilising novel data provided on special request by the Revenue Commissioners, sectoral profit levels are used as an indicator of a sector's ability to withstand a shock. Even when adjusting for firm size, the mainly indigenous exposed sectors in manufacturing show relatively low levels of profits as does the service sector of tourism. Profits are dominated by the Pharmachem sector on the goods side and the Financial Services and Communications and IT sectors on the services side. These sectors also contribute the most in corporation tax, in line with their profit levels. This is indicative of the potential for a first round fiscal impact arising from shocks to these large sectors.

- Overall, excluding the Pharmachem sector, the exposed sectors are mostly Irish owned, regionally based, have relatively low profit levels and have a greater share of small and medium- sized enterprises. In addition they have a relatively high multiplier and account for a relatively high share of employment in regions which have experienced a slower labour market recovery since the financial crisis period.

1. Introduction

1.1 Aim of the Research

The research in this paper is motivated by a desire to better understand which sectors of Ireland's economy are most exposed to the UK's departure from the EU.

1.2 Context

On 23 June 2016 the UK voted by referendum to leave the EU. Although currently still a member of the EU, this result sets the UK on a path to invoke Article 50 of the Lisbon Treaty. Once this article has been invoked it is expected to initiate two separate negotiation processes. There will be withdrawal negotiations, expected to last at least two years, and separate negotiations over the future relationship between the UK and the EU, expected to take longer than the withdrawal negotiations. Underlying this process is the fact that a UK EU exit will ultimately mean a rewriting of the regulatory rule book in terms of the freedom of movement of goods, services, capital and people between the UK and the remaining EU27 member states.[5] How this will ultimately translate into real changes will depend on the negotiation process between the UK and the EU. As such, there is a wide array of potential outcomes.

Due to Ireland's close economic and financial linkages with the UK, the Irish economy is likely to be affected by the consequences of the UK departure from the EU over the medium term. The severity of the impact is, however, difficult to gauge at this stage. Crucially, it will depend on what path the future relationship between the UK and the EU takes, especially regarding trade, financial flows, and the movement of labour.[6] For example, the separation of the UK from the EU could lead to an increase in tariff and non-tariff barriers that would have a negative impact on sectors in Ireland which export to the UK. In addition to the exporter impact, trade barriers could cause disruption to the global production networks that characterise many modern industries, making it more costly for sectors to source inputs.[7] This uncertainty in the trade relationship would be a major change as, since 1973, more or less all of the trading relationship between the UK and Ireland has been governed by the Single Market framework. A further economic impact on Ireland could come from a potential future slowdown of the UK economy.[8]

Many of the potential issues for the Irish economy have previously been outlined in the pre-referendum analysis of Barrett et al., (2015). This paper presents a more detailed examination of a particular aspect of the impact on Ireland by aiming to analyse how the exit could impact the exporting sectors of the Irish economy. Using sectoral data at the two digit level, this paper identifies the sectors that are exposed to the UK, their dependence on the UK in terms of turnover and imported materials,

[5] Ernst and Young (July 2016), "Ernst and Young Item Club Summer Forecast: The World post-Brexit".

[6] See Barrett et al., (2015), "Scoping the Possible Economic Implications of Brexit on Ireland"; Ibec (2016), "The impact of a possible Brexit on Irish business"; Davy Research (March 31, 2016), "The economic impact of Brexit on Ireland"; and Central Bank of Ireland (2015), "Macro-Financial Review (2015:II)".

[7] Dicken, P., 2004. Webs of Enterprise: The Geography of Transnational Production Networks. In: Dicken, P. (Ed.), Global Shift: Reshaping the Global Economic Map in the 21st Century. SAGE Publications, London.

[8] A separate report by the ESRI, in collaboration with the Department of Finance, attempts to model the headline macroeconomic impacts across a range of scenarios representing a range of post referendum UK-EU relationships. The results indicate a possible fall in Irish GDP relative to baseline in the range of 0.5 to 1.2 per cent over two years. See Department of Finance (June 2016), "Summer Economic Statement".

as well as some of their key economic characteristics such as employment, output, multipliers, profitability and tax contributions.

Analysing the impact of external shocks will always be of particular importance in the case of the Irish economy as Ireland is characterised as being among the most globalised economies in the world. Exports of goods and services have a greater importance for Ireland's economy relative to other countries while Ireland also has a long-standing and strong export relationship with the UK, particularly in specialised goods (Ruane et al., 2013).[9]

We focus on the exposure of sectors in this paper as there is a diverse exporting relationship with the UK among the sectors of the Irish economy and the impending post-referendum negotiation process could foment economic shocks in this important trading partner. These shocks could have heterogeneous impacts across sectors. Indeed, previous research has already highlighted the fact that sectoral impacts would vary according to the relative importance of the UK as some sectors are more exposed than others (Barrett et al., 2015).

At a more general level, there is a growing international literature investigating the importance of macroeconomic fluctuations on the performance of sectors of the economy (Jacobson et al., 2011).[10] These studies have found a substantial impact from adverse macroeconomic developments on indicators of firm and sectoral default and, equally importantly in terms of the analysis in this paper, they have found that these effects impact different industries to varying degrees.[11] These studies have found that, among a set of macroeconomic variables, changes in the output gap have a particularly strong impact on firms and sectors. This is of particular importance given the forecasts of potentially reduced growth in the UK following the referendum result. In the literature focusing on Ireland this heterogeneous reaction of sectors to adverse economic conditions has been previously observed.[12]

In light of the referendum result, Ireland's strong reliance on exports and the potential for diverse sectoral impacts, this paper:

- First outlines the data sources and variables used for the analyses in this paper (see Section 2);
- In Section 3, the analysis then provides a high-level look at some of the key economic features of the global exports of goods and services from Ireland as well as its sectoral breakdown;
- Section 4 focuses specifically on Irish trade to the UK by commodity group and develops a measure to quantify how exposed sectors of Ireland's economy are to the UK;
- In Section 5, the data source used changes to allow for a more in-depth analysis of the exposures of the manufacturing sectors of the Irish economy. Using Census of Industrial Production (2014) data, this analysis assesses the ability of sectors to withstand a UK trade related shock, in terms

[9] Ruane, Siedschlag and Murphy (2013), "Globalisation and Ireland's Export Performance", Economic and Social Research Institute Working Paper No.451.

[10] Jacobson, Linde and Roszbach (2011), "Firm Default and Aggregate Fluctuations", Board of Governors of the Federal Reserve System, International Finance Discussion Papers No. 1029.

[11] See for example Jacobson et al., (2011), Bruneau et al., (2008) and at an aggregate level Ewing (2003). Bruneau, de Bandt and el Amri (2008), "Macroeconomic Fluctuations and Corporate Financial Fragility", Journal of Financial Stability. Vol. 8. Ewing (2003), "The Response of the Default Risk Premium to Macroeconomic Shocks", The Quarterly Review of Economics and Finance. Vol. 43.

[12] Lawless and McCann (2013), "Determinants of Default: Evidence from a Sector-Level Panel of Irish SME Loans", The Economic and Social Review, Vol. 44, No. 4. Kelly O'Brien and Stuart (2014), "A Long-Run Survival Analysis of Corporate Liquidations in Ireland", Central Bank of Ireland Research Technical Paper, 10/RT/14. These papers are in the context of small and medium sized enterprises.

of the reliance of a sector's turnover on UK-bound exports as well as a sector's production on UK sourced imports, and describes other key economic characteristics of these sectors;

- In order to provide a more in-depth view of the services sector Annual Services Inquiry data is used in Section 6. This details key Irish macroeconomic aggregates for this sector. These service sector aggregates include employment, turnover, output (value added), and the number of enterprises. In addition, Tourism and Travel data from the CSO is analysed to provide a descriptive analysis of the potential impacts on this sector stemming from its exposure to the UK.
- Finally, in Section 7, an analysis of the profit levels and corporation tax payments at the sectoral level in Ireland is presented. This is done on a per employee basis to give an indication of the ability of sectors to withstand an economic shock and the potential fiscal spillovers from a disruption in any of these sectors.

2. Data Sources

2.1 Introduction

This section discusses the data sources and variables used for the analyses in this paper. It outlines the data, the limitations of the data, and reasons why different sources are chosen.

2.2 Data Source and Variables

A number of different data sources from the Central Statistics Office and data provided by the Revenue Commissioners are drawn on for the analysis.

- To examine high level trends in Ireland's exports of goods and services by geographic destination the analysis in this paper uses External Trade in merchandise (goods) exports data and Balance of Payments (BOP) data for Irish Services exports.[13]
- To perform a more detailed analysis of the manufacturing and services trade with the UK, two further sources of data are used in the paper. This involves data from both the Census of Industrial Production (CIP) and the Annual Services Inquiry (ASI) at the NACE 2 digit level of sectoral aggregation. These sources include data on turnover, employment (including at a regional level) and gross value added.[14]
- In order to determine how changes to exports due to the UK's exit of the EU may impact employment in Ireland the prior data sources are supplemented with Quarterly National Household Survey data.
- For analysis of sectoral profitability and fiscal contribution, also at the NACE 2 digit level, data from the Revenue Commissioners are utilised.
- Data on multipliers are taken from the CSO's input output tables.
- It is important to note that due to the variety of data sources used in this paper there are instances where sectors of the economy are given different names due to classification differences between the data sources. For example, the Chemicals sector described in Section 4 corresponds broadly to the Pharmachem sector in Section 5. However, in the case of Food & Live Animals in Section 4 and Food & Beverage in Section 5, there is a considerable difference between the figures.

2.3 Summary

Table 1 summarises the main sources of data used in this paper, including the NACE and SITC reference codes.[15] Further detail of the Balance of Payments, NACE and SITC categorisations are presented in the Appendix.

[13] Balance of Payments (BOP) data summarises, for a specific time period, the economic transactions in both goods and Services that occur between residents of Ireland and non-residents. However, due to data confidentially the BOP goods data at NACE Rev 2 is not publically available from the CSO thus, to examine the goods sectors in Ireland External Trade data is used. It is possible to construct NACE categories from product-level data available from UN COMTRADE, however the focus in this paper is on pre-aggregated data.

[14] The CIP and ASI 2014 data involves a methodological change to the data from 2008-2012. This will impact on the numbers in the previous version of the paper. For a discussion of these changes see; http://www.cso.ie/en/media/csoie/methods/documents/pdfdocs/multisectoral/RevisedSBSnote.pdf.

[15] SITC is defined as the Standard International Trade Classification which is a statistical classification of the commodities entering external trade. It is designed to provide the commodity aggregates required for purposes of economic analysis and to facilitate the international comparison of trade-by-commodity data. NACE is the "statistical classification of economic activities in the European Community" and is the subject of legislation at the European Union level, which imposes the use of the classification uniformly

Table 1. Data Sources[16]

Data	Source	Economic Information	Categorisation Level
Balance of Payments	CSO	Export of Services	Services Exports and Imports are presented in 10 categories
External Trade	CSO	Export of Goods	SITC (2 digit) Rev 4
Quarterly National Household Survey	CSO	Employment	NACE (2 digit) Rev 2
Census of Industrial Production	CSO	Export of Goods, Turnover, Employment, and Number of Enterprises	NACE (2 digit) Rev 2
Corporation Tax Returns, Form (CT1)	Revenue Commissioners	Profit levels and Corporation Tax	NACE (2 digit)
Input-Output Tables	CSO	Multipliers	NACE (2 digit)
Annual Services Inquiry	CSO	Gross Value Added, Employment, Turnover and Enterprise Income	NACE (2 digit)

2.3 Data Limitations

In Sections 3 and 4 of this paper the data used are from the External Trade Statistics and the Balance of Payments, while from Section 5 onward the data sources also include the Census of Industrial Production and the Annual Services Inquiry. Broadly speaking, the first two data sources, External Trade and BOP, can be thought of as categorising sectors on a commodity basis while the latter two sources provide greater detail in relation to economic characteristics.

In this paper reference is made to the export of goods in Sections 4 and 5. As part of these analyses, two data sources are used, namely External Trade statistics from the CSO for goods export data (Section 4), and the CSO's Census of Industrial Production for manufacturing sector export data as a proxy of goods trade data (Section 5). This change of source on goods exports is employed as the CIP contains data on the economic characteristics of the sectors, such as turnover and employment, which is not available in the External Trade data.

In terms of comparability between these data sources, not all sectors can be precisely linked due to difference in methodology. There is a discrepancy between the share of UK-related exports in the Food and Live Animals sector in Section 4 (External Trade of goods) and the Food & Beverage sector in Section 5 (Census of Industrial Production, CIP). This discrepancy is due to the differences in methodology and classification employed by the CSO in compiling these data sources. Specifically, External Trade statistics are compiled using the Standard International Trade Classification (SITC), which is based on physical product classifications, whereas the CIP is based on the Statistical

within all the Member States. It is a basic element of the international integrated system of economic classifications, which is based on classifications of the UN Statistical Commission (UNSTAT), Eurostat as well as national classifications; all of them strongly related each to the others, allowing the comparability of economic statistics produced worldwide by different institutions.

[16] The Balance of Payments (firms) and Quarterly National Household (Households) data are survey data. Balance of Payments surveys are conducted by the CSO and by the Central Bank of Ireland. Other data obtained from administrative sources are also used. The External Trade data are a combination of Customs-based non-EU trade statistics and data from the Intrastat Survey of Irish traders involved in trade with other EU member states. The collection of trade data is the responsibility of VIMA, a branch of the Revenue Commissioners.

Classification of Economic Activities in the European Community (NACE) classifications, which are based on economic activities.

Due to the distinction between products and economic activities under these classifications it is not possible to reconcile the two numerically. For example, some products which are accounted for as Food and Live Animals (SITC 0) under the SITC may be classified as NACE Category A, Agriculture, or indeed NACE Category C-10, Manufacture of Food Products. Furthermore, during the collection of External Trade statistics data enterprises do not report which NACE category they belong to but rather only the SITC codes of any products they import or export. This disparity is less evident in other sectors, such as between the Chemicals SITC category in Section 4 and the Pharmachem NACE category constructed in Section 5. In this case, the Chemicals and Related Products sector, to give Chemicals its full title, includes the import and export of pharmaceutical products and preparations. As such, Pharmachem and Chemicals are more closely aligned than the Food & Live Animals and Food & Beverage sectors.[17]

In summary, the shift in data sources from section 5 onwards in this paper is done as the first two data sources, the BOP and the External Trade statistics, contain either broader coverage of sectors, in the case of goods, or information on the destination of exports, in the case of services, in comparison to the latter two data sources, the CIP and ASI. The BOP and the External Trade statistics thus allow a more high-level and comparable analysis of Ireland's total goods and services exports to the UK. Establishment of the broad trends at this aggregation provide a context to the more detailed analysis that follows using the CIP and ASI. These data sources contain much richer data on the economic characteristics of sectors, albeit at the expense of coverage (for goods), and geographic detail (for services).

[17] Pharmachem and Chemicals are, in fact, broadly similar in terms of their exports to the UK. Indeed, some of the disparity between the two is accounted for by the fact that Chemicals in the SITC classification includes not only pharmaceutical products but also plastics. Plastics are not present in the Pharmachem sector constructed using CIP data. A detailed description of these sectors is contained in Tables 6 and 7 in the appendix for the SITC and CIP categories respectively.

3. Irish Exports and Imports: Destinations and Sectors

Section Summary

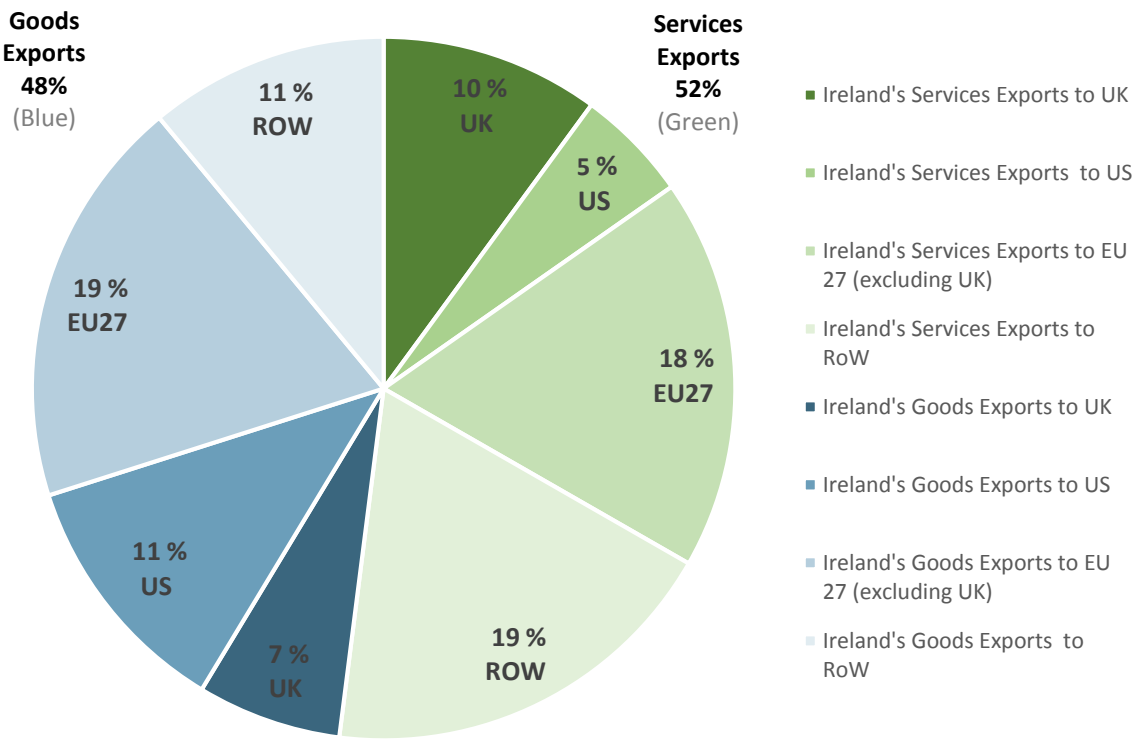
- This section provides a high-level overview of some of the key economic features of the exports of goods and services from Ireland. This is carried out at both the aggregate and the commodity grouping level for goods and services.
- With annual exports of goods and services of around €39bn, or about 17 per cent, of total Irish exports in 2015 the UK is an important trading partner for Ireland, and the largest single country destination.[18]
- The UK accounted for €15.5bn, or 14 per cent, of Ireland's total of goods exports in 2015, and €23.5bn, or 19 per cent, of Ireland's total of services exports in the same year.
- The top five key commodity groups in Ireland's overall exports are (i) Chemicals and Related Products, (ii) Computer Services, (iii) All Business Services, (iv) Machinery & Transport Equipment, and (v) Miscellaneous Manufactured Articles.
- Irish exports from these five commodity groups alone accounted for 75 per cent of Ireland's total global exports in 2015.
- In 2015, the UK accounted for 14 per cent of Ireland's total imports. This was €18bn, or 26 per cent of Ireland's total goods imports, and €12bn, or 8 per cent, of Ireland's total services imports that year.

3.1 Introduction

This section first presents an overview of Ireland's global exports of goods and services by their geographical destination. Having established the destination breakdown of total Irish exports, the section then examines which sectors of the Irish economy are responsible for this export activity. To this end the section presents the percentages of Ireland's global exports that are accounted for by the different sectors of the Irish economy. This analysis will provide context for subsequent sections of the paper that focus exclusively on the sectoral exporting relationship with the UK. In the final part of this section an overview of Ireland's global imports of goods and services is presented, again to add context for later sections.

[18] Note: The goods figures are sourced from the CSO External Trade statistics and so do not include the National Accounts concepts of merchandise and contract manufacturing trade.

Figure 1. Ireland's Exports by Region (Value of Goods and Services) as a Percentage of Total Irish Exports, 2015



Source: CSO International Trade in Services Balance of Payments and External Trade Goods data. Department of Finance analysis.

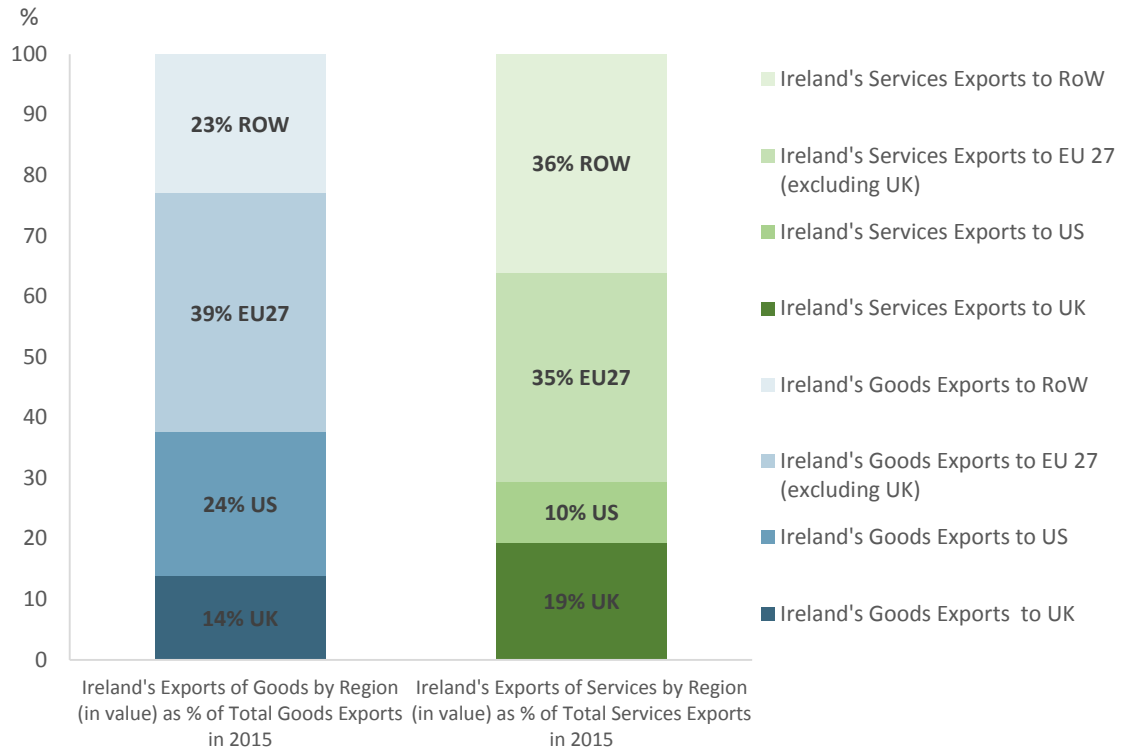
3.2 Ireland's Sectoral Exports of Goods and Services by Region in 2014

In 2015 the UK was Ireland's second largest exporting destination outside of the EU, and the largest single country destination. In 2015, annual exports of goods and services from Ireland to the UK were €39bn, or about 17 per cent of total Irish exports (see Figure 1).[19] The export of goods accounted for just under half of Ireland's total exports in 2015.

Taking goods and services separately, in Figure 2, the UK accounted for €15.5bn, or 14 per cent of Ireland's total of goods exports in 2015, and €23.5bn, or 19 per cent of Ireland's total of services exports in 2015.

[19] These figures are based on the data sources used in this paper.

Figure 2. Ireland's Exports of Goods and Services by Region[20]



Source: CSO International Trade in Services Balance of Payments and External Trade Goods data. Department of Finance analysis.

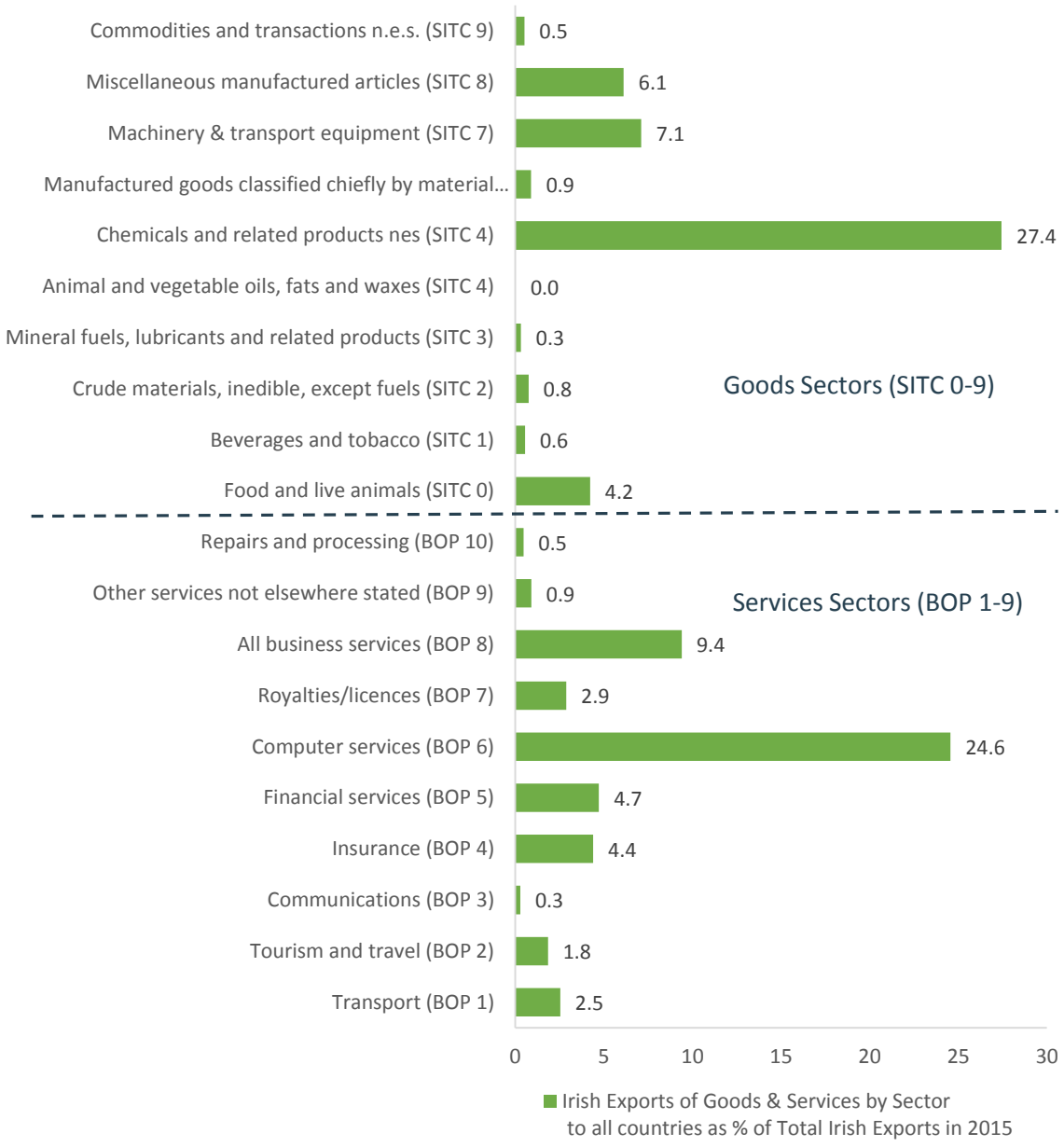
3.3 Ireland's Exports of Goods and Services by Sector

Turning now to which sectors account for these global trade dynamics Figure 3 shows that the top five exporting commodity groups are (i) Chemicals and Related Products, (ii) Computer Services, (iii) All Business Services, (iv) Machinery & Transport Equipment, and (v) Miscellaneous Manufactured Articles. Notably, Irish exports from these five commodity groups alone accounted for 75 per cent of Ireland's total global exports in 2015. The remaining 25 per cent of Irish exports are accounted for by the other 15 sectors.[21]

[20] The data presented here on exports only contains figures on direct exports. There may be additional exports that go through third country distribution points that will not be captured in these figures. One example of this is the case of Belgium, which is well known for its strong distribution infrastructure and activity (see Pharmaceutical Executive Editors (2013)), "Country Report: Belgium". In 2012 Ireland exported €14.9bn of chemical products to Belgium. It is likely some of this was for redistribution.

[21] It should be noted that the SITC categories are quite broad and some may be dominated by a few products. The significant concentration of trade in a few products is highlighted in Barrett et al., (2015).

Figure 3. Ireland's Exports of Goods and Services by Sector as a Percentage of Total Irish Exports in 2015

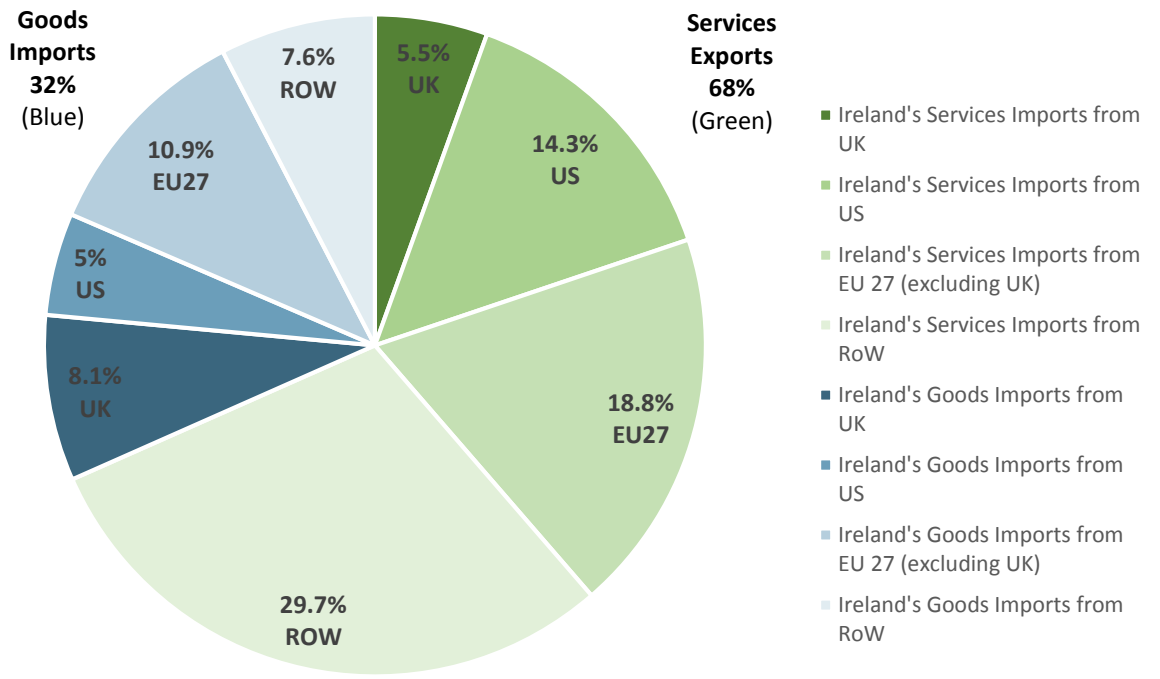


Source: CSO International Trade in Services Balance of Payments and External Trade Goods data. Department of Finance analysis.

3.4 Ireland's Imports of Goods and Services

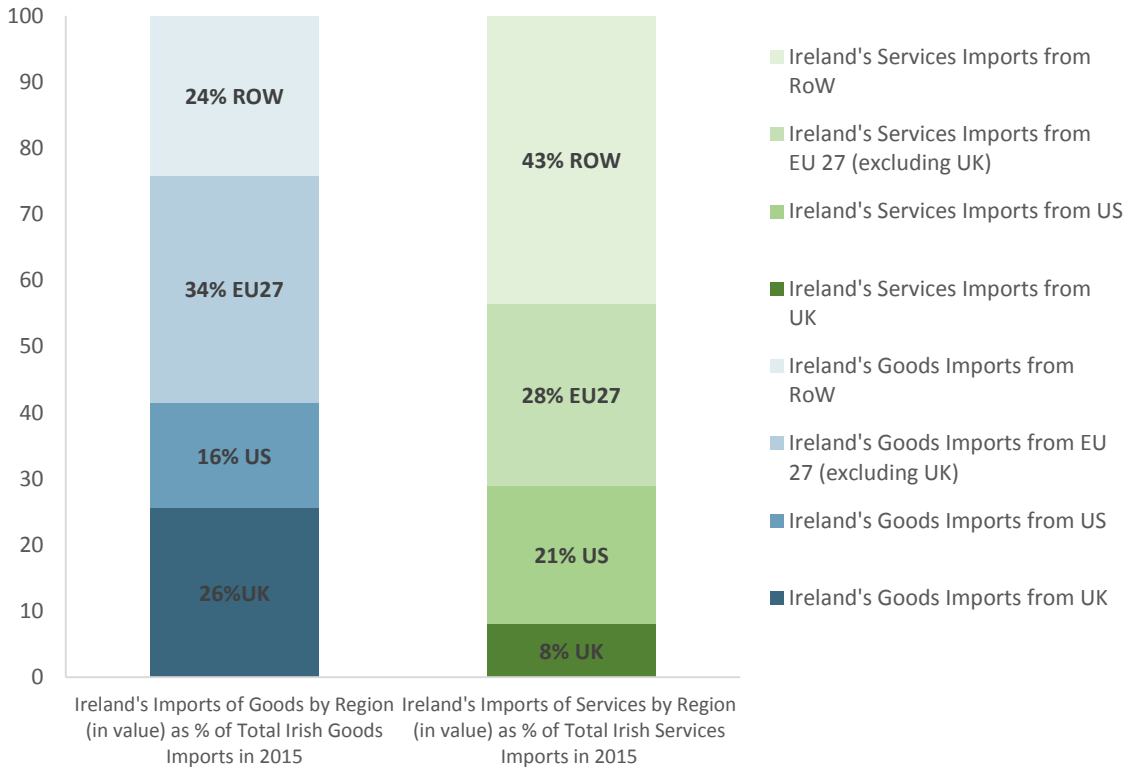
With annual imports of goods and services of around €30bn, or about 14 per cent of total Irish imports in 2015, the UK is an important source of intermediate goods and services for both final use and intermediate consumption. As illustrated in Figures 4 and 5, the UK is Ireland's second largest market, behind the EU, for goods imports, although it is relatively less important in terms of services imports. The UK accounted for €18bn, or just under 26 per cent, of Ireland's total goods imports in 2015, and €12bn, or eight per cent of Ireland's total services imports that year.

Figure 4. Ireland's Imports by Region (value of Goods and Services) as a Percentage of Total Irish Imports, in 2015



Source: CSO International Trade in Services Balance of Payments and External Trade Goods data. Department of Finance analysis.

Figure 5. Ireland's Imports of Goods and Services by Region



Source: CSO International Trade in Services Balance of Payments and External Trade Goods data. Department of Finance analysis.

4. Exports of Goods and Services to the UK by Sector

Section Summary

- This section focuses specifically on Irish exports to the UK by commodity group and develops a measure to quantify exposure to the UK.
- This section thus highlights the potential exposure of Irish exports to the UK. This is performed for both goods and services, using data from External Trade and Balance of Payments statistics.
- This section presents an exposure index. This is constructed by combining two concepts of exposure to UK exporting; size exposure and proportional exposure. Size exposure is the amount of exports from the sector destined for the UK as a share or Ireland's total exports to the UK. Proportional exposure is the share of a sector's global exports that go to the UK.
- The top five key commodity groups in Ireland's exports to the UK comprise of (i) Computer Services, (ii) Food and Live Animals, (ii) Transport Services, (iv) Chemicals and Related Products, and (v) All Business Services.
- Four out of the top five most exposed commodity groups, based on the exposure index, are goods sectors. These are Commodities, Food and Live Animals, Manufactured goods and Minerals.
- Transport is by far the most exposed service sector, followed by Insurance/Financial Services and Computer Services.

4.1 Introduction

In this section the analysis provides an overview of Ireland's exports to the UK, looking separately at the goods and services. Data is presented in a way that takes into account two dimensions of export exposure to the UK. The first measures the value of each commodity group's exports to the UK as a proportion of Ireland's total exports to the UK (the size exposure).[22] The second shows the importance of exports to the UK for each individual sector as a proportion of their global exports (the proportional exposure). An overall measure of exposure is then constructed which combines both of these measures into a single index. This index is used as a means of quantifying and comparing UK export exposure across both goods and services sectors.

4.2 UK Export Exposure

In analysing the exposure of a sector to the UK, there are two concepts of exposure that are important to capture. The first concept is related to a sector's importance for Ireland's overall export performance to the UK. If a sector accounts for a large share of Ireland's total exports to the UK then any change to this sector could have significant implications for the economy as a whole. The second is exposure at the sectoral level - where the UK is the destination for a high proportion of total sectoral exports, a sector would be very sensitive to changes in the UK economy or the introduction of tariff or non-tariff trade barriers. There may be a situation where a sector accounts for a low proportion of

[22] These sectors, or categories, are defined by the statistical reporting standard to which their publication is tied. Specifically, services exports are broken into ten sectors/categories by the CSO in their Balance of Payments publications– these are discussed in Annex 1. Goods exports are classified according to SITC classifications, of which there are also ten. Similarly, these are discussed in Annex 1. Throughout this section reference will be made to BOP and SITC numerical categories.

Ireland's overall exports to the UK, but it may send a high proportion of its exports to the UK. Conversely, a sector may account for a high proportion of Ireland's exports to the UK but if it is characterised by extensive global exporting activity, the UK may be a comparatively small market at the sectoral level. The two concepts can be thought of as size exposure and proportional exposure and are measured as follows: [23]

$$Size\ Exposure = \frac{Sector's\ Goods\ Exports\ to\ the\ UK}{Total\ Goods\ Exports\ to\ the\ UK} \quad (1)$$

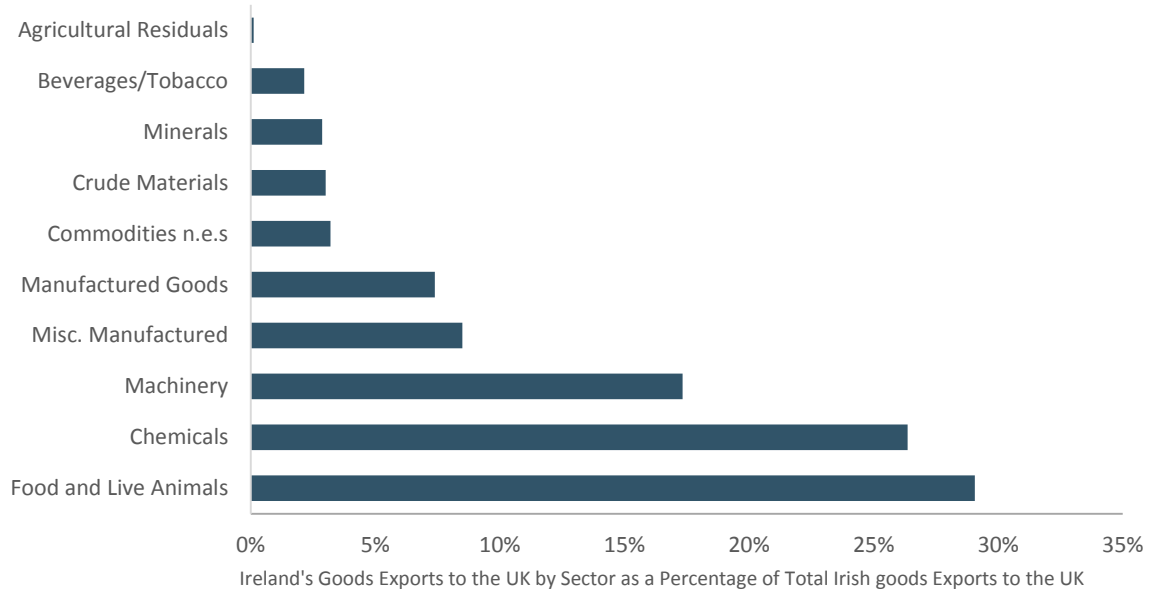
$$Proportional\ Exposure = \frac{Sector's\ Goods\ Exports\ to\ the\ UK}{Sector's\ Total\ Goods\ Exports} \quad (2)$$

These measures of export exposure to the UK are applied to goods and services exports separately. These results are presented and discussed in the subsequent subsections. This begins with the goods sector.

4.3 Ireland's Exports of Goods to UK by Sector

Total exports of goods to the UK were €15.5bn during 2015, or 14 per cent of total goods exports.[24] In the data used in this analysis these goods exports are classified, according to the SITC, into ten commodity groups.[25] The percentage share of each of these commodity groups in Ireland's exports to the UK in 2015 is presented below in Figure 6. This is the size exposure measure.

Figure 6. Ireland's Goods Exports to the UK by Sector as a Percentage of Total Irish Goods Exports to the UK (2015)



Source: CSO External Trade data. Department of Finance analysis.

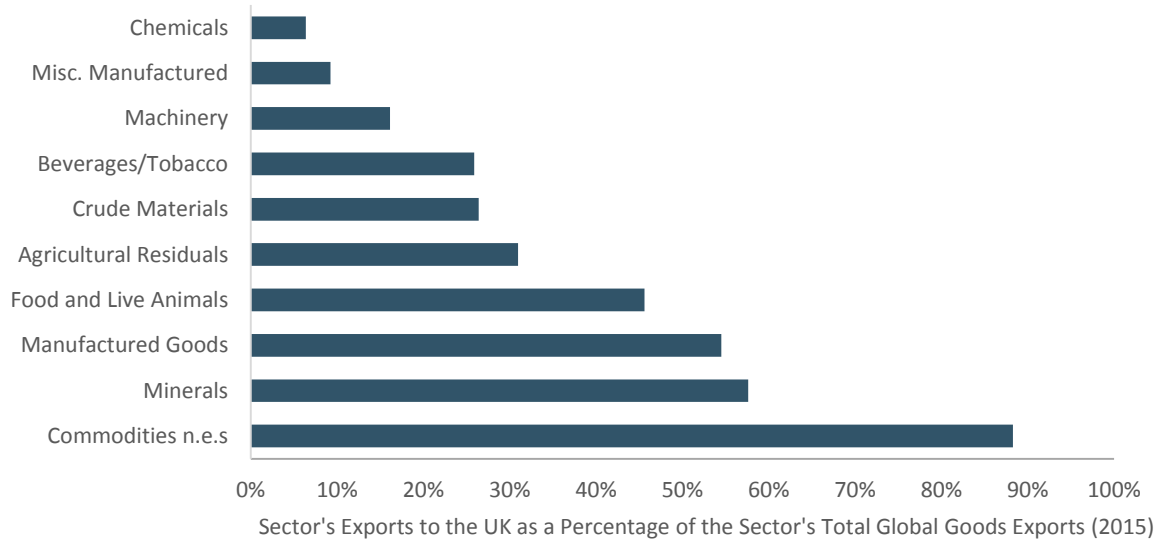
[23] Equation 1 and 2 relate to the exposure measures in terms of a goods sector, the same measures apply to services sectors.
[24] When referring to export totals this paper is restricted to reporting 2014 figures as services data are unavailable for 2015. For the goods sector, 2015 can be used as this data is available.
[25] For ease of reading, the SITC sectors have been abbreviated/renamed in some instances. A full breakdown of same is available in Table 4 in Annex 1.

The largest commodity groups in Ireland's goods exports to the UK are Food and Live Animals and Chemicals.[26] Yearly exports in both of these categories were 29 per cent and 26 per cent of goods exports to the UK (or €4.1bn and €3.6bn respectively). This accounts for a 55 per cent share of total Irish goods exports to the UK.

Machinery is next largest, accounting for a 17 per cent share over the same period. However, it is important to note that the Machinery commodity group is affected by the presence of trade in aircraft, and is therefore impacted by transactions in the volatile aircraft leasing sector.[27]

It is interesting to compare these percentages for Ireland's goods exports to the UK to the percentages for Ireland's global goods exports, shown earlier in Figure 3 in Section 3. From this comparison it can be seen that when the share of each commodity group in exports to the UK is considered, Food and Live Animals and Machinery and Transport Equipment make up a much greater share than in the global trade picture. This shows that these sectors disproportionately export to the UK relative to Ireland's global export portfolio. While these statistics indicate how important a sector's exports to the UK are to Ireland's overall global exports, they do not provide information on how important the UK is as an export market to a particular sector i.e., the sector's proportional exposure. To look at this aspect of exposure to the UK the share of goods exports within each sector which is bound for the UK is presented in Figure 7.

Figure 7. Sector's Exports to the UK as a Percentage of the Sectors Total Global Goods Exports (2015)



Source: CSO External Trade data. Department of Finance analysis.

It can be seen from this figure that the Commodities not elsewhere stated (n.e.s) category sends over 80 per cent of its goods exports to the UK. This is, however, a relatively small sector accounting for

[26] It should be noted that under the SITC Goods categorisation "Medical & Pharmaceutical Products" are combined with the sector called Chemicals.

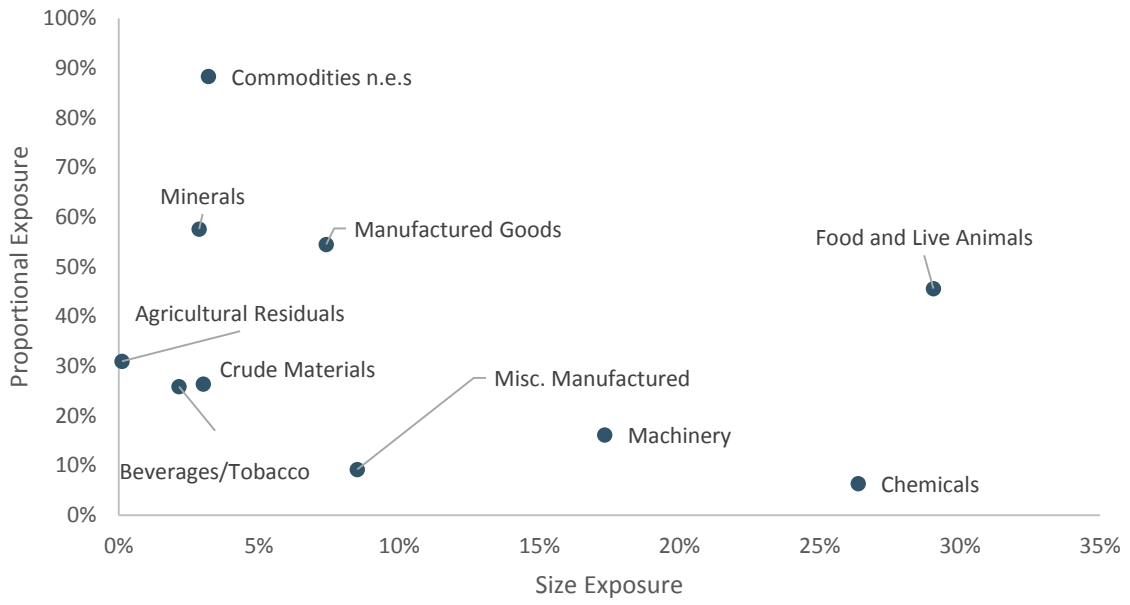
[27] See 'Moving to a Transfer of Economic Ownership Basis for Trade in Aircraft', Central Statistics Office Information Notice, July 2015. Sale of aircraft would have peaks and troughs over time. Aircraft are not manufactured in Ireland but the purchase or sale of an aircraft by an Irish-controlled firm is recorded as an import or export for statistical purposes

just four per cent of employment in 2015.[28] Other sectors with a high proportion of their exports bound for the UK are Manufactured Goods, Minerals and Food and Live Animals. The UK accounts for over 40 per cent of these sectors' exports.

4.4 UK Export Exposures of Goods Sectors

Having separately introduced and presented the size and proportional exposure measures, these two dimensions of exposure are now combined to provide an overall picture of the exposure of the goods sectors and to facilitate a comparison of these two measures. This comparison is shown in Figure 8.

Figure 8. Export Exposure to the UK of Goods Sectors (2015)



Source: CSO External Trade data. Department of Finance analysis.

The Food and Live Animals sector, which sends the largest value of exports to the UK (just under 30 per cent), is highly reliant on the UK by the proportional measure of exposure as almost half (45 per cent) of exports in this grouping are UK-bound. The Chemicals sector, by contrast, represents the second largest Irish goods export sector to the UK (26 per cent) under size exposure, but is not particularly dependent on the UK as only six per cent of total Chemical goods exports are UK-bound.

The diversity of the sectors and the value in using two different aspects of exposure can be seen in that the opposite situation exists for the Manufactured Goods commodity group. This commodity group accounts for seven per cent of total goods exports from Ireland to the UK, but UK exports account for 55 per cent of the sector's total exports in 2014. Minerals, which has a similar size exposure to the Beverage & Tobacco and Crude Materials groupings mentioned above, is much more reliant on the UK as a trade destination, 58 per cent of this classification of exports goes to the UK on average.

The exposure of the ten SITC categories can be broadly categorised as follows:

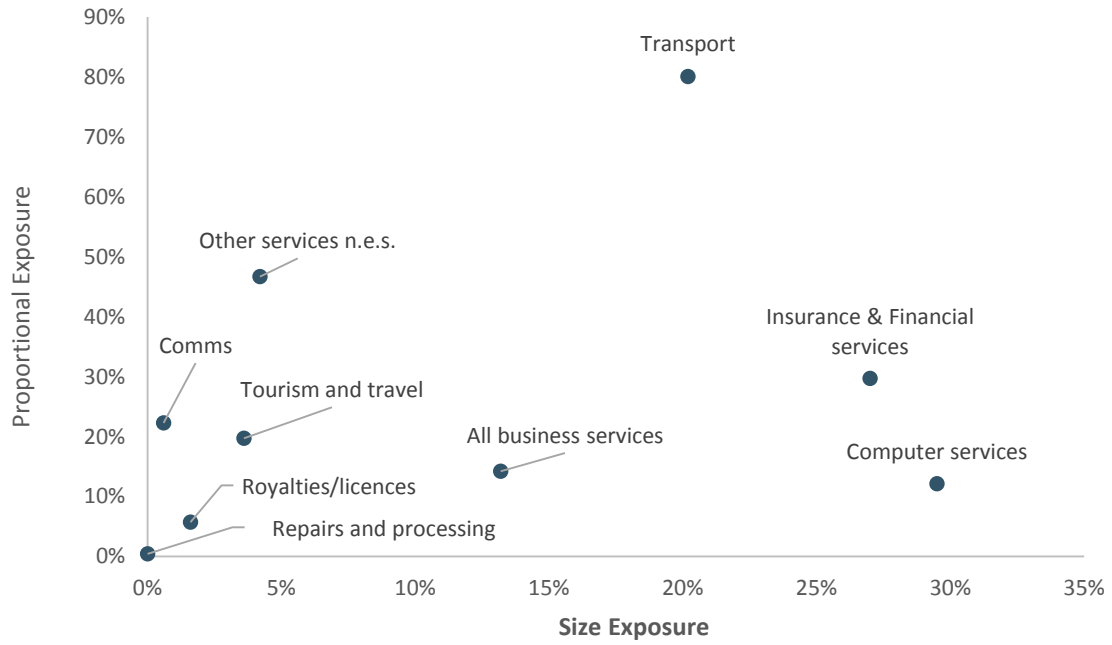
[28] The Commodities n.e.s categories could be affected by the threshold level used to define small traders. This sector includes unclassified postal packages, non-legal tender coin, gold (non-monetary), gold coin and monetary gold.

1) Heavily reliant on the UK as a trade destination and relatively important to the Irish export market (SITC0 – Food and Live Animals).
2) Extremely important to the Irish export market but less reliant on the UK as a trade destination (i.e. SITC5 - Chemicals).
3) Reliant (>25 per cent of export share) on the UK as a trade destination, and whilst individually small, of collective significance in terms of total goods exports to the UK (SITC's 1, 2, 3, 4, 6 and 9).[29]
4) Relatively reliant on the UK as a trade destination and relatively important to Ireland as a share of total exports (SITC's 7 and 8 – Machinery and Miscellaneous Manufactured Articles).

4.5 Services Sectors

The combined view of a sector's size and proportional exposures to the UK is now presented for the services sectors. This is shown in Figure 9.

Figure 9. Services Sectors Export Exposure to the UK (2015)



Source: CSO International Trade in Services Balance of Payments data. Department of Finance Analysis.

The main contributors to Irish service exports to the UK (size exposure) are Computer Services, Insurance/Financial Services, Transport and All Business Services. Taken together, these four sectors comprise a 90 per cent share of total services exports to the UK in 2015.

On the proportional exposure measure, a considerable share of Transport exports are to the UK, 80 per cent in 2015. This sector mainly represents passenger fare receipts of Irish passenger carriers from non-residents.[30] This service sector has the highest exposure to UK trade of all those reported, while Computer Services forms the largest service sector exporting to the UK in value terms, circa. €7bn for

[29] In order, and by their abbreviation; Beverage & Tobacco, Crude Materials, Minerals and Fuels, Agricultural Residuals, Manufactured Goods and Commodities n.e.s. See Table 6 in the Appendix for a full description.
[30] See CSO Balance of Payments Quarterly Statistical Compilation Methodology (updated June 2014).

a 30 per cent share of total services exports to the UK in 2015. In terms of this sector's global exports, exports of Computer services to the UK make up only 12 per cent of the total Computer Services export market. Exports of Insurance/Financial Services to the UK accounted for 30 per cent of that sector's exports. While both Communications and Other Services make up a very small portion of exports to the UK in value terms, both of these sectors have significant proportional exposure to the UK, 22 per cent and 47 per cent respectively.[31]

As with the goods sectors, it is of interest to compare these sectoral percentages of UK exports to the global percentages as reported earlier in Figure 3. It can be seen that the exports of Financial Services and Transport are disproportionately orientated to the UK relative to Ireland's global exports of services.

4.6 Goods and Services Exports by Sectors - an Exposure Index

In the previous two sections the analysis separately quantified the exposure of goods and services exports to the UK. The analysis contained two dimensions of sectoral exposure, firstly; the share of total exports to the UK from Ireland accounted for by that sector (the size exposure) and secondly the share of a sectors' exports which go to the UK (the proportional exposure). These two dimensions give a measure of both the importance of a sector in Ireland's overall exports to the UK and the importance of the UK to that sector. Both dimensions are important as, although a high proportion of a sector's exports may go to the UK, it may be a small part of Ireland's overall exports to the UK and vice versa.

To incorporate these two dimensions into a single measure an index is constructed. This will be termed the exposure index, e, and is given as:[32]

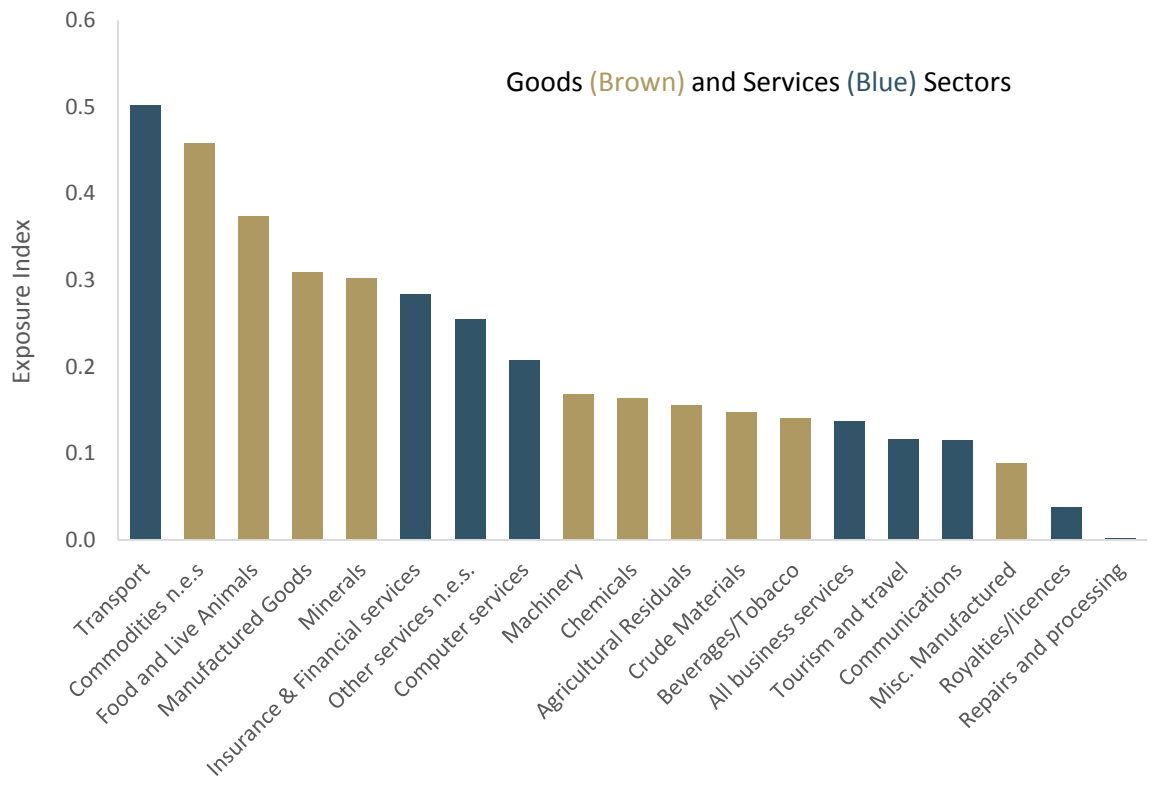
$$e = \sigma \frac{Sector's\ Goods\ Exports\ to\ the\ UK}{Total\ Goods\ Exports\ to\ the\ UK} + (1-\sigma) \frac{Sector's\ Goods\ Exports\ to\ the\ UK}{Sector's\ Total\ Goods\ Exports} \qquad (3)$$

This exposure index, to the best of our knowledge, is a novel approach to combining these concepts. As an example of the index, if a sector exports all of its output to the UK and this one sector also accounted for all Irish exports to the UK it would take a value of one. A sector which exports none of its output to the UK will take a value of zero. All other combinations will be in between these limits. The index provides an equal weight to both dimensions of exposure and its values are presented in Figure 10.

[31] Based on the available data – not available for all years.

[32] $e \in [0,1]$. $\sigma = 0.5$ is a weighting on the different components of exposure based on the equal weighting of the importance of both size and proportion to Ireland's economy. Note alternative exposure weightings (i.e. $\sigma = 0.25\ or\ \sigma = 0.75$) on the different components does not substantially change the group of exposed sectors, with no change in the list of sectors under a higher weight on the proportional measure.

Figure 10. Exposure Index of Goods and Services Sector Exports to the UK (Combined, 2015)[33]



Source: CSO External Trade and BOP data. Department of Finance analysis.

As can be seen from Figure 10, the sector that records the highest value is the Transport services sector. The next four sectors that measure highly in the exposure index are all goods sectors. Relative to the service sectors these account, on average, for a higher share of Ireland's exports to the UK and also send, on average, a higher proportion of their exports to the UK.

The next section will take a deeper sectoral look at the exposures and economic characteristics of manufacturing sectors in Ireland. As noted previously, in particular in Section 2, this will involve a change of data source. The section will exploit the information contained in the Census of Industrial Production to get a more detailed picture of this part of the economy. A similar look at selected services sectors will follow in the subsequent section.

[33] Note; as goods and services exports in 2015 each averaged around 50 per cent of total Irish exports, the exposure indices for both sectors are directly comparable.

5. Manufacturing Exports and Exposure to the UK

Section Summary

- In this section an in-depth analysis of how exposed the manufacturing sectors of the Irish economy are to the UK is undertaken using Census of Industrial Production (2014) data.
- The top five most exposed manufacturing sectors collectively accounted for 75 per cent of manufacturing gross value added (GVA) and 112,562 persons employed according to CIP 2014.[34] These sectors were; Pharmachem, Food & Beverage, Traditional Manufacturing, Materials Manufacturing, and Printing.[35]
- While the characteristics of these sectors are quite different, they rely on the UK for a broadly similar share of turnover (between four and 20 per cent). Four sectors, Food & Beverage, Traditional Manufacturing, Materials Manufacturing and Printing each import over 43 per cent of their production materials from the UK. This indicates that the UK is the main port of call when seeking to import, and so, import sourcing is relatively undiversified. The Pharmachem sector, by contrast, imports only six per cent of its production materials from the UK.
- Other sectoral characteristics include;
    - The Food & Beverage sector has almost 80 per cent of its employment based outside of Dublin. This is suggestive of a high importance of this sector in regional employment.
    - Relative to the foreign-owned Pharmachem sector, the other exposed sectors have a high share of indigenous ownership and are composed of SMEs.
    - Food & Beverage, Traditional Manufacturing and Materials Manufacturing have relatively high output multipliers, indicative of their backward linkages to the domestic economy. This suggests that a negative shock to output in these sectors could have significant second round effects.
    - Any impact on the UK-exposed sectors of the Irish economy will have strong regional consequences due to the geographically dispersed nature of these sectors' production locations. Indeed, the Border region has a higher share of total employment in four out of five of the most exposed sectors than any other region of the country.

5.1 Introduction

In this section the analysis turns to a more detailed examination of the exposure of Ireland's manufacturing sectors to the UK. This section builds on the findings in Section 4, which indicate that for the economy as a whole, exports of goods are relatively more exposed to the UK than services. As outlined in detail in Section 2, this change of data sources from the External Trade statistics will involve a change in the classification of sectors and also some differences in reported exposures. This is most notable in the food and agricultural sectors.

[34] It should be noted that the methodology used to calculate GVA in the CIP is different to that used in the National Accounts and the Input-Output tables. Results are however broadly similar.

[35] The Traditional Manufacturing sector contains activities such as the manufacture of wood, textiles, leather and paper. In the original version of this paper published with Budget 2017 Electrical Equipment was the fifth sector on this list. However due to significant methodological changes in the data set in this version it is replaced by the Printing sector.

Having first quantified the exposure of these manufacturing sectors to the UK, this section then looks at the relationship between the exposure measure for these sectors and their employment and turnover levels. This section also separately examines the share of sector turnover that derives from UK-bound exports. This analysis of the potential economic impact of a disruption to these sectors is then expanded further with a regional employment breakdown, data on the proportion of indigenous operators in the sector, an indicator measure of the size of firms in each sector, and, in terms of potential second round impacts, the multipliers associated with each sector. A summary measure, within the constraints of the available data, of each sector's labour intensity and level of productivity is presented to provide an indication of the sectors ability to withstand an economic shock.

Use of the CIP allows another aspect of UK exposure to be presented in this section, that of production chain import exposure. Many of the firms which make up the sectors in this paper will likely source their production inputs from a range of countries. Those that source a higher proportion of their inputs from the UK would face greater disruption by the imposition of tariff and/or non-tariff barrier with the UK.

5.2 The Census of Industrial Production and Manufacturing Export Activity

To conduct the more in-depth analysis of the goods component of Ireland's UK manufacturing exports the Census of Industrial Production (CIP) data is used.[36] The CIP is the only publically available data source that provides both the broad based coverage and the detail on turnover, employment, exports and imports at a disaggregation that can be used in the sectoral level analyses presented in this paper.[37] This data source also yields information on a sector's reliance on the UK for its turnover and imports.

Given that this section utilises a different data set to the earlier analysis of broad commodity groupings, it is useful to compare the coverage between the goods sector used in the preceding sections and the manufacturing sector from the CIP. According to the data sources (Balance of Payments and External Trade) used in the previous sections, in 2014 total Irish exports of goods and services amounted to €198bn, of which 47 per cent, €93bn, related to goods exports.[38] According to the CIP data analysed in this section, manufacturing exports amount to approximately €77bn in 2014. This represents about 83 per cent of goods exports that year, making it a reasonable proxy for the entire goods export market.[39]

It should be noted that while the output from the Pharmachem manufacturing sector corresponds well with the Chemicals sector of the External Trade in goods statistics, the same is not true of Food & Beverage vis-á-vis Food & Live Animals in the External Trade statistics. As has been described in section 2.3 of this paper, this is due to the non-comparability between the SITC commodity groups and NACE economic activity classifications in the Food sector.

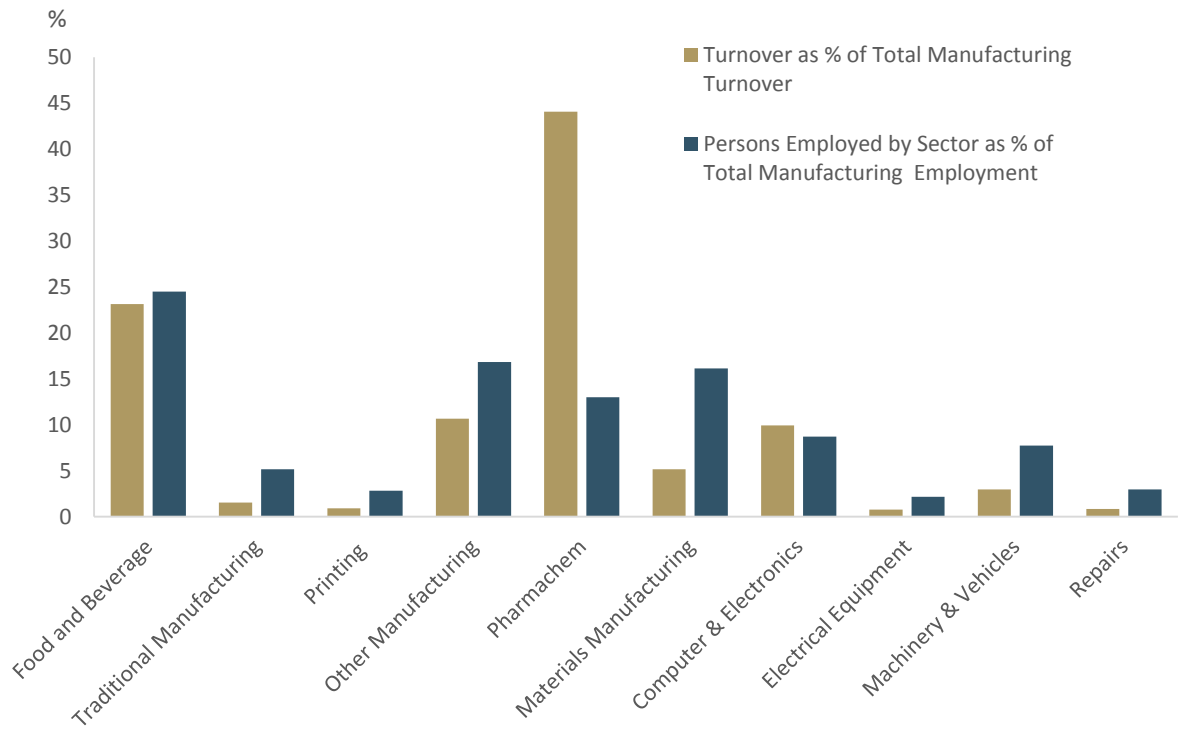
[36] The data used is the latest available release, CIP 2014.
[37] Although turnover includes products that are resold and GVA is a potential alternative measure in the analysis in this paper it is found that these variables can be used interchangeably without impacting the results.
[38] Over the period from 2012 to 2015 goods and services exports each averaged 50 per cent of total exports. Total exports, in this definition, does not account for contract manufacturing and merchanting.
[39] Part of the gap would be made up by non-manufactured goods such as live animals and other raw agricultural products.

Table 2 summarises the high level information from the CIP on which the following analysis is based. The manufacturing sector in the CIP is made up of 25 subsectors, these are shown in Figure 11.[40] For the purposes of this analysis some subsectors are aggregated and the analysis proceeds using ten categories of manufacturing activity.[41]

Table 2. Census of Industrial Production 2014 Data – NACE Categories C (Manufacturing)

			Euro (€'000s)		
Sector C - Manufacturing	**Employment (Persons)**	**Number of Industrial Enterprises**	**Turnover**	**Turnover from Exports**	**Exports to UK**
Total	**182,730**	**14,598**	**114,475,850**	**77,384,238**	**8,734,228**

Figure 11. Sector Share of Total Manufacturing Turnover and Employment



Source: CSO Census of Industrial Production 2014 data. Department of Finance Analysis.

Food & Beverage and Pharmachem account for over 67 per cent of total manufacturing turnover, 23 per cent and 44 per cent respectively.[42] Other Manufacturing (NACE 32) and Computers and Electronics (NACE 26) account for between 11 per cent and 10 per cent of total turnover respectively.[43]

[40] For the purposes of this analysis note that certain subsectors have been combined to provide a more clear and meaningful analysis. Due to missing values, for confidentiality reasons, Figure 14 covers 92 per cent of the total population of the CIP Manufacturing data for 2014.

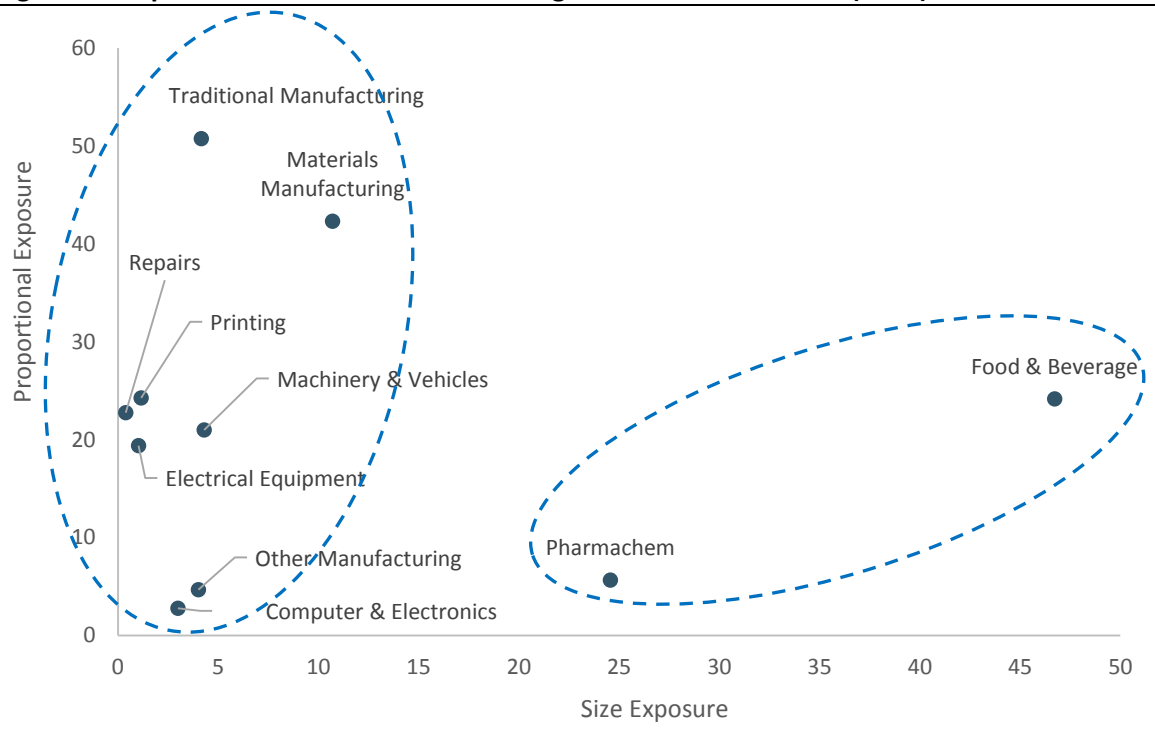
[41] In order to complete this analysis certain subsectors of the data are aggregated into larger sectors to allow for a more meaningful analysis. For a breakdown of the aggregation used see Table 8 in the Appendix.

[42] The Food & Beverage sector does not include agricultural employment explicitly. However, as the agriculture sector is closely linked with the Food & Beverage sector, an assumption is made that Food & Beverage dynamics ought to resemble those of Agriculture. The QNHS indicates that primary agricultural production employed approximately 90,000 people in 2012.

[43] For a more in-depth analysis focusing solely on the agricultural and food sector see Donnellan and Hanrahan (2016), "Brexit Potential Implications for the Irish Agri-Food Sector", Teagasc.

The potential sensitivity of these sectors to a decline in UK trade can be examined using the concepts of size and proportion exposure, as described in Section 4. The results of this are shown in Figure 12 below.

Figure 12. Exposure of Ireland's Manufacturing Subsector to UK Trade (2014)



Source: CSO Census of Industrial Production 2014 data. Department of Finance Analysis.

The Food & Beverage and Pharmachem sectors together account for 72 per cent (47 per cent and 25 per cent respectively) of total UK manufacturing exports. 24 per cent of total Food & Beverage exports are destined for the UK while six per cent of Pharmachem exports go to the UK. This indicates that the Pharmachem sector in Ireland is much more diversified in its export markets than the Food & Beverage sector.

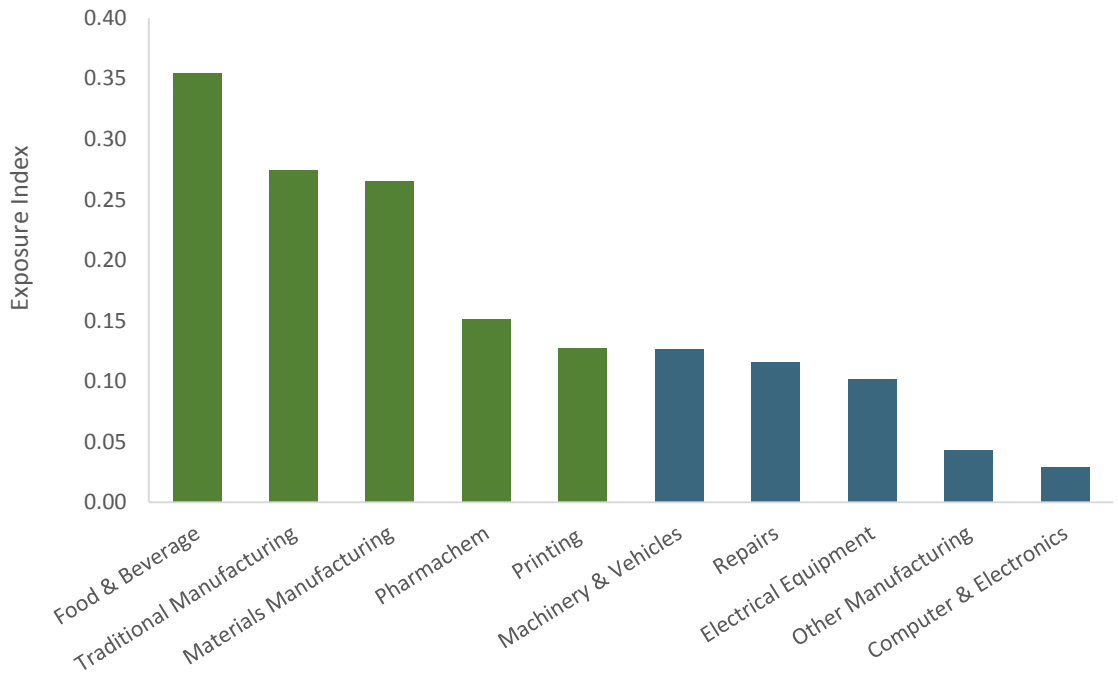
As can be seen from Figure 12, there are a number of sectors that contribute six per cent or less to total manufacturing exports to the UK. However, there is a considerable variation in the export exposure of each of these sectors. For example, on one side, Traditional Manufacturing sends over 50 per cent of its total exports to the UK. At the other end of the scale only five per cent of Other Manufacturing exports are UK-bound.

In terms of proportional exposure, Traditional Manufacturing, Printing, Food & Beverage, and Materials Manufacturing send at least 24 per cent of their exports to the UK. This indicates that the potential scenario of customs controls between the UK and Ireland could be particularly damaging for these sectors, given that the burden of customs controls is likely to fall more heavily on low value high volume/weight products (Barrett et al., 2015).

The relative exposure of each manufacturing subsector to UK trade can be further understood through a similar analysis to that found in Section 4.6, by using an "exposure index" which equally weights the contribution of each sector to total manufacturing exports to the UK (the size exposure) and the share

of subsector exports which are destined for the UK (the proportional exposure). Following Equation 3 this yields Figure 13.

Figure 13. Exposure Index for the Manufacturing Sector (2014, CIP)



Source: CSO Census of Industrial Production 2014 data. Department of Finance Analysis.

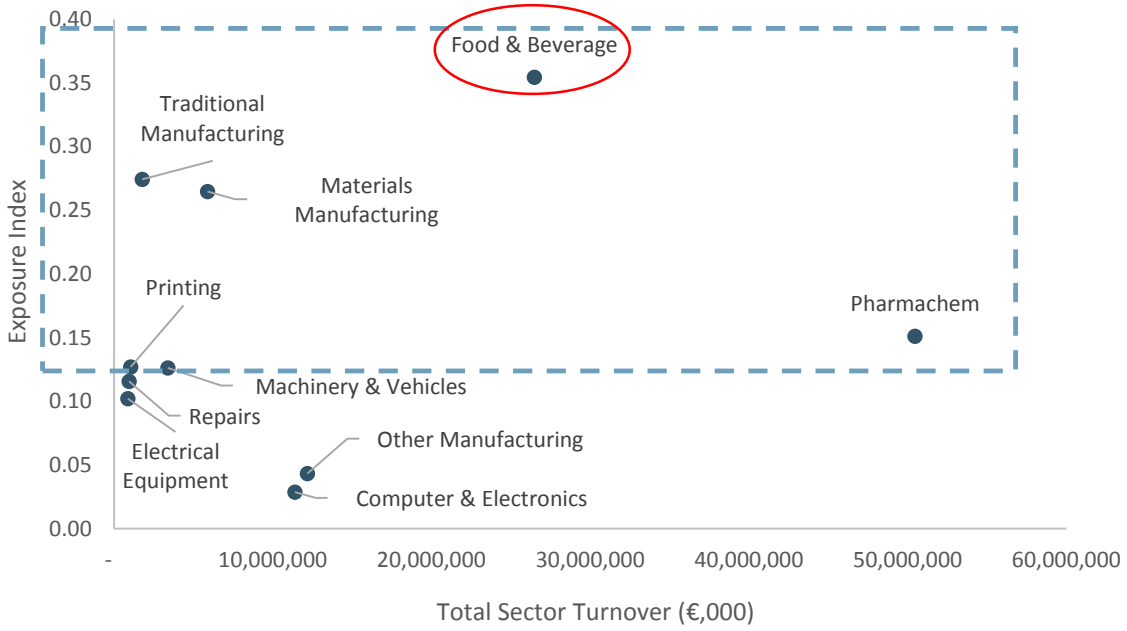
The calculation of the exposure index reveals that not only are Food & Beverage and Traditional Manufacturing two largest sectors in manufacturing in terms of turnover, they are the most exposed to the UK. According to Figure 13, the five manufacturing sectors which are most exposed to the UK, based on the exposure index, are:

- Food & Beverage;
- Traditional Manufacturing;
- Materials Manufacturing;
- Pharmachem; and,
- Printing.[44]

Having looked individually at the exposure of the manufacturing sectors this UK exposure measure is now combined with two measures of sector size, turnover and employment. This is done to add another perspective on exporting exposure to the UK given the importance of these economic variables. The result of this analysis is shown in Figures 14 and 15. This allows both a comparison of the size of sectors in the context of their exposure and the potential employment effects from possible adverse changes.

[44] In the original version of this paper, published with Budget 2017, Electrical Equipment was the fifth most exposed manufacturing sector based on data from the 2012 release of the Census of Industrial production. However based on the 2014 release it has now been marginal replaced by the Printing sector.

Figure 14. Exposure Index versus Turnover for Manufacturing subsectors (CIP, 2014)

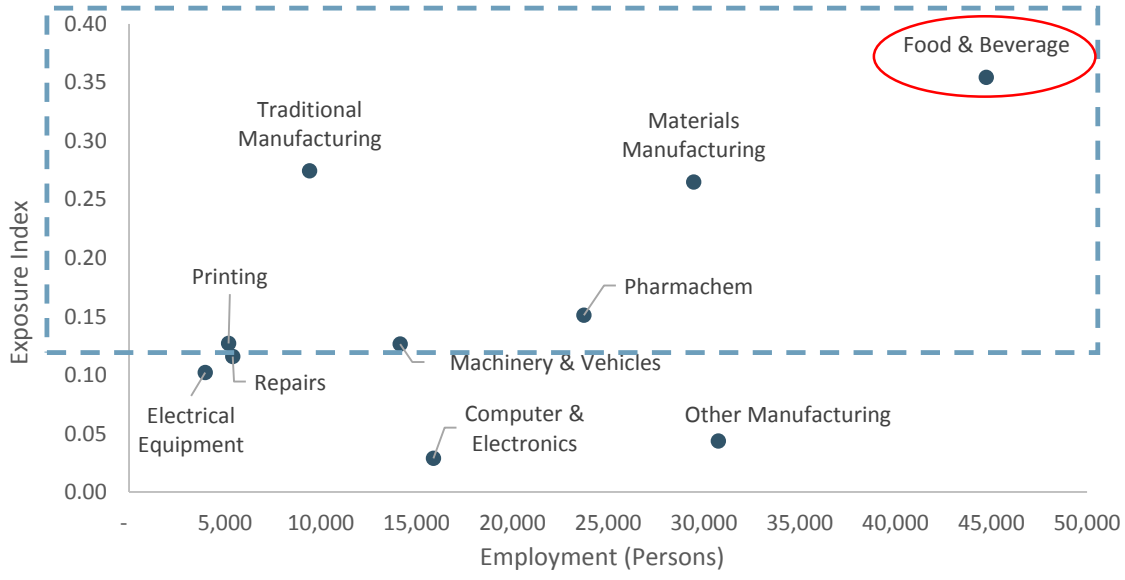


Source: CSO Census of Industrial Production, 2014. Department of Finance analysis.

Looking at the top five most exposed sectors, as described in Figure 14, it is clear that two, Food & Beverage and Pharmachem have a much higher turnover than Traditional Manufacturing, Printing and Materials Manufacturing.

Figure 15 shows that the Food & Beverage sector and Pharmachem remain the most exposed in terms of employment as well as turnover. However, the ordering of these sectors is reversed, as Food & Beverage has a greater share of employment than Pharmachem. In terms of overall employment, three of the ten sectors account for over half (57 per cent) of total manufacturing employment. These are (i) Food & Beverage, (ii) Materials Manufacturing and (iii) Other Manufacturing.

Figure 15. Exposure Index versus Employment for Manufacturing subsectors (CIP, 2014)



Source: CSO Census of Industrial Production 2014 data. Department of Finance Analysis.

The turnover figures presented so far are total turnover figures. An advantage of the CIP data is, however, that it contains information on turnover accounted for by exports to the UK. This can be thought of as how exposed a sector's sales are to the UK market. The top five most exposed manufacturing sectors, based on the exposure index methodology, have the following shares of turnover related to UK exporting:

Table 3. Shares of Turnover related to UK exporting in the Top Five Most UK-Exposed Manufacturing Sectors (based on the exposure index)

NACE Sector	Share of Turnover from exports to the UK, 2014
Food & Beverage (Sector C NACE 10-11)*	15%
Traditional Manufacturing (Sector C NACE 12-17)*	20%
Materials Manufacturing (Sector C NACE 22-25)*	16%
Pharmachem (Sector C NACE 20, 21)*	4%
Printing (Sector C NACE 18)	10%

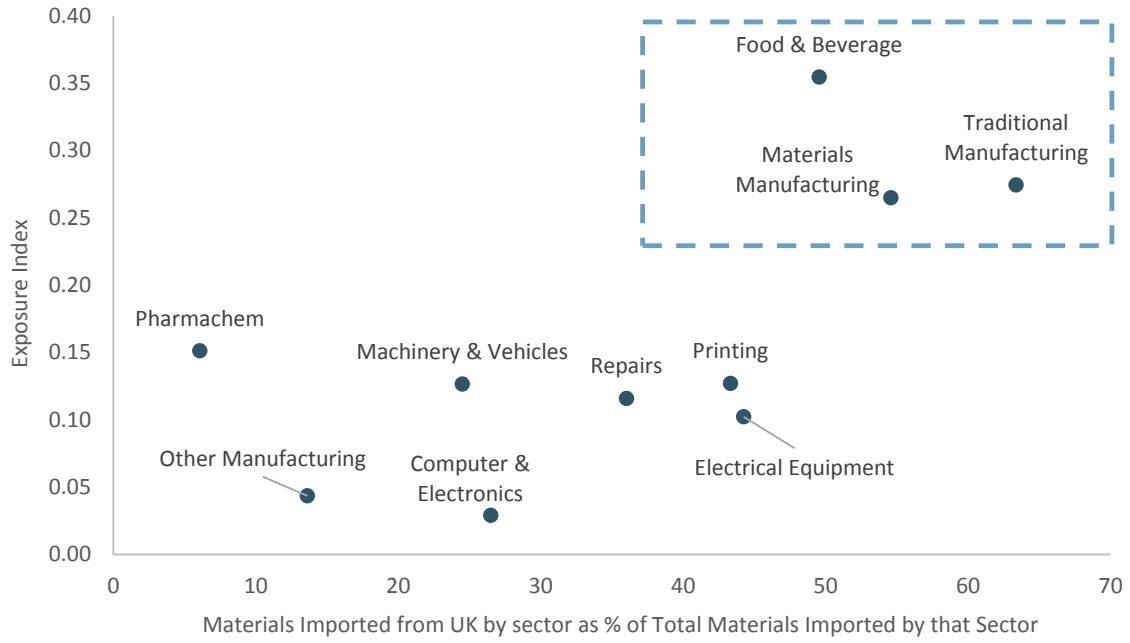
Source: CSO Census of Industrial Production 2014 data. Department of Finance Analysis.

As can be seen above, the top five exposed sectors depend on the UK for a broadly similar share of turnover ranging from four to 20 per cent.

5.3 Import Shocks and Production Chains

Firms located in Ireland, and thus the sectors analysed in this paper, could also face disruptions to their international production chains which could add to the cost of inputs as a result of a UK exit, particularly if tariff or non-tariff trade barriers were to be introduced. Figure 16 shows the share of each sector's manufacturing production inputs that are accounted for by UK-sourced imports. This is graphed against the measure of export exposure from the previous sections. This figure reveals that four sectors, Food & Beverage, Traditional Manufacturing, Materials Manufacturing and Printing each source over 43 per cent of their imported production materials from the UK. The Pharmachem sector, by contrast, sources only six per cent of its imported production materials from the UK, and so, has a much more internationally diversified production chain.

Figure 16. Share of Inputs Imported from the UK by Sector in 2014



Source: CSO Census of Industrial Production 2014 data. Department of Finance Analysis.
Note the vertical axis represents the export exposure index from Figure 13

Another aspect of production importing is the proportion of UK-imported materials out of total materials purchased. A sector may source a high proportion of their imported materials from the UK but imported materials may not account for a high proportion of total materials used in production. This is particularly the case in the Food & Beverage sector where, although the UK accounts for 49.5 per cent of imported materials, this only accounts for 10.6 per cent of the sector's total imports. This indicates that a high level of domestic intermediate goods are used in production. In the Materials Manufacturing and Traditional Manufacturing sectors this figure is much higher, with materials imported from the UK accounting for over 17 per cent of all materials used, indicating a potential exposure to disruption to their UK-associated production chain. The figures for the top five most exposed sectors are shown in Table 4:[45]

Table 4. Top Five most Exposed Manufacturing Sectors to the UK

NACE Sector	Percentage of Production Imports In 2014	Percentage of Total Materials used in 2014
Food & Beverage (Sector C NACE 10-11)*	49.5%	10.6%
Traditional Manufacturing (Sector C NACE 12-17)*	63.4%	17.1%
Materials Manufacturing (Sector C NACE 22-25)*	54.6%	19.4%
Pharmachem (Sector C NACE 20, 21)*	6.1%	3.9%
Printing (Sector C NACE 18)	43.3%	6.9%

[45] Further details are contained in Table 7 in the appendix.

Source: CSO Census of Industrial Production 2014 data. Department of Finance Analysis.

5.4 Economic Impact and Characteristics of the Exposed Sectors

Using the same five sectors identified by the exposure index, this section looks at key economic impact statistics such as output (value added) , more detailed employment data, domestic economy linkages, share of turnover accruing to Irish owned enterprises, Type 1 multipliers, and regional impacts.[46]

The sectoral economic impacts are summarised in Table 5. It can be seen that Pharmachem and Food & Beverages account for almost 70 per cent of manufacturing GVA. This highlights the high value add of the outputs produced by this sector. As well as having a high share of GVA, the Pharmachem sector also has a relatively low share of turnover accruing to Irish owned enterprises. By contrast, in the highly UK-exposed and employment-heavy Food & Beverage sector, 49 per cent of its turnover is accounted for by firms that are Irish owned. This indicates, that in terms of the composition of the exposed sectors, both multi-national and domestic Irish firms will be impacted by any economic disruption related to the UK.

The Traditional Manufacturing sector is one which records a high exposure measure due to the concentration of its exports in the UK market. The figures in Table 5 suggest that this sector is a labour intensive and low productivity sector. These characteristics imply that this sector would be relatively more vulnerable to changes in economic conditions. The Materials Manufacturing sector has similar characteristics. This is a manufacturing sector with a relatively high exposure index measure, a considerable degree of Irish ownership and high labour intensity. These characteristics are again suggestive of a higher sensitivity to changes in the trade relationship with the UK.

Turning to economy-wide spillovers, both the Food & Beverage sector and Traditional Manufacturing sectors have relatively high output multipliers. These output multipliers are suggestive of comparatively large second round economic impacts from any adverse changes to these sectors, which again score highly on the exposure index.

[46] See Table 12 of the CSO Input-Output Tables for Ireland 2011. A multiplier that also takes account of the consumption by employees that earn income in that sector is referred to as a Type 2 multiplier. Type 2 multipliers are not normally used in policy analysis and are not estimated in the analysis described herein.

Table 5. Turnover, Gross Value Added and Output Multipliers of the Top Five Manufacturing Sectors Exposed to the UK

NACE Sector	Turnover from indigenous enterprises as per cent of Total Sector turnover	Gross Value Added per Person Employed by sector (€'000)	Gross Value Added as per cent of Total Manufacturing Gross Value Added	Total Personnel Costs as a per cent of Gross Value Added by Sector	Output multipliers
Food & Beverage (Sector C NACE 10-11)*	49	207	24	21	1.5
Traditional Manufacturing (Sector C NACE 12-17)*	75	64	1	60	1.4
Materials Manufacturing (Sector C NACE 22-25)*	67	76	6	59	1.4
Pharmachem (Sector C NACE 20, 21)*	6	669	42	11	1.1
Printing (Sector C NACE 18)	58	82	1	49	1.2

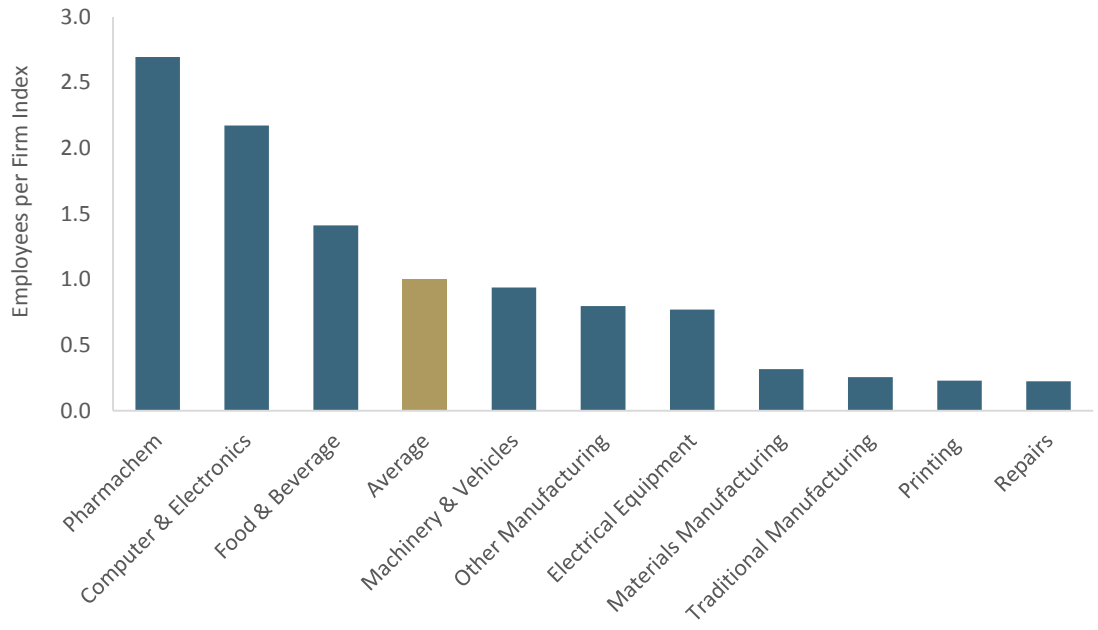
Source: CSO Census of Industrial Production 2014 data, and Input-Output Table 12 for Ireland 2011 data. Department of Finance Analysis. Note: Average Output multiplier for combined sectors (*) authors' calculations.

In terms of the size of these sectors, this is typically measured at the firm level whereas this paper focuses on the sectoral level. The CIP does, however, contain data on the number of enterprises in each sector and the number of employees. Although not at the firm level, this information can be used to gain a broad overview of whether a sector is likely to contain a high or low concentration of small and medium-sized enterprises.[47] This is shown as an index in Figure 17. The index normalises the average value of employees per firm in the CIP to one, other sectors are read as relative to this average. From this measure, the sectors which show a below average number of employees, and thus likely have a higher concentration of small and medium enterprises are, in descending order of size, Machinery & Vehicles, Other Manufacturing, Electrical Equipment, Materials Manufacturing, Traditional Manufacturing, Printing, and Repairs.

As can be seen from Figure 17, the Materials Manufacturing and Traditional Manufacturing sectors record less than half the average on this size indicator. As would be expected, this measure indicates that the Computer and Electronics, and Pharmachem sectors have the highest concentration of larger firms. These sectors record over three times the average for the size of sector in the CIP.

[47] Firm size is defined according to employee numbers as per OECD (2005), "OECD SME and Entrepreneurship Outlook: 2005", OECD Paris.

Figure 17. Index of Employees per Firm at the Sectoral Level



Source: CSO Census of Industrial Production 2014 data. Department of Finance Analysis.
The index normalises the average value of employees per firm in the CIP to 1.0, with all other sectors expressed relative to this

In Table 6 employment figures for the same five manufacturing sectors are presented by region. This table shows that the Food & Beverage sector is an important employment sector across all regions in Ireland. 25 per cent of the employment in this UK-exposed and employment-heavy sector is located in the Midlands region. This is the highest share in any region. In Traditional Manufacturing, employment is mainly based in both the Dublin and Midlands regions. Employment in the Pharmachem sector is mainly based around the Dublin, Midlands and South regions of the country. Each of the sectors has a relatively high share of employment outside of Dublin.

These figures suggest that any impact on the UK-exposed sectors of the Irish economy will have strong regional consequences due to the geographically dispersed nature of these sectors' production locations. That these sectors which record a high exposure to the UK have a substantial share of their employment in more rural regions is noteworthy, given the comparatively slow post-financial crisis labour market recovery of these areas compared to the Dublin region.[48]

[48] As of 2016 Q2 employment in Dublin was just four per cent below its pre-financial crisis peak. In the Border, South-West and West regions employment is still over 10 per cent below the pre-crisis peak. In the Midlands and Mid-West the figures are over nine per cent lower than the pre-crisis peak. This data is sourced from the CSO's QNHS.

Table 6. Persons Employed in Each Region as a Percentage of Total Employment by Sector[49]

NACE Sector	Dublin	Midlands	South-East	South-West	West Region	Border	Outside-Dublin
Food & Beverage (NACE 10-11)*	18	25	19	16	5	17	82
Traditional Manufacturing (NACE 12-17)*	29	27	9	9	9	17	71
Materials Manufacturing (NACE 22 to 25)	13	33	15	15	9	15	87
Pharmachem (NACE 20, 21)*	23	15	13	34	7	8	77
Printing (NACE 18)	54	14	19	16	5	7	46

Source: CSO Census of Industrial Production 2014 data. Department of Finance Analysis.

The previous analysis looked at the distribution of employment in the exposed manufacturing sectors in the regions of Ireland. It is also of interest to quantify the relative importance of these sectors as a share of total employment in these regions. In terms of the share of total employment in each of these regions accounted for by these sectors, the Border region contains the highest share of employment in the Food & Beverage sector.[50] In this region this sector accounts for six per cent of total employment. This compares to a share of two per cent of total employment for this sector in Dublin. On a more general point, the Border region records the highest regional share of total employment in four out of the five most exposed sectors across all regions, Pharmachem being the exception.[51] This result suggests that this region's employment is much more concentrated in UK-exposed sectors than any other region of the country.

In sum, the in-depth analysis reveals that:

- The most exposed manufacturing sectors based on the exposure index approach are Pharmachem and Food & Beverage. These are also the largest sectors in terms of turnover (Pharmachem) and employment (Food & Beverage).
- Both the Materials Manufacturing and Traditional Manufacturing sectors record relatively high exposure measures and a high labour intensity. Indicative measures also show them as low productivity sectors. This suggests that these sectors would be sensitive to changes in the economic environment, particularly in relation to the UK.
- The Food & Beverage, Traditional Manufacturing and Materials Manufacturing sectors source over 40 per cent of their imports from the UK. Of total production materials used, over 20 per cent are sourced from the UK in the Traditional Manufacturing and Materials Manufacturing sectors. This indicates the potential exposures these sectors have to production chain disruption stemming from their UK linkages.

[49] Data on Electrical Equipment sector in the South-west are not available due to data confidentiality considerations.

[50] These figures are calculated by combining the CIP and QNHS data. For a more detailed analysis of the regional aspect of sectoral employment see Morgenroth (2008), "Exploring the Economic Geography of Ireland", Journal of Statistical and Social Inquiry of Ireland. Vol. 38.

[51] Calculated using QNHS and CIP data.

- The Food & Beverage sector is an important employment sector across all regions in Ireland. Any impact on the UK-exposed sectors of the Irish economy will have strong regional consequences due to the geographically dispersed nature of these sectors' production locations. Indeed, the Border region has a higher share of total employment in four out of five of the most exposed sectors than any other region of the country.
- Some of the most exposed sectors have a relatively large concentration of small and medium sized enterprises. These sectors with a below average size are, in descending order, Machinery & Vehicles, Electrical Equipment, Repairs, Materials Manufacturing, Traditional Manufacturing and Printing.

6. Services Sectors Export Exposure

Section Summary

- In this section a further analysis of the services sectors is undertaken using Annual Services Inquiry (2014) and Quarterly National Household Survey (QNHS) data.
- Findings of the sectoral analysis indicate that the six services sectors of (i) Transport, (ii) Tourism and Travel, (iii) Communications, (iv) All Business Services, (v) Other Services, and (vi) Repairs and Processing, collectively account for €73bn in GVA and 989,000 employees according to ASI 2014.
- Key findings, highlighted previously in Section 4, indicate that (i) Transport, (ii) Insurance/Financial Services and (iii) Computer Services are the services sectors most exposed to the UK. The ASI and QNHS further indicate that these three sectors are significant sources of employment in the Irish economy.
- Tourism and Travel does not rank among the most exposed traded services sectors under the exposure index measure, however, the sector is important to Ireland both in terms of the number of enterprises and the level of employment it accounts for.
- Whilst services sectors may not be affected by trade tariffs to the same extent as some of the most exposed manufacturing sectors, certain services sectors, in particular Tourism and Travel, may be affected by currency fluctuations, such as by the recent sharp deterioration of Sterling vis-á-vis the euro.

6.1 Introduction

In previous sections of this paper the analysis has mainly focused on how exposed Irish exports and imports of goods and services are to the UK. In order to build on this analysis and provide a more in-depth view of the services sector, the ASI and QNHS are employed to detail the key Irish macroeconomic aggregates in the services sectors. These aggregates include turnover, output (value added), the number of enterprises and employment. Tourism and Travel data from the CSO are used to provide a descriptive analysis of the potential risks to this sector, stemming from its exposure to the UK.

6.2 Service Sector Aggregates

As illustrated in Table 7, the six services sectors of (i) Transport, (ii) Tourism and Travel, (iii) Communications, (iv) All Business Services, (v) Other Services, and (vi) Repairs and Processing, collectively account for €73bn in GVA and 989,000 employees in Ireland.[52] The findings in Section 4, based on the composite measure of size and proportional exposures, highlighted that (i) Transport, (ii) Insurance/Financial Services and (iii) Computer Services are the most exposed services sectors in terms of exports to the UK. In terms of employment, it is also noted that these three sectors are significant sources of employment in the Irish economy. For example, as shown in Table 7, Transport and Communications/Computer Services combined account for over 173,000 employees.

[52] As outlined in Table 9, the Repairs and Processing sector contains the retail sector.

Table 7. Irish Services Sector Enterprises, Turnover, Gross Value Add and Employment

Balance of Payment Categories	Number of Distribution and Services Enterprises in 2014	Turnover (€'000) in 2014	Gross Value Added (€'000) in 2014	Persons Engaged (Number) in 2014
Transport	24,595	18,813,443	6,930,499	91,985
Tourism and Travel	17,790	9,750,106	3,925,209	161,097
Communications/Computer Services	13,687	99,020,998	22,545,557	82,010
All business Services	66,119	52,019,625	19,888,315	255,468
Other Services not elsewhere specified	17,722	6,224,013	2,015,183	61,805
Repairs and Processing	45,618	133,152,598	18,049,302	336,866

Source: CSO Annual Services Inquiry 2014 data. Department of Finance Analysis. Note: Insurance/Financial Services and Computer Services figures are not included in Table 7 as they are not disaggregated into separate sectors in the CSO Annual Services Inquiry.

The ASI data that is used in this section has the drawback that that it does not contain the same level of sectoral disaggregation as available in the Balance of Payments data. This restriction means that the Insurance/ Financial Services sector, which ranked as the second most exposed Service sector in Section 4, is not included separately in Table 7 above. To gain more specific detail on the employment levels in this important sector data from the QNHS is used. Based on this data combined employment in financial service activities and insurance accounted for over 89,500 jobs or five per cent of total employment in Ireland in Q1 2016.[53]

The Insurance/Financial Services sector in Ireland has a larger share of economic activity the Irish economy in comparison to the average share for this sector among other euro area states. This can be seen in terms of gross value added (GVA). GVA in the Insurance/Financial Services sector combined account for eight per cent of gross domestic product (GDP) in Ireland in 2014. In comparison, in 2014, the Insurance/Financial Services sector GVA accounted for just under five per cent of euro area GDP.[54]

6.3 The Tourism and Travel Sector

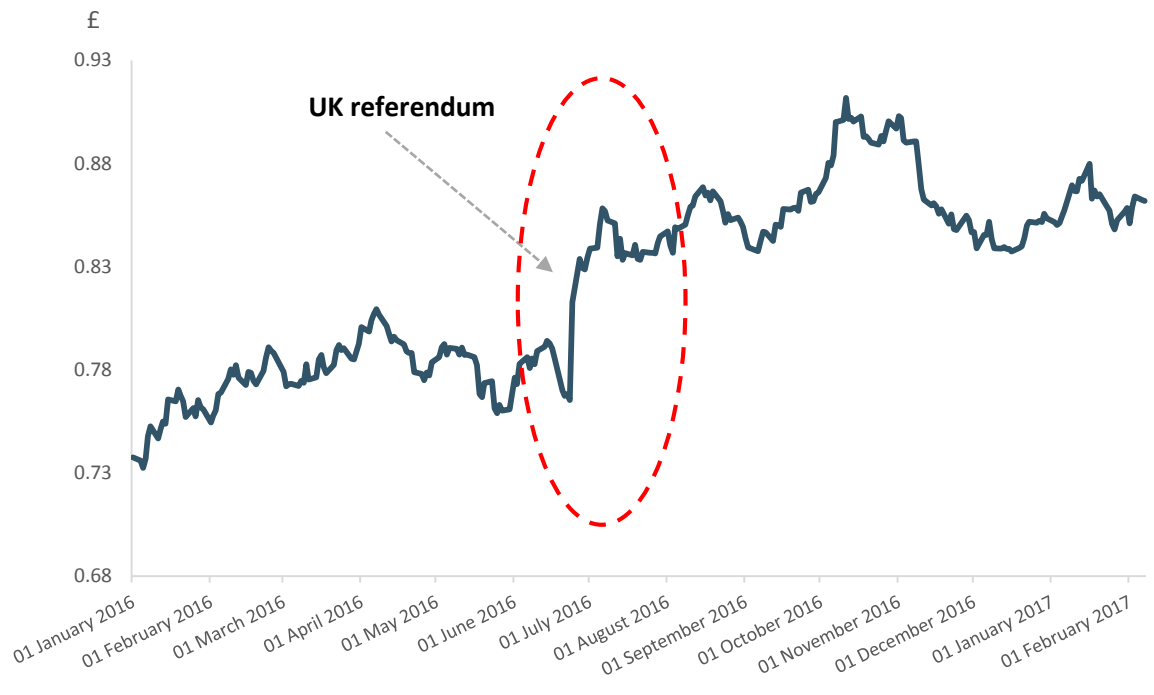
Although Tourism and Travel does not rank among the most exposed services sectors in terms of the exposure index measure as presented in Section 4, it can be seen from Table 7 that this sector is important to Ireland's economy both in terms of the number of enterprises and the employment levels in the sector. For example, as shown in Table 7, in 2014 there were over 161,000 persons employed in Tourism and Travel, a level similar to the number of persons employed in both the Transport and Communications/Computer Services sectors combined.

Although it is not as exposed as other sectors, one consequence of the recent referendum that could have a strong impact on the Tourism and Travel sector is volatility in the exchange rate. Recent

[53] This share has remained reasonably stable over the past number of years.
[54] This analysis is based on Department of Finance and Eurostat data. These figure should be taken as approximations as they don't account for losses.

currency dynamics are illustrated in Figure 18 below. Since the UK vote on 23rd June, the fall in Sterling versus the euro has made it relatively more expensive for British visitors to travel, purchase goods and stay in Ireland.

Figure 18. Euro versus UK Sterling currency rate movements

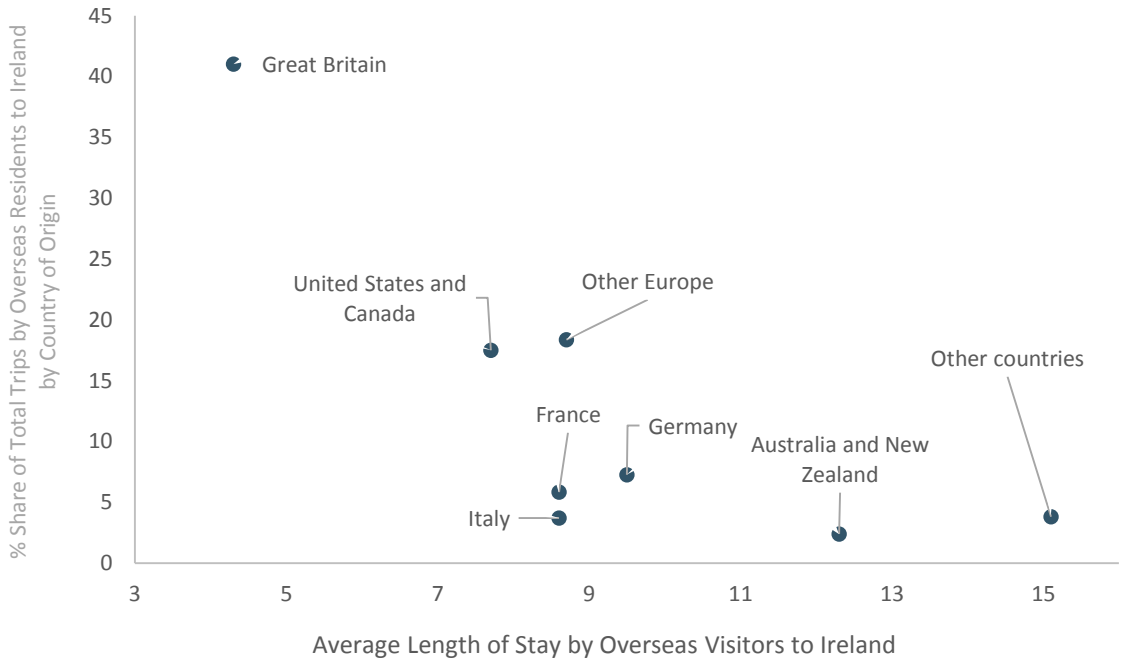


Source: Bloomberg data. Department of Finance analysis.

This strong step change in the value of Sterling is of particular importance for Ireland's Tourism and Travel sector as, in 2015, visitors from the UK accounted for 41 per cent of the 8.6 million overseas trips to Ireland by non-residents. The share of trips, in comparison to other countries and regions, and also the average length of stay (in nights) by overseas visitors to Ireland, is shown graphically in Figure 19. From this it can be seen that that as well as accounting for the vast majority of overseas trips to Ireland, visitors to the UK also have the shortest length of stay. This high volume of short trips is suggestive of a market characterised by a relatively high elasticity of demand i.e., a higher sensitivity to price, and thus, one which would be relatively more influenced by movements in the exchange rate.

Again, utilising the CSO's Tourism and Travel data to look more specifically at trips of a very short duration to Ireland, measured as same-day trips, the UK again dominates this market. Residents of the UK account for 48 per cent of all same day trips to Ireland and 81 per cent of same day business trips in 2015.

Figure 19. Percentage Share of Trips to Ireland by Country of Origin versus Average Length of Stay by Visitors to Ireland by Country of Origin 2015



Source: CSO Tourism Statistics 2015, Department of Finance Analysis

In summary, although detailed data, such as that contained in the CIP for manufacturing, is not available for the service sectors, service firms are of vital importance for the Irish economy. Services sectors account for the majority of economic activity and employment in Ireland. In Section 3 it was shown that a number of the larger services sectors record a significant degree of exposure to the UK. Although not a sector that fits well with the exposure measures presented in this paper, other available data suggests that the Tourism and Travel sector has a high degree of exposure to the UK due to the volume and nature of travel and also its exposure to exchange rate dynamics.

7. Fiscal Impacts

Section Summary

- In this section data is presented on profit levels and corporation tax payments at the sectoral level. This data is used to give an indication of the ability of sectors to withstand an economic shock and the potential fiscal spillovers from an adverse change in any of these sectors.
- The Pharmaceutical and Chemicals sector is by far the largest contributor to corporation tax receipts in the goods sector of the Irish economy. This sector also records the highest level of profit per employee.
- Pharmaceutical and Chemicals also record a high exposure measure to the UK indicating a potential fiscal spillover.
- The two other most exposed goods sectors are Food & Beverage and Traditional Manufacturing. These sectors report a lower share of profit per employee relative to other sectors, indicating they may be more exposed to shocks.
- On the services side, the Financial Services and Communication and IT sectors make up the vast majority of profits and corporation tax contributions and also have a relatively high exposure measure.

7.1 Introduction

Utilising data supplied by the Revenue Commissioners, this section presents the profit levels and corporation tax payables of different sectors of the Irish economy.[55] It should be noted that, due to confidentiality constraints, it was not possible to present the data at the level of aggregation seen in the other sections of this paper. The aggregation in this section is at a higher level and so, although being broadly similar, it is not identical.[56] The exposure index also changes in this section to reflect the altered aggregation.

7.2 Sectoral Profit Levels and Corporation Tax Payables

The figures on profitability and corporation taxes are presented as ratios per employee. The data is scaled in this way to aid comparability by providing some control for the size of the different sectors. Employee numbers are a commonly used control for size in firm level analyses.[57] Although the following is not a causal analysis, profits are used to provide an indicator of a sector's ability to withstand a shock - in this case a shock from trade restrictions and or a reduction in growth in the UK.[58] Sectoral profits per employee in the manufacturing sector are presented in Figure 20. As is

[55] This analysis is based on the sum of adjusted profits and corporation tax payables by industry sector. Adjusted profits refer to a company trade profits before capital allowances. Corporation tax data refers to the gross calculated corporation tax payables by industry sector, and therefore does not include subsequent corporation tax repayables. Data refers to the corporation tax registered firms only. It therefore does not take into account full contribution in tax and numbers of enterprises in that are not in the corporation tax sector.

[56] Details of the aggregation used to combine the Revenue data with the exposure measures is contained in Table 12 in the appendix.

[57] See for example; Siedschlag, Kileen, Smith and O'Brien (2011). "Internationalisation and the Innovation Activities of Services Firms", ESRI Working Paper No. 406. To keep the data consistent, Revenue employment data from Pigott and Walsh (2014) is used. Pigott and Walsh (2014). "Corporation Tax – A Note on the Context and Concentration of Payments", Statistics and Economic Research Branch, Revenue.

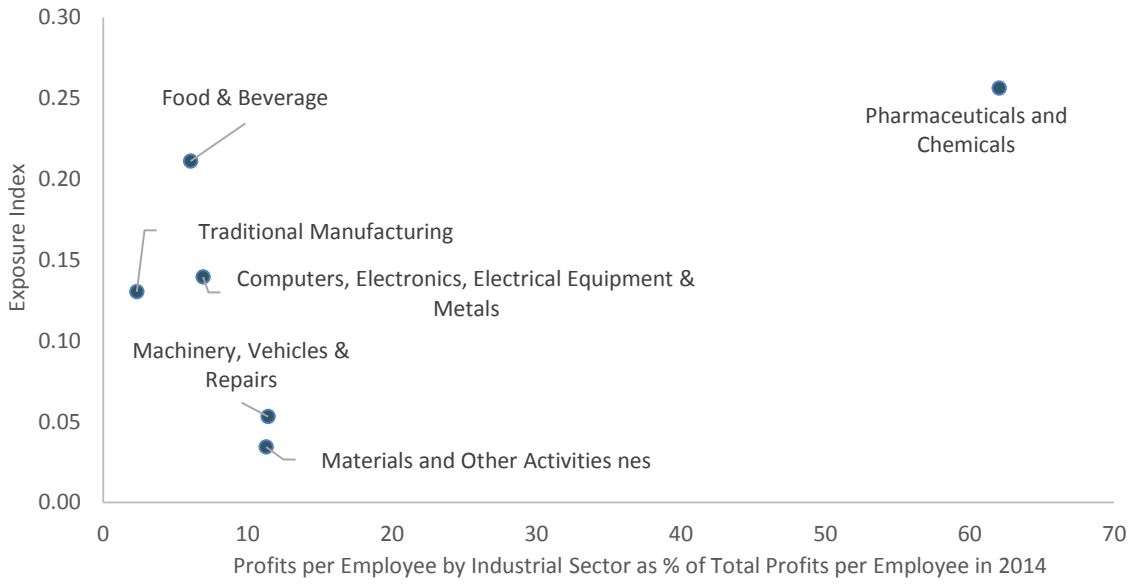
[58] Data limitations prevent a more involved analysis of survival. For an example of this more detailed approach see; Agarwal and Gort (2002). "Firm and product life cycles and firm survival", American Economic Review, 92, 184-190, Audretsch and Mahmood

consistent with Figure 3, which provides an overview of the major export sectors of the Irish economy, the manufacturing side is dominated by the Pharmaceutical and Chemicals sector. This sector accounts for over 60 per cent of the profits in manufacturing and also has a high score on the exposure index, indicating a potentially large fiscal impact on the Irish economy from a UK-related disruption.

Section 5 highlighted the Food & Beverage sector as being the most exposed of the manufacturing sectors. In Section 5 it was also shown that this is an employment-heavy sector. The numbers highlighted in Figure 20 are thus a particular concern for the Irish economy as they indicate that this sector, which shows up as highly exposed to the UK and as employing just under 40,000 people, is also a sector that operates in a comparatively low profit environment, potentially leaving this sector in a more vulnerable position. Low profitability suggests less scope to maintain production and employment in response to trade restriction, a trading partner slowdown or an exchange rate fall. Section 5 also highlighted that this would have potentially strong consequences for Ireland is more regional and rural labour markets due to the location of economic activity in this sector.

Given the composition of the Traditional Manufacturing sector and the low GVA measures it reports in Section 5, it is unsurprising that this sector displays the lowest profit per employee measure of any of the manufacturing sectors. The composition suggests a low tech sector and the GVA numbers support this view. This result and the specific analysis of the manufacturing sectors presented in Section 5 indicates that this sector could be at a high degree of risk from any UK-related disruption as this sector is both highly exposed to the UK and is also operating in a comparatively low profit environment. As with Food & Beverage, this could have a disproportionate impact on more regional labour markets.

Figure 20. Exposure Index versus Profits per Employee by Manufacturing Sector as a Percentage of Total Profits per Employee in 2014

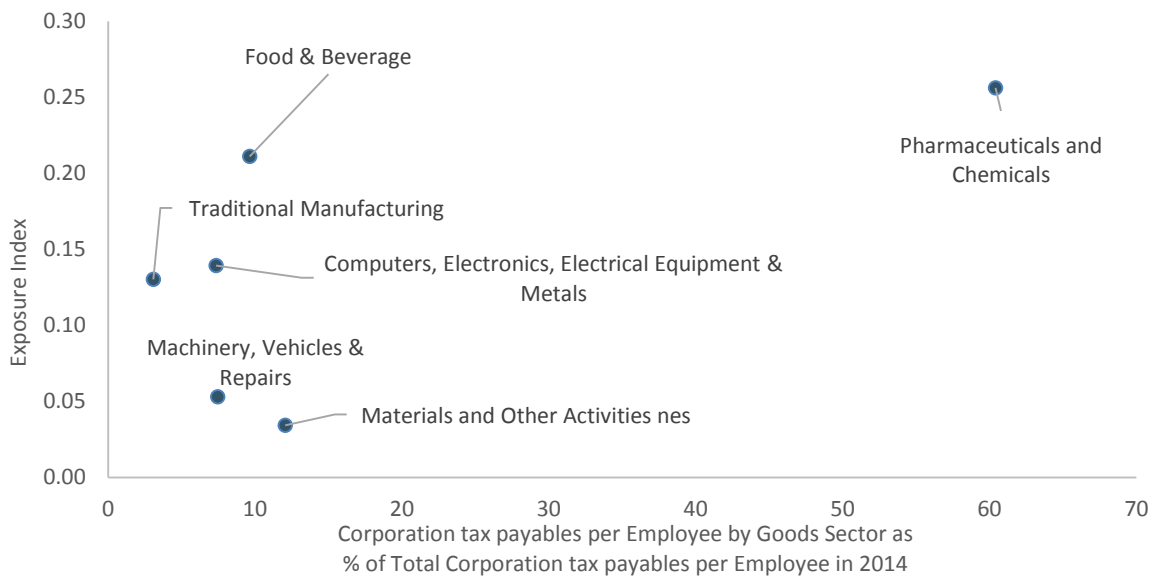


Source: Revenue Commissioners and Department of Finance analysis.

(1995). "New Firm Survival: New Results Using a Hazard Function", The Review of Economics and Statistics, 77, 97-103, and McGuinness, Hogan and Powell (2016). "European trade credit use and firm survival". DCU Working Paper.

The impact on the general economy from an adverse development in the Food & Beverage or the Traditional Manufacturing sector would be expected to come through the employment channel. This would be due to their relatively low profitability and the likely accompanying increased risks to firm survival. The impact on the economy from the Pharmaceutical and Chemicals sector would potentially operate through a different channel. This is highlighted in Figure 21. This figure captures an aspect of any potential fiscal impact from a disruption to sectors connected with the UK. As can be seen in Figure 21 below, the Pharmaceutical and Chemicals sector accounts for over 60 per cent of the total corporation tax take per employee in the manufacturing sector. This indicates that, although the profit level would seem to indicate an ability survive a shock, the corporation tax payables reveal that any disruption in this sector could have a substantial spillover on the government's fiscal position due to the sector's size.

Figure 21. Exposure Index versus Corporation Tax Payables per Employee by Manufacturing Sector as Percentage of Total Corporation Tax Payables per Employee in 2014



Source: Revenue Commissioners and Department of Finance analysis.

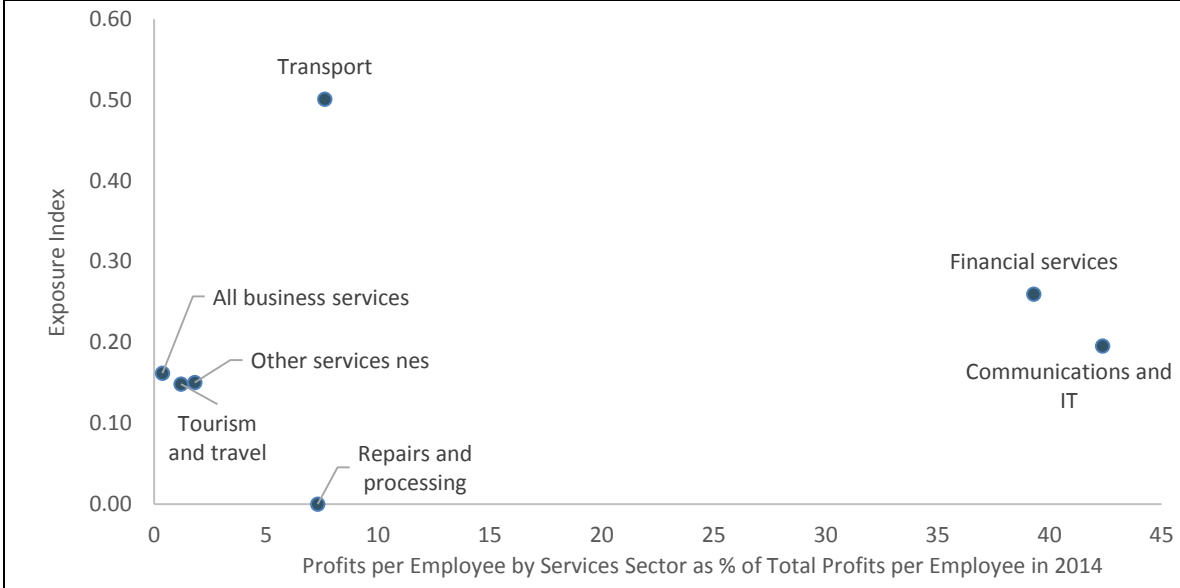
As stated, the aggregation of sectors in this section is not identical to the rest of the paper due to confidentiality considerations. For the services sectors, there is an additional issue in that there is no exact matchup defined for matching the BOP sectoral categorisations with the NACE categorisations. This matching is necessary to link the service sectors exposure measure to the profit and corporation tax data. An approximate matching is performed in this paper and results should be taken in this context.[59]

For the service sectors, the profits per employee results are presented in Figure 22. Profits in these sectors are in the majority generated in the Financial Services and Communications and IT sectors. Although the transport sector dominates in terms of the exposure index, it should be noted that the level of exposure to the UK for the Financial Service and Communication and IT sector is comparable

[59] For a description of the approximate amalgamation see Table 9 in the Appendix.

to that of the most exposed manufacturing sectors. Also of note from this figure is that the Transport sector has a profit level per-employee that is comparatively low.

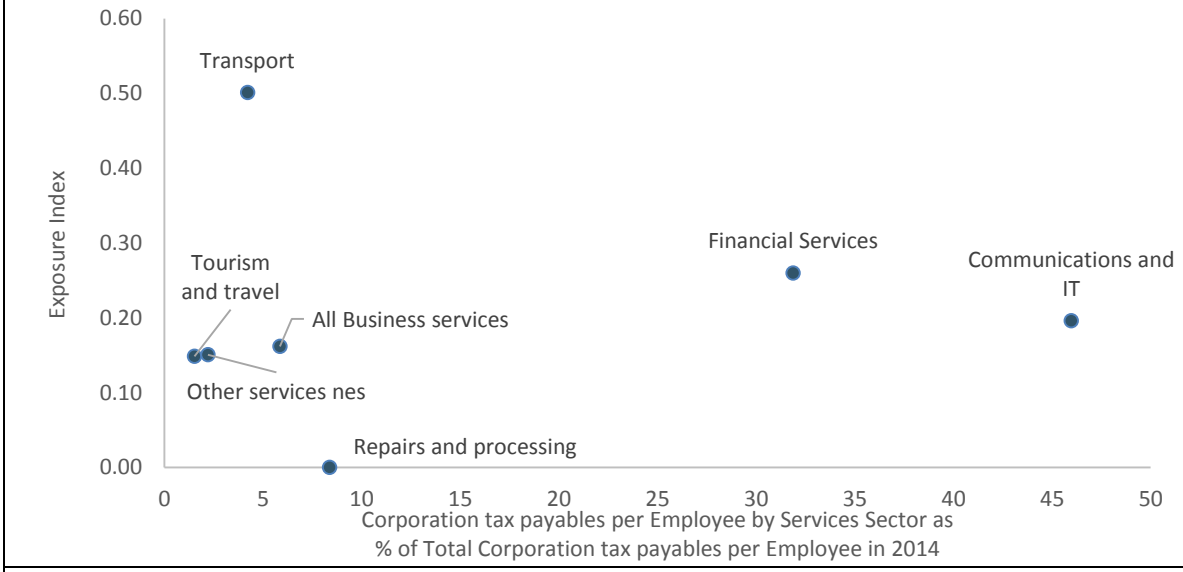
Figure 22. Exposure Index versus Profits per Employee by Services Sector as a Percentage of Total Profits per Employee in 2014



Source: Revenue Commissioners and Department of Finance analysis.

Turning to Figure 23, and the potential fiscal impact, corporation tax payables in the services sector come mainly from the Financial Services and Communication and IT sectors. The relatively high exposure measure and the large share of the tax contribution indicates that a UK-related disruption to these sectors could, as in the case of the pharmaceutical and chemicals industry, potentially have a large impact on tax receipts and, thus, the government's fiscal position.

Figure 23. Exposure Index versus Corporation Tax Payables per Employee by Services Sector as a Percentage of Total Corporation Tax Payables per Employee in 2014



Source: Revenue Commissioners and Department of Finance analysis.

8. Appendix

Table 8. Balance of Payments Categories of Services

10 Service Sectors	*BOP Service Export Sectors*
1	*Transport*
2	*Tourism and Travel*
3	*Communications*
4	*Insurance Services*
5	*Financial Services*
6	*Computer Services*
7	*Royalties and Licences*
8	*All Business Services*
9	*Other Services not elsewhere specified*
10	*Repairs and Processing.*

Some specific points of note in relation to the Balance of Payment Services ten categories are:

1) ***Transport*** adjusted to include freight element of merchandise imports that are valued on a *free on board (*f.o.b.) basis rather than a *cost, insurance and freight* (c.i.f.) basis. Note; ***Merchandise*** exports and imports are valued f.o.b. (*free on board*) for BOP purposes. While imports are valued c.i.f. (*cost, insurance and freight*) in the official external trade statistics, adjustments are made to reflect an estimated f.o.b. valuation. These adjustments result from the application of different c.i.f./f.o.b. conversion ratios to the values of imports from within the European Union and from outside the European Union. In addition and in line with EU and ECB requirements, merchandise imports from within European Union member states are compiled on the basis of country of consignment rather than country of ultimate origin (as was the case formerly). Some adjustments are also made to the official merchandise trade statistics to conform to the BOP change of ownership and market valuation principles.
2) For ***tourism/travel*** the credit item represents the receipts of residents from non-resident visitors other than passenger fare receipts of Irish passenger carriers from non-residents; the latter are included under *transport* credits. The *tourism/travel* debit item represents foreign expenditure by Irish residents on foreign travel. Because of the difficulty of separately distinguishing passenger fares paid to non-resident carriers this element of expenditure is generally included in the *tourism/travel* debit item (rather than being more appropriately categorised as a debit item under *transport*. Payments made to Irish passenger carriers by Irish residents are excluded.
3) ***Communications*** covers postal and courier services and telecommunications services. Postal and courier services include the pick-up, transport and delivery of letters, postcards, printed matter, parcels and packages. Telecommunications services include the transmission of sound, images and other information by telephone, radio and television broadcasting, electronic mail, facsimile services and by satellite delivery. Also included are cellular telephone services and internet access services. Details of expenditures by resident enterprises on services purchased from non-residents are obtained from the BOP surveys of these enterprises. Information on receipts from non-residents in respect of their purchases of Irish-produced communications services are obtained from resident service providers.
4) The value of ***insurance Services*** provided to non-residents by resident insurers (credit) is estimated as the value of direct and supplementary premiums earned less the value of claims payable less increases in the actuarial element of insurance technical reserves. Supplementary premiums consist of investment income earned on investing the insurance technical reserves. For BOP purposes, this income is attributed to the policy holders and is also treated as being paid back to the insurance company by them. To obtain the value of insurance services purchased from non-resident insurers (debit), the ratio of the estimated service charge to total premiums for insurance exports is applied to the total premiums payable to non-resident insurers. Reinsurance transactions (e.g. premiums and claims) are recorded on a gross basis and, hence, insurance service credits and debits are accordingly higher than they would have been if recorded on a net basis. This gross recording treatment of reinsurance transactions has no net impact on the insurance service balance as the reinsurance element on the credit and debit sides are offsetting.

In relation to merchandise imports, the freight insurance element of the c.i.f. to f.o.b. adjustment referred to above under *merchandise* is recorded under *insurance*.

5) ***Financial Services*** covers non-interest receivables and payables in respect of financial intermediary and auxiliary services (other than those of insurance enterprises and pension funds). Also included are margins between interest payable and the reference rate on loans and deposits (called financial intermediation services indirectly measured (FISIM).

6) **Exports and imports of computer software** which is embedded in hardware or carried on other physical media are not included in *Computer Services* but under *merchandise*. Sales and purchases of software transmitted electronically as well as exports of certain software licences are recorded under *Computer Services.* This item also includes receipts and payments in respect of computer software licence fees as a conscious CSO departure from the international recommendations and as referenced under item (vi) above.

7) ***Royalties/Licences*** include franchises and similar rights as well as other royalties and licence fees. Franchises and similar rights comprise international payments and receipts of franchising fees and the royalties paid for the use of registered trademarks. Other royalties and licence fees includes international payments and receipts for the authorised use of intangible, non-produced, non-financial assets and proprietary rights (such as patents, copyrights and industrial processes and designs) and with the use, through licensing agreements, of produced originals or prototypes (such as manuscripts, and cinematographic works and sound recordings). As a conscious CSO departure from the international recommendations, receipts and payments in respect of computer software licence fees are not included under *royalties and licence fees* but are instead included under *Computer Services* (see item (viii) below). A further deviation from the international standards is that royalty receivables and payables in connection with the entertainment industry (mainly concerning film distribution and musical recordings and performances) are currently excluded from *royalties and licence fees* and included under *other services not elsewhere specified*.

8) ***All Business Services*** covers receivables and payables for (a) *research and development,* (b) *operational leasing* and (c) *miscellaneous business services. Research and development* services cover those services that are associated with basic research, applied research and experimental development of new products and processes. Activities in the physical sciences, social sciences and humanities are covered, including the development of operating systems that represent technological advances. Also included is commercial research related to electronics, pharmaceuticals and biotechnology. Outright sales and purchases of the results of research and development (such as patents, copyrights and industrial processes) are included. These transactions tend to occur infrequently but the amounts involved can vary substantially. Amounts payable and receivable for use of such proprietary rights are included under royalties/licences *(see above)*. *Operational leasing* covers rental receivables and payables in respect of leasing (other than financial leasing) and chartering, without operators, of aircraft, ships and other transport or other equipment and plant. *Miscellaneous business services* covers legal, accounting, management consulting, public relations, advertising and marketing and other professional and technical services as well as agricultural services. It also covers inter-affiliate management fees and other trade related services such as commissions earned by resident agents or paid to non-resident agents in connection with imports or exports.

9) ***Other Services not elsewhere specified*** covers construction services, personal and cultural services (e.g. fees and royalties for film, television and musical recordings and performances), educational services and government services. The last sub-category includes credit and debit entries for (a) the estimated expenditures of embassy and consular staff in the host countries, (b) non-labour expenditures by governments towards the provision of embassy and consular services in the host countries, and (c) receipts i.e. credits, in respect of collection of Ireland's budgetary contributions to the EU).

10) ***Repairs and processing*** covers processing and repair work by residents on goods that are owned by non-residents (and vice versa). The value includes any parts or Materials Manufacturing supplied by the repairer and included in the charge.

Further details in relation to the Balance of Payment categorisations can be found at the following: http://www.cso.ie/en/media/csoie/surveysandmethodologies/surveys/bop/documents/pdfs/BopBkgdnotes.pdf

Table 9. NACE Codes and Economic Sectors

NACE Codes	Economic Sectors 2 digit (NACE Rev.2)
(A) **Agriculture, forestry and fishing**	01 Crop and animal production, hunting and related service activities 02 Forestry and logging 03 Fishing and aquaculture
(B) **Mining and Quarrying Industry**	05 Mining of coal and lignite 06 Extraction of crude petroleum and natural gas 07 Mining of metal ores 08 Other mining and quarrying 09 Mining support service activities
(C) **Manufacturing**	10 Manufacture of food products 11 Manufacture of beverages 12 Manufacture of tobacco products 13 Manufacture of textiles 14 Manufacture of wearing apparel 15 Manufacture of leather and related products 16 Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting Materials Manufacturing 17 Manufacture of paper and paper products 18 Printing and reproduction of recorded media 19 Manufacture of coke and refined petroleum products 20 Manufacture of chemicals and chemical products 21 Manufacture of basic pharmaceutical products and pharmaceutical preparations 22 Manufacture of rubber and plastic products 23 Manufacture of other non-metallic mineral products 24 Manufacture of basic metals 25 Manufacture of fabricated metal products, except machinery and equipment 26 Manufacture of computer, electronic and optical products 27 Manufacture of electrical equipment 28 Manufacture of machinery and equipment n.e.c. 29 Manufacture of motor vehicles, trailers and semi-trailers 30 Manufacture of other transport equipment 31 Manufacture of furniture 32 Other manufacturing 33 Repair and installation of machinery and equipment
(D) **Electricity, gas, steam and air conditioning supply**	35 Electricity, gas, steam and air conditioning supply
(E) **Water Supply; Sewerage; Waste Management and Remediation Activities**	36 Water collection, treatment and supply 37 Sewerage 38 Waste collection, treatment and disposal activities; Materials Manufacturing recovery 39 Remediation activities and other waste management services
(F) **Construction**	41 Construction of buildings 42 Civil engineering 43 Specialised construction activities
(G) **Wholesale and retail trade; repair of motor vehicles and motorcycles**	45 Wholesale and retail trade and repair of motor vehicles and motorcycles

	46 Wholesale trade, except of motor vehicles and motorcycles 47 Retail trade, except of motor vehicles and motorcycles
(H) **Transportation and storage**	49 Land transport and transport via pipelines 50 Water transport 51 Air transport 52 Warehousing and support activities for transportation 53 Postal and courier activities
(I) **Accommodation and Food Service Activities**	55 Accommodation 56 Food and beverage service activities
(J) **Information and Communication**	58 Publishing activities 59 Motion picture, video and television programme production, sound recording and music publishing activities 60 Programming and broadcasting activities 61 Telecommunications 62 Computer programming, consultancy and related activities 63 Information service activities
(K) **Financial and Insurance Activities**	64 Financial service activities, except insurance and pension funding 65 Insurance, reinsurance and pension funding, except compulsory social security 66 Activities auxiliary to Financial Services and Insurance activities
(L) **Real Estate Activities**	68 Real estate activities
(M) **Professional, scientific and technical activities**	69 Legal and accounting activities 70 Activities of head offices; management consultancy activities 71 Architectural and engineering activities; technical testing and analysis 72 Scientific research and development 73 Advertising and market research 74 Other professional, scientific and technical activities 75 Veterinary activities
(N) **Administrative and support service activities**	77 Rental and leasing activities 78 Employment activities 79 Travel agency, tour operator reservation service and related activities 80 Security and investigation activities 81 Services to buildings and landscape activities 82 Office administrative, office support and other business support activities
(O) **Public administration and defence; compulsory social security**	84 Public administration and defence; compulsory social security
(P) **Education**	85 Education
(Q) **Human health and social work activities**	86 Human health activities 87 Residential care activities 88 Social work activities without accommodation
(R) **Arts, entertainment and recreation**	90 Creative, arts and entertainment activities 91 Libraries, archives, museums and other cultural activities 92 Gambling and betting activities

	93 Sports activities and amusement and recreation activities
(S) **Other Service NACE activities**	94 Activities of membership organisations 95 Repair of computers and personal and household Goods 96 Other personal service activities
(T) **Activities of households as employers of domestic personnel**	97 Activities of households as employers of domestic personnel
(U) **Activities of extraterritorial organisations and bodies**	99 Activities of extraterritorial organisations and bodies

Table 10. SITC Codes and Division Descriptions

SITC Division Codes	SITC Economic Division Descriptions
(0) **Food and Live Animals**	00 Live animals other than animals of Division 03 01 Meat & meat preparations 02 Dairy products & birds' eggs 03 Fish, crustaceans, molluscs and preparations thereof 04 Cereals & cereal preparations 05 Vegetables & fruit 06 Sugar, sugar preparation & honey 07 Coffee, tea cocoa, spices & manufactures thereof 08 Feeding stuff for animals (excl. unmilled cereals) 09 Miscellaneous edible products & preparations
(1) **Beverages and tobacco a.k.a. "Beverages/Tobacco"**	11 Beverages 12 Tobacco & tobacco manufactures
(2) **Crude Materials Manufacturing, inedible, except fuels a.k.a. "Crude Materials Manufacturing"**	21 Hides, skins & fur skins, raw 22 Oil seeds & oleaginous fruits 23 Crude rubber (include synthetic & reclaimed) 24 Cork & wood 25 Pulp & waste paper 26 Textile fibres & their wastes 27 Crude fertilisers & minerals, excl. coal, petroleum etc. 28 Metalliferous ores & metal scrap 29 Crude animal & vegetable Materials Manufacturing nes
(3) **Mineral fuels, lubricants and related products a.k.a. "Minerals"**	32 Coal, coke & briquettes 33 Petroleum, petroleum products & related Materials Manufacturing 34 Gas, natural & manufactured 35 Electric current
(4) **Animal and vegetable oils, fats and waxes a.k.a. "Agricultural Residuals"**	41 Animal oils & fats 42 Fixed vegetable fats & oils 43 Animal or vegetable Materials Manufacturing nes
(5) **Chemicals and related products nes a.k.a. "Chemicals"**	51 Organic chemicals 52 Inorganic chemicals 53 Dyeing, tanning & colouring Materials Manufacturing

	54 Medical & pharmaceutical products 55 Essential oils, perfume Materials Manufacturing; toilet & cleansing preps 56 Fertilisers (other than those of Division 27) 57 Plastics in primary forms 58 Plastics in non-primary forms 59 Chemical Materials Manufacturing & products nes
(6) **Manufactured Goods classified chiefly by material a.k.a. "Manufactured Goods"**	61 Leather; leather manufactures nes; dressed furskins 62 Rubber manufactures nes 63 Cork & wood manufactures (excl. furniture) 64 Paper, paperboard & articles thereof 65 Textile yarn, fabrics, made-up articles & related products 66 Non-metallic mineral manufactures nes 67 Iron & steel 68 Non-ferrous metals 69 Manufactures of metals nes
(7) **Machinery & transport equipment a.k.a. "Machinery"**	71 Power generating machinery & equipment 72 Machinery specialised for particular industries 73 Metalworking machinery 74 General industrial machinery & equipment nes & parts nes 75 Office machines & automatic data processing machines 76 Telecommunications & sound equipment 77 Electrical machinery, apparatus & appliances nes & parts 78 Road vehicles (include. air-cushion vehicles) 79 Other transport equipment
(8) **Miscellaneous manufactured articles a.k.a. "Misc. Manufactured"**	81 Prefab buildings; plumbing & electrical fixtures & fittings 82 Furniture & parts thereof; bedding, cushions etc 83 Travel goods, handbags & similar containers 84 Articles of apparel; clothing accessories 85 Footwear 87 Professional, scientific & controlling apparatus nes 88 Photographic apparatus; optical goods; watches clocks 89 Miscellaneous manufactured articles nes
(9) **Commodities and transactions not classified elsewhere a.k.a. "Commodities n.e.s."**	91 Postal packages not classified according to kind 93 Special transactions and commodities not classified according to kind 96 Coin (other than gold coin), not being legal tender 97 Gold, non-monetary (excluding gold ores and concentrates) 98 Gold coin and monetary gold 99 All other commodities and transactions

Table 11. NACE Code Aggregation for CIP Data

Subsector Description	NACE Code	NACE Sectors
Food & Beverage	**10 to 11**	10 – Manufacture of food products 11 – Manufacture of beverages
Traditional Manufacturing	**12 to 17**	12 – Manufacture of tobacco products 13 – Manufacture of textiles 14 - Manufacture of wearing apparel 15 – Manufacture of leather and related products 16 – Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting Materials Manufacturing 17 – Manufacture of paper and paper products
Printing	**18**	18 – Printing and reproduction of recorded media
Pharmachem	**20,21**	20 – Manufacture of chemicals and related products 21 – Manufacture of basic pharmaceutical products and pharmaceutical preparations
Materials Manufacturing	**22 to 25**	22 – Manufacture of rubber and plastic products 23 – Manufacture of other non-metallic products 24 - Manufacture of basic metals 25 – Manufacture of fabricated metal products, except machinery and equipment
Computers & Electronics	**26**	26 – Manufacture of computer, electronic and optical products
Electrical Equipment	**27**	27 – Manufacture of electrical equipment
Machinery & Vehicles	**28 to 30**	28 – Manufacture of machinery and equipment not elsewhere classified 29 – Manufacture of motor vehicles, trailers and semi-trailers 30 – Manufacture of other transport equipment
Other Manufacturing	**19, 31, 32**	19 – Manufacture of coke and refined petroleum products 31 – Manufacture of furniture 32 – Other manufacturing
Repairs	**33**	33 – Repair and installation of machinery and equipment

Table 12. NACE Codes matching to Balance of Payments and Goods/Manufacturing Sectors for Revenue data

NACE Categories - Goods & Manufacturing Sectors	NACE Codes	Goods Sector Categories
Food & Beverage	**10-12**	Food & Beverage
Traditional Manufacturing and Printing and reproduction of recorded media	**13-18**	Traditional Manufacturing
Manufacture of coke and refined petroleum products/ Manufacture of chemicals and chemical products/ Manufacture of basic pharmaceutical products and pharmaceutical preparations/ Manufacture of rubber and plastic products	**19-22**	Pharmaceuticals and Chemicals
Manufacture of other non-metallic mineral products/ Manufacture of basic metals/ Manufacture of fabricated metal products, except machinery and equipment/ Manufacture of computer, electronic and optical products/ Manufacture of electrical equipment/ Manufacture of machinery and equipment nes	**23-28**	Computers, Electronics, Electrical Equipment & Metals
Manufacture of motor vehicles, trailers and semi-trailers/ Manufacture of other transport equipment/ Manufacture of furniture/ Other manufacturing/ Repair and installation of machinery and equipment	**29-33**	Machinery, Vehicles & Repairs
Mining and Quarrying Industry/Electricity, gas, steam and air conditioning supply/ Water Supply; Sewerage;/Waste Management and/ Remediation Activities	**05-09, 35-39**	Materials and Other Activities nes
NACE Categories - Services Sectors	**NACE Codes**	**Balance of Payment Categories**
Transportation and storage (H)	**49-53**	Transport (BOP 1)
Accommodation and Food Service Activities (I)	**55-56**	Tourism and travel (BOP 2)
Information and Communication (J)	**58-63**	Communications/IT (BOP 3)
Financial and Insurance Activities (K)	**64-66**	Financial Services (BOP 5)
Real Estate Activities (L) Professional, scientific and technical activities (M) Administrative and support service activities (N)	**68** **69-75** **77-82**	All Business Services (BOP 8)
Public administration and defence; compulsory social security (O) Education (P) Human health and social work activities (Q) Arts, entertainment and recreation (R) Other Service NACE activities (S)	**84-88** **90-93** **94-96**	Other Services not elsewhere specified (BOP 9)
Wholesale and retail trade; repair of motor vehicles and motorcycles (G)	**45-47**	Repairs and processing (BOP 10)

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