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EXPORT ACTIVITY, SPECIALISATION AND STRUCTURAL CHANGE

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in fulfilment of the requirements for the degree of
Doctor of Philosophy (PhD)

October 2004

Declaration

I declare that this thesis is entirely my own work and has not been submitted for a degree at this or any other university. I agree that the Library of Trinity College, University of Dublin may lend or copy this thesis upon request.

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Summary

This thesis examines the evolution of Ireland's manufacturing exports. In particular, it focuses on the changing pattern of specialisation both of products and of destinations. The first two chapters examine specialisation at the aggregate sector level; the second half of the thesis continues the analysis by looking at the experiences of exporting firms, asking which firms become exporters and where they send their exports.

This thesis contains four empirical chapters investigating different aspects of Ireland's export experience. Chapter Two examines export specialisation, comparing the Irish experience to that of six other European economies. Two aspects of specialisation are identified: specialisation in products within the sector and specialisation in the geographic coverage of a sector's exports. Extremely detailed trade data from Eurostat is used, decomposing sectors to 8-digit level and destination information to over 200 partner countries. The most significant result in this chapter was the importance of geographic coverage on sector exports. This provided a test of the Evenett and Venables (2001, 2002) proposition that 'geographic spread of trade' is a major determinant of export growth

The third chapter focuses on Ireland. Changes in specialisation patterns of employment and exports are examined, drawing attention to the differing evolutions of high and low technology sectors. This chapter documents the growth of employment and exports in Ireland since the mid-1970s, especially in terms of changing sector shares. It then asks if the patterns of Irish specialisation fit the predictions of Imbs and Wacziarg (2003), who recently demonstrated the existence of a U-shape in specialisation across countries as income increases. I find evidence of the predicted U-shaped pattern in employment, but a picture of increasing specialisation in exports.

Chapters Four and Five look at exports at the firm level. Chapter Four analyses the choices made by individual firms to enter the export market. It uses data on a sample

of Irish firms over seventeen years to test whether sunk costs influence the decision to enter or exit the export market. We find significant inertia in firm movements in and out of exporting, with previous export activity a strong explanatory factor for current export market participation. In addition, this paper tests for the existence of spillover effects in exporting, in particular if the levels of export activity in a sector increase the probability of a firm participating in the export market. Significant evidence of sunk costs was found, based on the observed persistence of export activity and the explanatory power of previous exporting experience on current export status. However, only limited evidence of spillovers was found in determining export market participation.

Chapter Five extends the analysis of the geographic dimension of trade by examining the trading patterns of individual Irish firms. There has been no prior study of this aspect of trade at the firm level. This gap in the literature is primarily due to an absence of firm level data containing detailed information of export destinations. Utilising a new firm survey carried out by Forfás, the determinants of export participation and market coverage of Irish firms are explored in this chapter. Aggregate data does not tell us if a sector is geographically diversified because there are many exporting firms each of which specialises in a separate destination, or if the firms themselves are selling their exports in many markets. This analysis is made possible by access to a new survey dataset of Irish firms compiled by Forfás, which includes detailed information on firm characteristics and on the destinations of their exports. We find that a large number of firms serve only the domestic market and many exporting firms export to a single foreign market. A number of firm characteristics, such as size, age and technology level are found to be associated with export participation and with market diversification.

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Chapter 1

Introduction

From joining the European Community to the impact of the oil price shocks and from the economic stagnation of the early eighties to the spectacular growth of the 'Celtic Tiger' era, the Irish experience since the nineteen-seventies has contained much to interest economists. This thesis examines one aspect of this experience, the evolution of manufacturing exports. In particular, it focuses on the changing pattern of specialisation, in terms of products exported and of their geographic range. The first two chapters examine specialisation at the aggregate sector level; the second half of the thesis continues the analysis by looking at the experiences of exporting firms, asking which firms become exporters and where they send their exports.

The extent of the change in economic circumstances over the past thirty years can be seen in Figures 1.1 and 1.2. After very moderate growth up until the late 1980s, Figure 1.1 shows how GDP per capita and per worker have increased dramatically in the last decade. As we can see in Figure 1.2, between 1970 and 1988, Ireland's GDP per capita ranged between 60 and 70 percent of the EU average. After many years of lagging behind, Irish GDP per capita began to converge rapidly from 1988 and reached EU average levels in 1997. Since then,

Ireland has continued to grow and has now significantly surpassed the EU average income. Irish average growth rates have been almost 1½ percent higher than those of the EU over the past three decades. Figure 1.3 shows that Irish growth rates were higher than the EU average for all periods since 1970, with the exception of the very low growth from 1980 to 1985. Since 1990, and in particular during the period 1995 to 2000, Irish growth rates have been exceptionally high, both by Irish historical standards and in comparison to the rest of the EU. Many explanations have been put forward for this 'Celtic Tiger' phenomenon and are covered extensively by Barry (1999), Sweeny (1999) and Murphy (2000). One factor put forward as an explanation has been the strong outward orientation of the Irish economy.

In Sweeny's discussion of the causes of Ireland's economic growth, he describes the country as "one of the greatest trading nations of the world" (Sweeny, 1999). In 2000, Ireland was certainly one of the most open economies in the world with trade (imports and exports) worth approximately 180 percent of GDP. In addition to the growth of exports, there has been a marked change in the composition and destination of Irish exports. The policy of attracting Foreign Direct Investment (FDI) to use Ireland as an export base has had amongst its effects a change in the structure of Irish exports away from the traditional food and textile sectors towards the higher technology sectors of Computers, Chemicals and Electronics. This has also affected the employment structure, with for example three-quarters of employment in the Chemicals and Electronics sectors arising from foreign-

owned companies (Murphy and Ruane, 2004). The specialisation patterns of exports and employment are described in Chapter Three.

As well as the change in the composition of Irish exports, there has been a reorientation in the destination pattern of Irish exports. This has been evident in the move away from the United Kingdom as the dominant export market for Irish goods. From independence to the nineteen-sixties, the UK market accounted for over two-thirds of Ireland's exports. This fell gradually, particularly after membership of the EC in 1973, and by the late 1990s a little over a quarter of exports were going to the UK (Barry, Bradley and O'Malley, 1999; O'Sullivan, 1998).

The growth of Irish exports has been aided by a number of factors. These include the introduction of tax relief on profits from exporting introduced in 1956, a measure later replaced by a single low corporation tax rate (Murphy and Ruane, 2004). Membership of the EU and the Single Market have increased access to European markets for Irish firms and has made Ireland an attractive base for foreign multinationals.

This thesis contains four empirical chapters investigating different aspects of Ireland's export experience. Chapter Two examines export specialisation, comparing the Irish experience to that of six other European economies. Two aspects of specialisation are identified: specialisation in products within the sector

and specialisation in the geographic coverage of a sector's exports. Extremely detailed trade data from Eurostat is used, decomposing sectors to 8-digit level and destination information to over 200 partner countries. The data cover the period 1988 to 1999 for Belgium-Luxembourg, Denmark, Greece, Ireland, the Netherlands, Portugal and the UK. A novel aspect of this chapter is the use of 'absolute' rather than relative measures of specialisation. This allows each country's specialisation pattern to be examined individually, identifying changes in industrial structure even if they are taking place at a similar rate across countries. The most significant result in this chapter was the importance of geographic coverage on sector exports. This provided a test of the Evenett and Venables (2001, 2002) proposition that 'geographic spread of trade' is a major determinant of export growth

The main findings are a move towards increased specialisation in sectors and diversification in market coverage. This was particularly true of Ireland, where the magnitudes are much larger than for the other countries. Econometric tests of specialisation on sector exports show a highly significant and positive relationship between sector exports and diversification across destination markets for all of the countries in the sample. The findings on product coverage within the sectors are less conclusive. In contrast to the results found for the other six countries, in Ireland the product count has a significant negative effect, indicating that the most specialised sectors have the highest export levels.

The third chapter and the rest of the thesis focuses on Ireland. Changes in specialisation patterns of employment and exports are examined, drawing attention to the differing evolutions of high and low technology sectors. In the Irish context an important element has been the emergence of a substantial high-technology sector. The main elements of this chapter are to document the growth of employment and exports in Ireland since the mid-1970s, especially in terms of changing sector shares. It then asks if the patterns of Irish specialisation fit the predictions of Imbs and Wacziarg (2003), who recently demonstrated the existence of a U-shape in specialisation across countries as income increases. I find evidence of the predicted U-shaped pattern in employment, but a picture of increasing specialisation in exports.

Chapters Four and Five look at exports at the firms level. Chapter Four analyses the choices made by individual firms to enter the export market. It uses data on a sample of Irish firms over seventeen years to test whether sunk costs influence the decision to enter or exit the export market. A probit specification tests the probability of exporting in the current period given past exporting experience, controlling for the firm's initial export status. We find significant inertia in firm movements in and out of exporting, with previous export activity a strong explanatory factor for current export market participation. Methodologically, the contribution of this paper is the use of a two-step estimation procedure suggested by Orme (1997), which controls for the influence of initial conditions. In addition, this paper tests for the existence of spillover effects in exporting, in

particular if the levels of export activity in a sector increase the probability of a firm participating in the export market. Significant evidence of sunk costs was found, based on the observed persistence of export activity and the explanatory power of previous exporting experience on current export status. However, only limited evidence of spillovers was found in determining export market participation.

Chapter Five extends the analysis of the geographic dimension of trade by examining the trading patterns of individual Irish firms. Ireland is known as a highly specialised economy, the bulk of exports coming from a relatively narrow range of products. However, changes in geographic specialisation have not received as much attention, and there has been no prior study of this aspect of trade at the firm level. This gap in the literature is primarily due to an absence of firm level data containing detailed information of export destinations. Utilising a new firm survey carried out by Forfás, the determinants of export participation and market coverage of Irish firms are explored in this chapter.

One shortcoming of the existing literature on sunk costs in exporting, which was followed in Chapter Four, is that the export market is treated as a single entity. With multiple export markets, one must ask if experience of exporting to one market reduces the cost of entering further export markets. *A priori,* it would appear sensible to suggest that sunk costs of entering a new market would be

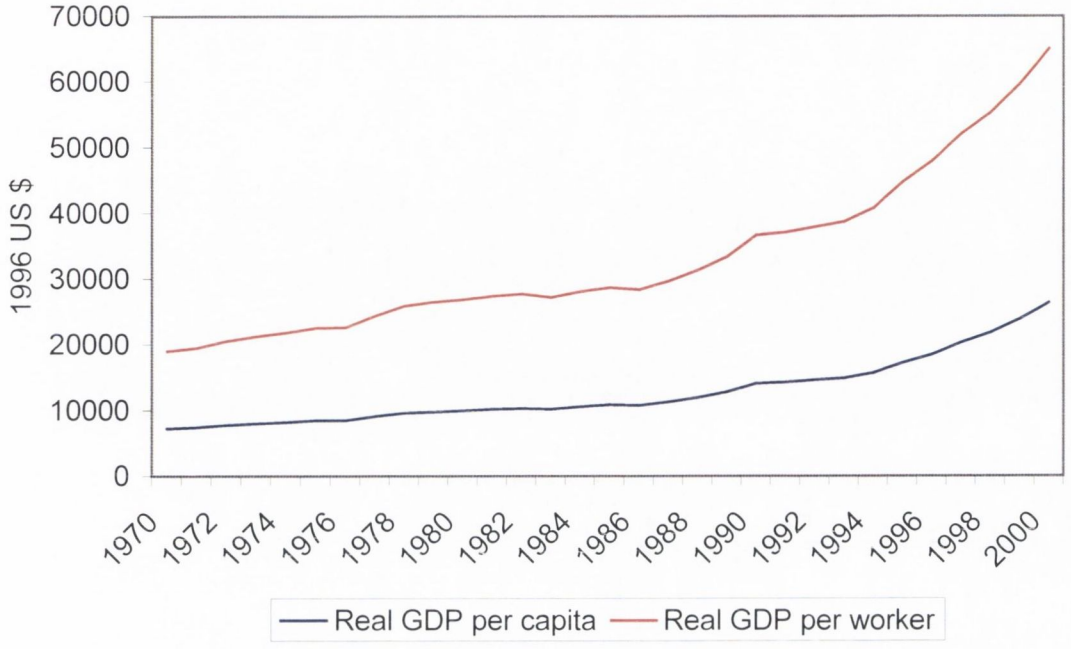
reduced if the firm already had exporting experience, particularly if it was already exporting to a similar or neighbouring country.

Chapter Five presents an extension of the analysis of the geographic dimension of trade. It does so in an entirely new way by examining the trading patterns of individual Irish firms. Aggregate data does not tell us if a sector is geographically diversified because there are many exporting firms each of which specialises in a separate destination, or if the firms themselves are selling their exports in many markets. This analysis is made possible by access to a new survey dataset of Irish firms compiled by Forfás[1], which includes detailed information on firm characteristics and on the destinations of their exports. We find that a large number of firms serve only the domestic market and many exporting firms export to a single foreign market.

The final chapter summarises the findings of the four empirical studies. It also discusses some policy implications and suggested areas for further research prompted by the other chapters.

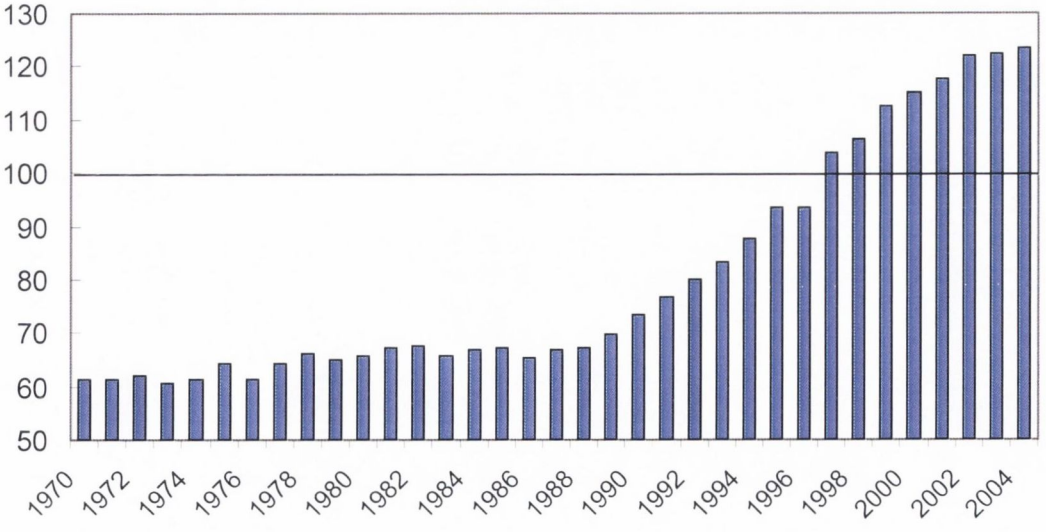
[1] Forfás is the policy and advisory board for industrial development in Ireland.

Figure 1.1: GDP Per Capita and Per Worker



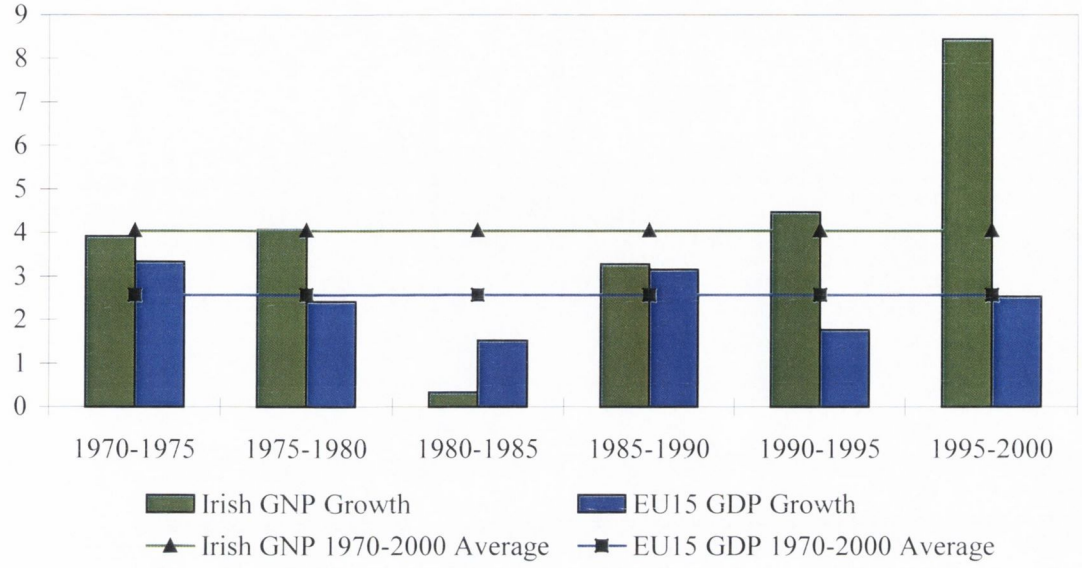
Source: Heston, Summers and Aten (2002), Penn World Table Version 6.1

Figure 1.2 Irish GDP as Percentage of EU-15 Average



Source: Eurostat

Figure 1.3 Irish and EU Growth Rates



Source: Murphy and Ruane (2004)

Chapter 2

Market and Product Specialisation of Exports

"From a European perspective specialisation according to comparative advantage and the deeper division of labour will enhance efficiency and competitiveness and therefore be beneficial. On the other hand, specialisation in narrow product groups may increase the demand risk for individual countries and especially increase the vulnerability for lagging regions."
(Wolfmayr-Schnitzer, 1999)

2.1 Introduction

Specialisation and concentration are central topics in the study of international trade. The existing literature typically focuses on a country's specialisation across 3- or 4-digit sectors relative to other economies. One of the contributions of this thesis is to consider how specialisation has evolved at different levels of aggregation. Another is to examine the market coverage of sector exports in a sample of EU countries.

This chapter examines the impact of specialisation for sector level exports and export growth, i.e. the subject is within-sector specialisation, rather than country level specialisation across sectors. I look at two dimensions of specialisation: specialisation in products (or sub-sectors) within the sector, and also

specialisation in terms of markets exported to i.e. the geographic coverage of a sector's exports. Evenett and Venables (2001, 2002) find that the extension of an existing product line to a new geographic market accounts for around one-third of export growth, with the contribution being made by the introduction of new products averaging ten percent of growth.

The terms 'specialisation' and 'concentration' are used synonymously in this thesis. A country's exports are specialised in an industry if a large share of the country's exports are in that industry. Exports are specialised in a country where a small number of industries account for a large proportion of exports; likewise, the exports of a particular industry are specialised where the exports are largely confined to a small number of products. Market specialisation in terms of exports is defined as a large share of the exports being destined for a small number of foreign markets. It is important to distinguish this from the "geographic concentration of industries" i.e. the distribution of a particular industry across a number of countries, which is not dealt with in this thesis (see Aiginger, 1999 for a review of this issue).

Another significant difference is the use of absolute rather than relative measures of specialisation. This allows each country's specialisation pattern to be examined individually rather than compared to a potentially moving average value. Although relative measures of concentration or specialisation are useful, they will not identify changes in industrial structure that are taking place at a

similar rate across countries. In this chapter, a simple count measure of products and markets is used, as well as a Herfindahl index, which is weighted by market size.

Extremely detailed trade data for seven EU countries are used to examine the evolution of specialisation from 1988 to 1999. Although this is a relatively short time period, a number of interesting results are obtained, demonstrating in particular the importance of increasing the market coverage (or geographic diversification) for sector exports. The countries covered are Belgium-Luxembourg, Denmark, Greece, Ireland, the Netherlands, Portugal and the UK. The data comes from Eurostat's COMEXT CD-ROM and includes export information at an 8-digit level to over 200 partner countries. Two sectoral classifications are used to examine changes in specialisation within different groups. Two sectoral taxonomies are used to classify the four-digit sectors. The OECD Process Taxonomy (OECD, 2001) divides sectors into high, medium-high, medium-low and low technology, based on R&D intensity. The Neven classification (Neven, 1995), divides industries into five groups based on input characteristics.

At the country level, the Herfindahl index of product and destination specialisation across 4-digit sectors shows a slight tendency towards increased specialisation in sectors and diversification in market coverage. For six of the seven countries, the changes are quite small in magnitude. Ireland proves to be an

exception, showing a marked increase in sector specialisation and diversification in market coverage. Econometric tests on specialisation on sector exports show a highly significant and positive relationship between sector exports and diversification across destination countries for all of the countries in the sample. This holds for both count of markets and the Herfindahl measure of concentration. The findings on product coverage within the sectors are less conclusive. In contrast to the results found for the other six countries, in Ireland the product count has a significant negative effect.

The chapter is arranged as follows. Section 2.2 provides an overview of trade theory's predictions for the pattern of specialisation, and some empirical evidence to date. Section 2.3 describes the data sources. The descriptive statistics and empirical results are presented in section 2.4, and section 2.5 concludes.

2.2 Literature

2.2.1 Trade Theory Review[1]

The keystone of traditional trade theory is the idea of comparative advantage developed by David Ricardo in the early nineteenth century. Based on an assumption of perfect competition and zero transport costs, this theory predicts that the gains from trade are maximised if each country specialises completely in the product in which it has a proven comparative advantage.

[1] This section draws mainly on Krugman and Obsfeld (1997)

The Ricardian law of comparative advantage explains the existence and pattern of international trade based on relative cost advantages in the trading countries. The Heckscher-Ohlin (H-O) model tries to explain why such comparative advantages emerge. In the H-O framework trade is based on the differences in relative factor endowments among countries, and the type of good to be exported depends on the factor of production with which the country is well endowed, or has an abundant supply of, relative to other countries. It is important to note that the operation of this model is based on the assumption of identical production functions and technologies in both countries. Differences in factor endowments impact upon the costs of production as the cost of producing a good depends on factor prices e.g. wages for labour.

The H-O model predicts specialisation in goods that are intensive in the production factor the country is best endowed with e.g. a labour abundant country will specialise in goods that are labour-intensive in production. Little empirical support has been found for the H-O model, although tests such as that by Trefler (1993) find better results can be obtained by dropping the equal technologies assumption and adjusting for differing productivity levels. The introduction of explicit technological differences to augment traditional trade theory was made by Posner (1961). His 'technology-gap model' introduces changes in products or production due to innovation, which gives the country responsible a comparative advantage until the technology has time to be diffused to other countries. The

speed at which new developments are made therefore becomes a determinant of international specialisation.

This approach was then developed further in models of product life cycles (e.g. Krugman 1979) where the source of comparative advantage lies in the ability to innovate and trade is driven by this advantage in new products and in on-going technology transfer to the lower-innovation country. Initially the level of innovation was taken as exogenous, but Grossman and Helpman (1991) endogenised innovation as being the result of deliberate research and development activity. Externalities to R&D mean technology transfer still occur but, as in the product life cycle model, only with a lag.

All the trade theories mentioned focus on specialisation driven by some sort of comparative advantage, either in endowments or technology, and may therefore be viewed as most applicable to explaining trade amongst countries at different stages of development. They do not address the issue of why countries with very similar endowments and technology would engage in trade or why much trade in intra- rather than inter-industry. 'New' trade theory focuses on these points and introduces increasing returns to scale and product differentiation as factors in explaining trade and specialisation

Both of the previous theories regarded trade as being determined by differences across countries allowing gains to be made when they specialised and traded. A

more recent approach has developed from the empirical observations that factor prices have not begun to converge, even between countries with close trade links, and that a great deal of trade is intra-industry trade i.e. goods from the same industry are traded across countries, for example Germany exports *and* imports cars.

The existence of economies of scale and imperfect competition give countries an incentive to specialise and trade even if there are no differences in their endowments or technologies. Looking at individual countries, this desire for variety explains the existence of intra-industry trade as differentiated products within an industry are exchanged across states. This form of trade is most likely to be found between countries with similar economic characteristics, tastes and level of development. All the theories predict some element of specialisation, albeit driven by different forces – comparative advantage, technology, production externalities and economies of scale. It would appear reasonable to assume that the same forces would influence the specialisation within, as well as between, sectors.

2.2.2 Empirical Findings

The industrial structure of Europe and the distribution of industry across countries have been examined in a number of studies. These focus on comparative measures of specialisation such as Balassa's Revealed Comparative Advantage (see for example Brülhart, 2001). This paper differs from the standard literature

in using an absolute rather than comparative measure of concentration; namely, a count measure and the Herfindahl index commonly used in industrial economics to measure market power within an industry. This allows us to examine the evolution of specialisation of products within sectors and of diversification of sector exports across geographic markets for each country without having to be concerned about changes in the comparison category. Although frequently extremely useful, relative measures of concentration or specialisation will not identify changes in industrial structure that are taking place at a similar rate across countries.

Dalem, Laursen and Villumsen (1996a, 1996b) also make this distinction between what they refer to as "specialisation *intra-country*" and divergence or convergence that occurs *across* countries. They find that export patterns are "sticky" in that initial conditions are important and changes occur only very slowly. Evidence of de-specialisation in country exports and convergence across countries is found for their sample of OECD countries.

Using comparative measures of export data the EC also found that there is a trend to de-specialisation in exports even when production becomes more specialised (e.g. in UK) and only five EU countries see increasing specialisation in exports (Germany, Italy, France, Spain and Ireland). Ireland was the most specialised country and continued to increase specialisation throughout the 1990s (European Commission, 1999).

Empirical tests frequently analyse relationship between openness and growth, but Bensidoun *et al.* (2001) find that the effect may be dependent on the country's specialisation pattern. Developing countries that specialise in goods whose world demand is growing or in goods with potential for learning should exhibit better growth performance than those specialising in goods with declining or inert demand and little learning potential. They conclude that "the nature of specialisation, and more particularly the adaptation of specialisation patterns to international demand" have an effect on growth.

Evenett and Venables (2001, 2002) present a decomposition of the growth of exports of twenty-four developing countries comparing exports (products and destinations) in 1970-74 and 1993-97. They find that across all these countries it is extremely unusual for a country to drop the exportation of any product line and that exports to existing trading partners account for approximately half of all export growth. The extension of an existing product line to a new geographic market accounts for around one-third of export growth, with the contribution being made by the introduction of new products averaging ten percent of growth. The "geographic spread of trade" by exporting a product to a new market is more likely if the exporting country already exports to a country close to the new market. Evenett and Venables refer to this as "distance to the supply frontier", and use it as a new variable to enhance the usual gravity model variable of distance between countries.

Evenett and Venables attribute the importance of this supply frontier distance to "the effect of information acquisition by exporting firms about potential new foreign markets". Once a firm has made the initial decision to export and has learnt about the costs and opportunities of trading in its destination market, it may find that this knowledge also applies to other similar or neighbouring markets, encouraging the firm to expand the geographic coverage of its exports. The existence of sunk costs for a firm entering the export market is a topic examined further in Chapter Four, and the geographic coverage of individual firms' exports is the topic of Chapter Five.

The importance of the geographic dimension of trade has also been raised in a shift-share analysis of Irish exports for the 1970s and 1980s. O'Donnell (1998) found the effect of market destination on export growth varied over time, depending to a large extent on whether the UK, Ireland's largest export market, was growing faster or slower than the world average. Repkine and Walsh (1999) demonstrate the importance of initial conditions in terms of trade orientation and the effect it can have on sector growth. A history of exporting to the EU under central planning is found to be a key determinant of sector growth during the transition process for Central and Eastern European countries. Sectors specialising in exporting to fellow centrally planned economies (CMEA countries) showed much lower growth, or even decline.

Portfolio-type models of trade emphasise the spreading of risk in exporting by diversifying across products and markets (Hirsch and Lev, 1971, is a classic example). In a similar vein, Barry and Kearney (2003) undertake a portfolio analysis of Ireland's manufacturing employment. They find the specialisation strategy of concentrating in a few high technology sectors has brought Ireland closer to the mean-variance efficiency frontier. Although they find that the volatility of employment growth is higher in foreign-owned manufacturing, this is not interpreted as a cause for concern regarding the vulnerability of overall employment. As foreign and indigenous employment growth rates are not perfectly correlated[2], some degree of risk hedging may be possible.

2.3 Data Sources

We use export data from seven EU members: Belgium-Luxembourg[3], Denmark, Greece, Ireland, the Netherlands, Portugal and the United Kingdom. The data contains information on exports to all partner countries from 1988 to 1999. Some adjustments to the partner countries had to be made in order to maintain comparability over the time period. For example, the figures for countries of the Former Soviet Union, former Yugoslavia and Czech and Slovak Republics were

[2] The correlation coefficient is 0.86. The foreign sector experienced higher growth and higher volatility than the Irish sector. A combination of the two could therefore allow higher growth than the Irish sector alone could achieve, while reducing the standard deviation compared to both sectors individually (Barry and Kearney, 2003).

[3] Until 1999 Belgium and Luxembourg reported statistics jointly and are hence treated as a single entity for the purposes of this paper.

combined to coincide with their 1988 equivalents. The Federal and Democratic Republics of Germany figures prior to 1991 were combined to be comparable to the current German data. Other countries that had to be adjusted in this way were Ethiopia and Eritrea, Israel and Gaza & West Bank, and North and South Yemen. This ensures that the evolution of a country's export destinations and market specialisation are not distorted by geopolitical changes over time.

The data are taken from the Eurostat COMEXT CD-ROM, which contains all intra- and extra-EU trade statistics. These are reported using the EU's Combined Nomenclature (CN) system of defining sectors. The CN is closely related to the Harmonised System (HS) nomenclature, but includes further subdivisions of sectors down to an 8-digit level. The data in this thesis comprises information on over 1100 four-digit sectors, containing approximately 11,685 8-digit divisions. For simplicity, the 8-digit divisions are referred to as products throughout the chapter, and the 4-digit level as sectors. Appendix 2.1 lists the sectors at the more aggregated 2-digit level. Some additional data is also used in Figures 2.1 and 2.2, which comes from the Penn World Tables Version 6.1 (Heston, Summers and Aten, 2002). All other figures and tables in this chapter refer to author's calculations based on the Eurostat data.

Two sectoral taxonomies are used to classify the four-digit sectors. The OECD Process Taxonomy (OECD, 2001) divides sectors into four groups: high technology, medium-high technology, medium-low technology and low

technology. The classification is based on research and development intensity in production and includes the R&D intensity of inputs. The second classification of sectors is that of Neven (1995), which divides industries into five groups based on input characteristics. These are high technology and high human capital (sectors with high wage to value added, high average wages and high levels of white collar employment), high human capital, low investment (low investment/value added, high average wages, high wage/value added), labour intensive (low average wage, high wage/value added, low investment/value added), labour and capital intensive (high investment/value added, low average wage, low white collar employment, intermediate wage/value added) and human capital and investment intensive (high average wages, intermediate wages/value added, high investment/value added, high white collar). These taxonomies were available from the Institute of Development Studies website, University of Sussex and are as used by Kaplinsky and Paulino (2004). The sectors covered by the OECD taxonomy are listed in Appendix 2.2 and the Neven classification is in Appendix 2.3.

2.4. Specialisation and Diversification Results

2.4.1 Descriptive Statistics

Two measures of market coverage are used to determine specialisation of sector export levels. Firstly, we follow Walsh and Whelan (1999, 2004) who found a

simple count measure of market niches covered gave a strong indication of total sector size. Count measures of product variety in international trade are also used by Frensch and Gaucaite-Wittich (2004). Secondly, for the empirical analysis a Herfindahl index is used, representing the sum of the squared market shares. Market shares refer to the share of sector exports of an individual product when we are discussing product specialisation, and to the share of a particular geographic market for a sector's exports when we discuss geographic specialisation. The Herfindahl index ranges from 0 to 1, with 1 indicating complete specialisation in a single product or market, and 0 representing complete diversification with no dominant product or market.

Over the period 1988-1999, total exports increased in all countries, as shown in Table 2.1 and Figure 2.3. The increase in exporting is particularly marked for Ireland (left-hand scale), but an upward trend is clear for all countries. Trade as a percentage of GDP however remained relatively stable as shown in Figure 2.2. The exception is Ireland, which shows a quite dramatic increase in exports as well as in general economic growth (Figure 2.1). Openness to trade is much greater at all time periods in Ireland and Belgium, both showing trade/GDP ratios of substantially above 100%. The remaining five countries (Greece, Denmark, Portugal, Netherlands and UK) are clustered between 50% and 70% for most of the period.

Although the main interest of this chapter is on specialisation within sectors, Figures 2.4 and 2.5 present country level changes in product and destination specialisation across 4-digit sectors respectively, measured by a Herfindahl index. These are in line with the standard literature on specialisation, which concentrates on the share of different sectors within the overall economy. These more aggregated measures show a slight tendency towards increased specialisation in sectors and diversification in market coverage. With the exception of Ireland, the changes are quite small in magnitude. This is only to be expected given that twelve years is a short time period over which to analyse structural changes. However, this makes the evolution of Ireland's export specialisation even more pronounced. Ireland shows quite dramatic increases in sector specialisation and diversification in market coverage. The growing importance of high technology industries and the reduced dependence on the UK market may go a long way in explaining this phenomenon.

Looking at specialisation within 4-digit sectors, Table 2.1 shows average sector specialisation in products and in market coverage. Looking at the average number of products per sector, we see a gradual increase in the number of products (8-digit CN) per sector (4-digit CN). Belgium increases products per sector from 6.9 in 1988 to 7.5 in 1998. Greece shows one of the largest increases in product coverage, going from 3.2 in 1988 to 5.1 in 1989. Netherlands, Portugal and the UK show smaller increases, while Denmark's coverage remains fairly static (6.2 in 1988 and 6.3 in 1999). Ireland is the only country that shows a

decrease in the average number of products per sector, although the change is relatively minor. It has an average of 5.2 in 1988 and this is reduced to 5.0 in 1999, indicating that there may be a move towards increased specialisation within sectors towards exporting a smaller range of products.

Another measure of product specialisation is the Herfindahl index (HH), and the average value across sectors is reported in Table 2.1. Looking at the values across countries in 1988 there does not appear to be much divergence in terms of levels of product specialisation. The most diversified country is the UK, with a HH measure of 0.492, while the most specialised is Ireland with a HH of 0.587. The average across all seven countries is 0.557. In 1999, the UK remains the most diversified (0.508) despite increasing its level of specialisation and Ireland is still the most specialised, having increased its HH value to 0.613. The Netherlands and Greece also increased their levels of specialisation. However, Belgium, Portugal and Denmark show increased diversification in their average sector Herfindahl indices. The average values of within-sector specialisation present a mixed picture with some of the sample increasing and others decreasing their levels of product specialisation. Average figures may of course disguise much activity at the sector level, particularly if a country contains some sectors that are becoming more specialised and others simultaneously becoming more diversified.

The summary statistics for country coverage are also presented in Table 2.1. The count measures show major cross-country differences, ranging from 7.7 for

Greece to 69.8 for the UK in 1988. It is logical to suppose that much of this difference is explained simply in terms of the overall size of the country. This hypothesis is strengthened when we look at the equivalent values for the HH index of geographic shares, which controls for size of the sector and shows much greater similarity across the seven sample countries. The count of destination markets shows an unequivocal increase for the entire sample over the time period. Ireland, for example, increases market coverage of its sectors from an average of 10.3 to 13.9. The increase for Greece is particularly marked, doubling its market coverage from 7.7 to 14.6 between 1988 and 1999. The only variation in this pattern of increase geographic spread of trade is the UK which shows an increase from 69.8 in 1988 to 74.5 in 1996 before slightly reducing its coverage to 70.5 by the end of the sample period.

Average HH indices for geographic market specialisation show a slight tendency towards increased diversification for most countries. Belgium, Ireland, Portugal and the UK all show lower values of the HH index for 1999 compared to 1988 implying that their exports are now spread more equally over existing markets or that they have expanded to export to new markets. Greece and the Netherlands are practically unchanged in their levels of destination concentration. This would indicate that, although they have increased their market coverage according to the count measure, their exports to their main markets have also increased enough to counteract the effect the geographic spread would be expected to have on concentration (recall that the Herfindahl index uses squared market shares which

automatically gives greater weighting to larger markets). Finally Denmark is the only country that shows increased specialisation in the markets it exports to, again despite increases in the actual country coverage count measure.

The next step was to group exporting sectors by two different industry taxonomies (OECD and Neven) as described above in Section 2.3. Figures 2.6 to 2.12 show the contributions of each of the OECD groups (high, medium-high, medium-low and low technology) to overall exports in the seven countries over the period[4]. Growth in exports is evident in all countries, as was observed earlier. However some shifts in the amount of exports from the different technology groups is also apparent. Belgium's main export growth comes from the medium-high technology group of sectors, as does Portugal's. Other countries show fairly even growth for all technology levels, for example Greece and Denmark. Increased exports in medium-high and high technology accounts for most export growth in the remaining three countries. The most striking shift in the export structure is in the case of Ireland, with massive growth in the high technology group accounting for the majority of overall export growth[5]. Low technology sectors have also experienced some growth, although medium-low sectors appear to have been static over the period.

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[4] Note that not all sectors are given a classification by the OECD or the Neven taxonomies and therefore the sum of the groups in these graphs differs from the country's export total and from one another. The sectors covered by the taxonomies are listed in Appendix 2.2 and 2.3 respectively.

[5] There has been much discussion over how much of this high-technology exporting may be due to transfer pricing practices, but there is no way to address this issue with the available data.

Figures 2.20 to 2.33 present the product and market Herfindahl indices for the four OECD categories for each country. Looking first at the graphical representation of specialisation of sectors within the OECD groups, low technology sectors have become more concentrated in Belgium and the UK. This is true to an even greater extent in Ireland. Remaining countries show fairly stable levels of concentration for this class. The medium-low technology sectors have changed little in Belgium or Ireland. In Denmark this group show initial increased concentration, up to around 1993, and subsequent re-diversification, as does the UK. Greece shows a slightly erratic picture of increased, then falling concentration. The Netherlands and Portugal show very slight diversification. The medium-high technology group has become rather more diversified in Belgium, and very slightly in Denmark. Ireland shows a small increase in specialisation, but only after 1995. Portugal and the UK meanwhile show the largest changes in specialisation for medium-high technology sectors, both becoming a great deal more concentrated. The final group, high technology sectors become a little less concentrated in Denmark initially, although begin to turn from 1993 and increase concentration once again. The high technology sectors in Greece become appreciably less concentrated, while Ireland too shows some increased diversification in these sectors albeit to a much smaller extent. It is noteworthy that Ireland's level of specialisation in this group (HH above 0.2) remains the highest of all the countries. Portugal and the Netherlands in contrast become much more concentrated, but still remain slightly less specialised in the high technology group than Ireland.

The geographic specialisation dimension for the OECD groups shows low technology sectors becoming more diversified over time, with the single exception being a slight increase in concentration from the UK after 1997. The medium-low group becomes more diversified in Ireland and the UK but shows little change for the other countries. The medium high group moves towards increased diversification in Belgium and Ireland. For the UK there is initially a fall in concentration but this is then followed by a rise to end the sample period slightly above its initial position. Belgium, Greece and Ireland show the most change in geographic concentration, becoming more diversified over the twelve years.

Equivalent analysis is undertaken for the Neven classification of sectors, with the contribution of the different components to total exports show in Figures 2.13 to 2.19. Most of the remaining categories grow at fairly constant rates in line with overall export growth. The most obvious shifts are an increase in the importance of 'high technology, low investment' sectors in Denmark, in 'high technology, high human capital' in the Netherlands and UK, and in 'labour and capital intensive' in Portugal. There is another dramatic shift in the case of Ireland, this time in the growth of 'high technology, high human capital' sectors, which dwarf any changes in the other Neven groups.

Changes in the sector and geographic concentration for the Neven groups are presented in Figures 2.34 to 2.47. The 'human capital, investment' group becomes more diversified in Portugal and the UK, as well as in Ireland where there is quite sharp drop in specialisation post-1995. This group changes little in the other countries, apart from a fall and subsequent return to original concentration levels in Belgium. The 'labour intensive' group becomes less specialised in most of the countries over the period. 'Labour and capital intensive' however becomes more concentrated in the Netherlands, Portugal and the UK, although it remains steady in the other countries. The 'high human capital, low investment' sectors becomes considerably less specialised in Greece but more specialised in Ireland and to an extent in Portugal. 'High human capital, high technology' becomes more specialised in Belgium, the Netherlands and UK. Although the Irish specialisation measure for this group does not change a great deal, it remains appreciably higher than for any of the other countries. For all of the Neven classification groups, there is a trend towards increased geographic diversification for all countries apart from Portugal and the UK. For Portugal increased concentration applies only to the 'high technology, high human capital' group, but for the UK the move towards increased concentration is common to all groups.

2.4.2 Empirical Results

The econometric specification tests the effect on sector exports of the two dimensions of specialisation – product and destination. These take the form of simple OLS tests of the following equation:

$$Export_s = \beta_1 + \beta_2 productspec + \beta_3 geospec + \beta_4 taxonomy + \beta_5 yeardum + \varepsilon_s$$

Where $Export_s$ is the level of exports of sector *s*, *productspec* is a measure of specialisation of the products contained in the sector, *geospec* is a measure of geographical or market specialisation of the sector, *taxonomy* is a dummy variable describing the sector according to the OECD or Neven classifications and *yeardum* is a year dummy. Finally, ε is the error term.

The first results presented in Table 2.2 use count measures of specialisation: the number of products (8-digit sub-sectors) that a sector produces, and the number of countries in which the sector's exports are sold. The results are generated separately for each of the seven countries and include a year control but do not yet introduce either of the sector classifications. The results show a highly significant and positive relationship between sector exports and country coverage for all of the countries in the sample. This gives support to the proposition put forward by Evenett and Venables (2001, 2002) that geographic spread has important consequences for exporting. These results show that exports and market diversification are correlated. However, they do not provide a definitive answer with regard to the direction of causality. Are sector exports large because they

export to many markets or does access to a large number of markets result in greater sector exporting? Geographic diversification allows exporters access to a larger pool of potential consumers, therefore greater coverage could lead to higher levels of exports. On the other hand, industries with a high level of exports may be more likely to be those seeking out additional markets.

The findings on product coverage within the sectors are less conclusive. A positive and significant effect is found for Belgium-Luxembourg, Denmark, the Netherlands, Portugal and the UK. For most countries therefore the greater the product coverage, the higher are their exports. However this does not hold for all; the effect for Greece, although also positive, is insignificant. In contrast to the results found for the other six countries, in Ireland the product count has a significant negative effect. As already noted, Ireland is the most specialised of the countries in the sample and this may be affecting the result. It could be interpreted as indicating that Irish exports are focusing more on obtaining economies of scale. It is possible the other countries in the sample are balancing economies of scope from increased product coverage, along with economies of scale from market coverage in their largest export sectors.

Table 2.3 repeats the same exercise with an alternative variable for specialisation, this time using the Herfindahl indices for product and geographic concentration of the sectors. The country HH results do not show as great an effect on exports as the country count variable in the previous estimation. It is significant and positive

for Greece and the Netherlands, indicating that exports are higher the more concentrated the sector is geographically. This could be explained as indicating that even as geographic coverage grows, the major export destinations of a country are also growing. The result for Portugal is the opposite, showing higher exports related to more dispersed sectors. Product specialisation is consistent across all the countries, with higher sector exports associated with reduced concentration over products. However the result is not significant in the case of Greece. Table 2.4 converts the exports and specialisation measures into logs. The country specialisation measure is significant in every case except Ireland in this specification, but the sign of the relationship differs by country. For Belgium-Luxembourg and Portugal geographical dispersion is associated with higher exports, whereas for Denmark, Greece, the Netherlands and UK, higher values of the concentration index are connected to higher exports. The log of product specialisation has the same effect in all cases, with greater de-specialisation being connected with higher exports.

The next two tables include our sector classification variables: Table 2.5 presents results using the OECD Process Taxonomy and Table 2.6 has the results incorporating the Neven taxonomy of sectors. The Herfindahl results in Table 2.5 again show a mixed picture for geographic specialisation and support for diversification in product coverage. The sector classifications are relative to the low technology sectors. For Belgium, medium-low and medium-high technology sectors are considerably higher in terms of exporting compared to the low

technology base category. High technology also exports more than low technology but the coefficient is smaller than for the other two groups. Danish exports have a fairly large and positive coefficient for the high technology group. The medium-low group have a negative relationship with exports relative to low technology, and the third group (medium-high) has no statistically significant difference from the base category. We have already seen in Figure 2.8 that the bulk of Greek exports come from the low technology group of sectors and the regression results confirm this, with negative coefficients on the effect on exports of the other three categories (although one of the groups, medium-low, is not statistically significant). An effect of similar magnitudes but opposite effect is observed for Ireland, with medium-high and high technology significantly and positively associated with exports compared to the base category. It is worth noting that the coefficient on high technology for Ireland is the highest of the technology group results obtained across all countries. The Netherlands and UK both show increasingly positive coefficients for the higher technology groups. Portugal, like Greece, has the largest share of low technology exports, and correspondingly negative coefficients on the other groups.

The results including the Neven taxonomy are in Table 2.6, showing the categories relative to a base group of labour-intensive industry. Again looking at these results by country, we see that Belgian exports are most determined by the 'high tech, high human capital' sectors, with a sizeable effect also coming from the 'high human capital and investment' sectors. Denmark has only one group,

'high human capital, low investment' showing a positive association with exports compared to the base category. The other groups have lower exports in comparison to the 'labour intensive' group. Greek exports are primarily in the 'labour intensive' or 'human capital and investment' groups; Portugal too has negative coefficients on all classifications compared to the 'labour intensive' group, and particularly so for the 'high tech, high human capital' sectors. The Netherlands, Ireland and the UK all show evidence of the importance of the 'high tech, high human capital' sectors in their exports. Once again the coefficient showing the contribution made by the higher technology sectors for Irish exports is extremely large.

The final estimations look at sector export growth, using changes in the specialisation measures as explanatory variables. In Table 2.7 we see a significant positive effect of increasing geographic coverage on export growth, for all countries except Belgium. The effect is particularly strong for Ireland, Greece and Portugal. Increasing product counts within sectors has a positive effect on growth for all countries but is significant only in the cases of Greece, Ireland and Portugal. Table 2.8 presents the estimation results substituting the Herfindahl indices instead of the count measures. Changes in the country HH is significant only for Ireland, where increased geographic diversification is associated with export growth. The product HH shows a positive relationship between increased concentration and export growth, and is significant for Denmark, Portugal and the UK. This conflicts with the result from the count measure of specialisation.

However, it is possible to increase both the simple count and the weighted Herfindahl index simultaneously; if exports to a dominant market are growing, this effect may offset the diversification across additional markets.

2.5 Conclusions

The time period under consideration was one of export growth and changing patterns of specialisation for the seven countries examined. The most significant result was the importance of geographic coverage on sector exports. This result is consistent with the Evenett and Venables (2001, 2002) proposition that 'geographic spread of trade' is a major determinant of export growth, with countries selling existing products to new markets rather than extending their product range. However in this chapter we have shown that sectors with a wider range of products are also likely to have higher exports.

The contribution of this chapter was to look at two dimensions of specialisation: specialisation in products, already the topic of much research, and specialisation of the geographic coverage of a sector's exports. I have also made use of absolute rather than relative measures of specialisation. This allows each country's specialisation pattern to be examined regardless of changes in industrial structure that are taking place at a similar rate across countries. The measures

used were a count of products and markets and a Herfindahl index, which weighted concentration by market size.

Trade data for Belgium-Luxembourg, Denmark, Greece, Ireland, the Netherlands, Portugal and the UK was used to examine the evolution of specialisation from 1988 to 1999. At the country level, the Herfindahl index of product and destination specialisation across 4-digit sectors shows a slight tendency towards increased specialisation in sectors and diversification in market coverage. For six of the seven countries, the changes are quite small in magnitude. Ireland proves to be an exception, showing a marked increase in sector specialisation and diversification in market coverage. Econometric tests on specialisation on sector exports show a highly significant and positive relationship between sector exports and diversification across destination countries for all of the countries in the sample. This holds for both count of markets and the Herfindahl measure of concentration. The findings on product coverage within the sectors are less conclusive. In contrast to the results found for the other six countries, in Ireland the product count has a significant negative effect.

The case of Ireland, which will be examined in more detail in the next chapters, was particularly interesting. It experienced the largest changes in its specialisation patterns, and is the most specialised of all the countries in the sample. It was the only country where increased product concentration had a positive effect on exports, and where the high technology sectors were

particularly important. The geographic element is equally influential in determining sector exports, as with the other countries. Part of the explanation for Ireland's results on product specialisation in its exports must be due to the industrial policy focus on attracting Foreign Direct Investment (FDI). The Industrial Development Agency (IDA), when given responsibility for developing Ireland's appeal as a base for multinational enterprises, centred its attention on export-orientated companies in a very narrow range of sectors.

The IDA has been active in promoting export-led growth through attracting greenfield FDI by providing fiscal and financial incentives, and developing industrial clusters with linkages between foreign and domestic firms in certain sectors. The priority given to export orientated firms was obvious in the early years of the IDA. Prior to 1980, tax incentives were offered on export sales, although this was then changed to a uniformly low corporate tax rate for all companies and more recently incentives have been given to encourage research and development activities (Murphy and Ruane, 2003).

As we will see in the next chapter, most of Ireland's export growth has been in these high technology sectors of computers, chemicals and electronics, which industrial policy had identified as the main target of FDI incentives. By pursuing large FDI projects in such specific sectors, the Irish economy has become extremely specialised both in production and in exports. To date this appears to have been a successful policy, as the sectors in which specialisation has taken

place are high growth industries. By diversifying geographically, shocks in an individual market should not present a large problem for the economy. However, this highly specialised pattern could be vulnerable to an industry-specific shock.

Table 2.1: Summary Statistics by Country and Year

Belgium-Lux.	***1988***	***1989***	***1990***	***1991***	***1992***	***1993***	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***
Average Sector Exports	81798	90440	89088	85970	82154	88815	97081	104540	106940	115906	122275	n.a.
Average No. Products per Sector	6.9	6.9	6.95	7.0	7.1	7.1	7.2	7.4	7.3	7.5	7.5	n.a.
Average No. Destination Countries	39.3	40.7	40.8	40.8	41.2	43.3	44.6	45.0	45.6	46.2	45.7	n.a.
Average Product Concentration (HH)	0.564	0.565	0.564	0.565	0.567	0.561	0.554	0.55	0.547	0.552	0.553	n.a.
Average Destination Concentration (HH)	0.392	0.388	0.382	0.392	0.386	0.381	0.375	0.369	0.364	0.366	0.367	n.a.
Denmark	***1988***	***1989***	***1990***	***1991***	***1992***	***1993***	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***
Average Sector Exports	20239	20860	21480	21418	22207	21852	23326	25089	25764	26922	26772	28740
Average No. Products per Sector	6.2	6.0	6.1	6.1	6.2	6.2	6.3	6.3	6.2	6.2	6.3	6.3
Average No. Destination Countries	25.2	25.1	25.2	25.1	25.6	25.6	25.8	25.8	25.8	26.4	26.6	27.0
Average Product Concentration (HH)	0.577	0.579	0.584	0.585	0.583	0.573	0.561	0.582	0.566	0.559	0.561	0.565
Average Destination Concentration (HH)	0.309	0.321	0.319	0.314	0.311	0.309	0.308	0.326	0.310	0.297	0.308	0.323
Greece	***1988***	***1989***	***1990***	***1991***	***1992***	***1993***	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***
Average Sector Exports	4778	6501	5860	5858	6270	5914	6226	6610	7093	7495	7136	7190
Average No. Products per Sector	3.2	3.5	3.6	3.9	4.0	4.3	4.5	4.8	4.9	5.1	5.2	5.1
Average No. Destination Countries	7.7	8.9	9.0	10.0	10.4	11.2	11.6	12.0	13.1	13.9	14.4	14.6
Average Product Concentration (HH)	0.533	0.547	0.542	0.546	0.556	0.550	0.563	0.552	0.554	0.543	0.555	0.553
Average Destination Concentration (HH)	0.334	0.328	0.329	0.335	0.332	0.319	0.322	0.328	0.317	0.317	0.322	0.335
Ireland	***1988***	***1989***	***1990***	***1991***	***1992***	***1993***	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***
Average Sector Exports	15521	17561	16845	16891	17801	18690	22254	26127	28196	34941	42928	49620
Average No. Products per Sector	5.2	5.1	5.1	5.2	5.5	4.4	4.4	4.5	4.7	4.8	4.9	5.0
Average No. Destination Countries	10.3	10.5	10.9	11.3	11.8	11.3	12.0	12.3	13.3	13.5	13.8	13.9
Average Product Concentration (HH)	0.587	0.584	0.592	0.596	0.601	0.604	0.607	0.616	0.602	0.608	0.608	0.613
Average Destination Concentration (HH)	0.327	0.320	0.320	0.309	0.312	0.305	0.307	0.310	0.295	0.303	0.297	0.320

Table 2.1: Summary Statistics by Country and Year

Netherlands	***1988***	***1989***	***1990***	***1991***	***1992***	***1993***	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***
Average Sector Exports	83561	92968	89452	85528	80370	75367	89193	97002	101010	113015	115047	122371
Average No. Products per Sector	6.7	6.8	6.8	6.8	6.8	6.8	6.9	7.0	7.0	7.1	7.2	7.1
Average No. Destination Countries	44.8	45.8	46.4	46.5	47.1	47.1	47.5	47.3	45.3	48.0	48.9	49.6
Average Product Concentration (HH)	0.561	0.558	0.556	0.562	0.560	0.552	0.549	0.552	0.551	0.554	0.558	0.557
Average Destination Concentration (HH)	0.353	0.348	0.335	0.329	0.340	0.352	0.351	0.370	0.340	0.353	0.340	0.354
Portugal	***1988***	***1989***	***1990***	***1991***	***1992***	***1993***	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***
Average Sector Exports	10839	12909	13544	13117	13567	12203	13588	15169	16464	17560	18107	18608
Average No. Products per Sector	4.8	4.9	5.1	5.1	5.2	5.0	5.1	5.2	5.4	5.5	5.4	5.4
Average No. Destination Countries	11.9	12.6	13.4	13.7	13.7	13.9	14.9	15.1	16.1	17.8	16.6	16.6
Average Product Concentration (HH)	0.585	0.576	0.573	0.560	0.572	0.582	0.572	0.580	0.575	0.577	0.555	0.567
Average Destination Concentration (HH)	0.270	0.273	0.273	0.260	0.272	0.266	0.256	0.261	0.347	0.251	0.254	0.263
UK	***1988***	***1989***	***1990***	***1991***	***1992***	***1993***	***1994***	***1995***	***1996***	***1997***	***1998***	***1999***
Average Sector Exports	125281	131809	132309	128325	121432	124013	139301	143399	157179	188539	186902	194078
Average No. Products per Sector	7.0	7.0	7.1	7.1	7.2	7.2	7.4	7.6	7.6	7.7	7.8	7.6
Average No. Destination Countries	69.8	69.8	70.7	69.2	69.6	71.0	72.1	73.5	74.5	74.1	72.6	70.5
Average Product Concentration (HH)	0.492	0.500	0.496	0.496	0.501	0.504	0.499	0.505	0.501	0.501	0.505	0.508
Average Destination Concentration (HH)	0.311	0.305	0.299	0.306	0.309	0.296	0.307	0.308	0.306	0.300	0.302	0.303

Table 2.2: Country and Product Coverage

Dependent Variable: Sector Exports

	Belgium-Lux.	Denmark	Greece	Ireland	Netherlands	Portugal	UK
Country Count	4774***	1552***	1045***	6665***	3462***	1455***	3681***
	(29.48)	(64.1)	(44.5)	(57.3)	(32.83)	(31.8)	(27.8)
Product Count	2121***	796***	21	-2397***	3698***	1835***	8750***
	(0.40)	(9.57)	(0.39)	(-7.43)	(8.20)	(16.3)	(14.0)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. Observations	12221	13332	13332	13332	13332	13332	13332
F-test	478***	2338***	1180***	1384***	667***	1124***	610***
R2	0.105	0.345	0.209	0.238	0.131	0.202	0.12

T-statistics in parentheses

*** Denotes significance at 1%, ** at 5% and * at 10% levels

Table 2.3: Country and Product Herfindahl Indices

Dependent Variable: Sector Exports

	Belgium-Lux.	Denmark	Greece	Ireland	Netherlands	Portugal	UK
Country Specialisation (HH)	292	1807	1805*	9680	33495***	-9343***	-30090
	(0.02)	(0.82)	(1.75)	(1.33)	(2.86)	(-3.61)	(-1.56)
Product Specialisation (HH)	-173846***	-38391***	-914	-26691***	-149313***	-14495***	-200265***
	(-11.47)	(-19.38)	(-1.19)	(-4.69)	(-13.84)	(-7.92)	(-12.09)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. Observations	12221	13173	13173	13174	13173	13173	13170
F-test	11.66***	30.24***	0.89	4.64***	16.91***	6.99***	13.8***
R2	0.011	0.029	0.001	0.005	0.016	0.007	0.014

T-statistics in parentheses

*** Denotes significance at 1%, ** at 5% and * at 10% levels

Table 2.4: Country and Product Specialisation (Logs)

Dependent Variable: Ln Sector Exports

	Belgium-Lux.	Denmark	Greece	Ireland	Netherlands	Portugal	UK
Ln Country Specialisation (HH)	-0.05*	0.06**	0.074**	0.027	0.16***	-0.20***	0.08***
	(-1.79)	(2.17)	(2.14)	(0.79)	(5.9)	(-6.47)	(3.37)
Ln Product Specialisation (HH)	-1.85***	-2.38***	-2.01***	-2.15***	-1.91***	-2.11***	-1.75***
	(-52.7)	(-60.3)	(-43.2)	(-44.9)	(-57.9)	(-49.2)	(-68.3)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. Observations	10392	11497	10384	11494	12137	11349	12239
F-test	236.1***	282***	149.2***	156.2***	264.2***	197.7***	362.5***
R2	0.214	0.242	0.158	0.15	0.22	0.19	0.28

T-statistics in parentheses

*** Denotes significance at 1%, ** at 5% and * at 10% levels

Table 2.5: Specialisation and Technology Level

Dependent Variable: Ln Sector Exports

	Belgium-Lux.	Denmark	Greece	Ireland	Netherlands	Portugal	UK
Ln Country Specialisation (HH)	-0.081*** (-2.66)	0.118*** (3.94)	0.111*** (3.10)	0.022 (0.61)	0.139*** (4.95)	-0.225*** (-6.83)	-0.089*** (-4.16)
Ln Product Specialisation (HH)	-1.811*** (-50.13)	-2.317*** (-56.65)	-2.132*** (-44.43)	-2.11*** (-43.26)	-1.84*** (-54.06)	-2.065*** (-46.06)	-1.564*** (-63.84)
Medium-Low Technology	0.695*** (11.91)	-0.170*** (-2.78)	-0.559 (-0.84)	-0.147** (-2.29)	0.475*** (8.74)	-0.565*** (-8.78)	0.524*** (12.56)
Medium-High Technology	0.862*** (16.11)	0.043 (0.72)	-0.517*** (8.19)	0.286*** (4.61)	0.890*** (16.81)	-0.689*** (-11.14)	0.918*** (22.66)
High Technology	0.232*** (2.77)	0.854*** (9.51)	-1.151*** (-11.36)	1.355*** (14.48)	0.874*** (10.89)	-0.314*** (-3.42)	1.257*** (20.08)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. Observations	9198	10358	9295	10428	10769	10324	10821
F-test	185.9***	220.8***	137***	143.1***	211.6***	154.5***	319.3***
R2	0.233	0.255	0.191	0.18	0.239	0.193	0.321

T-statistics in parentheses

*** denotes significance at 1%, ** at 5% and * at 10% levels

Table 2.6: Specialisation and Neven Input Classification

Dependent Variable: Ln Sector Exports

	Belgium-Lux.	Denmark	Greece	Ireland	Netherland	Portugal	UK
Ln Country Specialisation	0.032	0.128***	0.077*	0.129***	0.132***	-0.261***	-0.033
(HH)	(0.83)	(3.52)	(1.68)	(2.81)	(3.99)	(-6.33)	(-1.19)
Ln Product Specialisation	-1.645***	-2.06***	-1.979***	-1.92***	-1.72***	-2.00***	-1.49***
(HH)	(-36.19)	(-41.37)	(-31.71)	(-29.6)	(-41.6)	(-35.21)	(-45.89)
Labour-Capital	0.295***	-0.975***	-1.32***	-0.326***	-0.035	-1.54***	-0.14**
	(3.57)	(-11.25)	(-13.42)	(-3.31)	(0.08)	(-16.34)	(-2.10)
High-HC, Low Investment	0.463***	0.427***	-1.261***	0.586***	0.52***	-1.43***	0.52***
	(4.57)	(4.14)	(-10.99)	(5.04)	(5.57)	(-13.07)	(6.93)
HC, Investment	0.737***	-0.013	0.339**	0.791***	1.01***	-0.82***	-0.33***
	(5.54)	(-0.09)	(2.17)	(4.91)	(7.89)	(-5.24)	(-3.17)
High tech, High HC	1.057***	-0.276**	-1.36***	0.966***	1.27***	-1.99***	0.96***
	(10.49)	(-2.53)	(-11.2)	(8.01)	(13.25)	(-17.13)	(12.02)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. Observations	5208	5996	5677	6188	6172	6140	6343
F-test	94.56***	153.8***	93.3***	73.9***	137.7***	115.5***	163.3***
R2	0.226	0.304	0.219	0.169	0.276	0.243	0.305

T-statistics in parentheses

*** Denotes significance at 1%, ** at 5% and * at 10% levels

Table 2.7: Product and Market Coverage and Sector Growth

Dependent Variable: Sector Export Growth

	Belgium-Lux.	Denmark	Greece	Ireland	Netherlands	Portugal	UK
Change Country Count	14.53	11.64***	25.32***	30.42**	7.81***	23.3***	5.52***
	(1.43)	(4.34)	(2.61)	(2.38)	(2.92)	(5.06)	(6.52)
Change Product Count	34.11	14.19	68.83***	106.01***	11.84	29.64**	5.36
	(0.69)	(1.46)	(3.01)	(3.01)	(0.87)	(2.44)	(1.18)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. Observations	10938	11632	10222	11029	11987	10940	11961
F-test	0.9	2.99***	2.41**	2.32***	1.66*	4.02***	5.55***
R2	0.001	0.003	0.003	0.003	0.002	0.004	0.006

T-statistics in parentheses

*** Denotes significance at 1%, ** at 5% and * at 10% levels

Table 2.8: Specialisation and Sector Growth

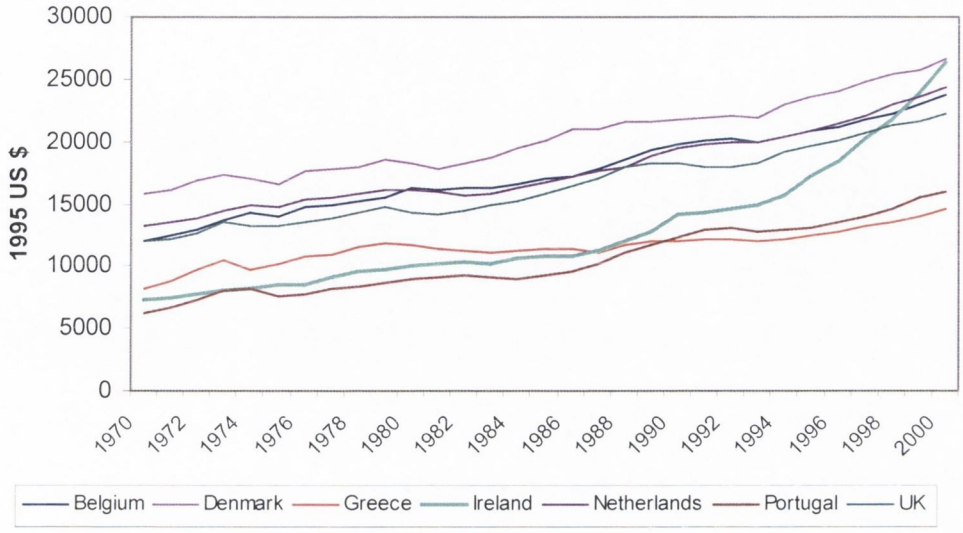
Dependent Variable: Sector Export Growth

	Belgium-Lux.	Denmark	Greece	Ireland	Netherlands	Portugal	UK
Change Country HH	104.2	38.7	26.9	-582.7**	-1.85	7.27	-6.53
	(0.54)	(0.86)	(0.20)	(-2.39)	(-0.03)	(0.09)	(-0.29)
Change Product HH	216.6	170.9***	121.1	109.6	15.08	179.7***	168.1***
	(0.44)	(2.72)	(1.02)	(0.56)	(0.12)	(2.72)	(2.96)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. Observations	10938	11482	10088	10888	11831	10798	11797
F-test	0.69	1.77***	0.79	1.37	1.00	1.60*	2.52***
R2	0.001	0.002	0.001	0.002	0.001	0.002	0.003

T-statistics in parentheses

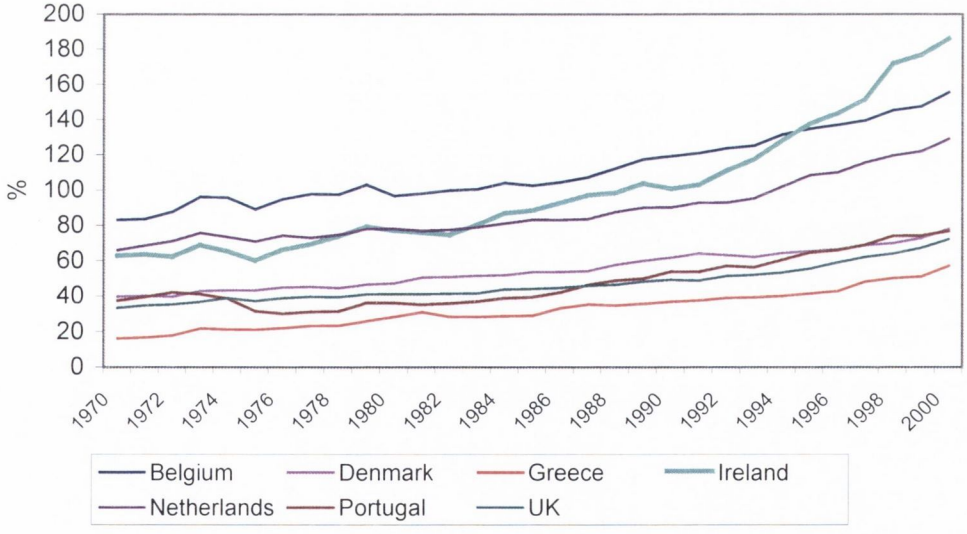
*** denotes significance at 1%, ** at 5% and * at 10% levels

Figure 2.1 Real GDP Per Capita, 1970-2000



Source: Heston, Summers Aten (2002), Penn World Table Version 6.1

Figure 2.2 Openness (Percentage of GDP) 1970-2000



Source: Heston, Summers Aten (2002), Penn World Table Version 6.1

Figure 2.3: Export Totals, 1988-1999

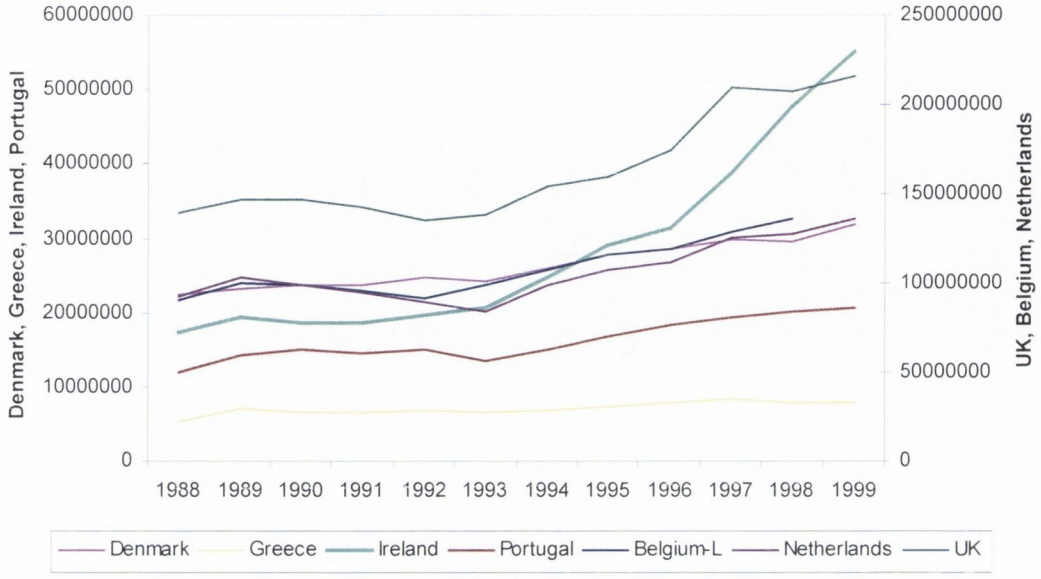


Figure 2.4: Sector Specialisation (HH)

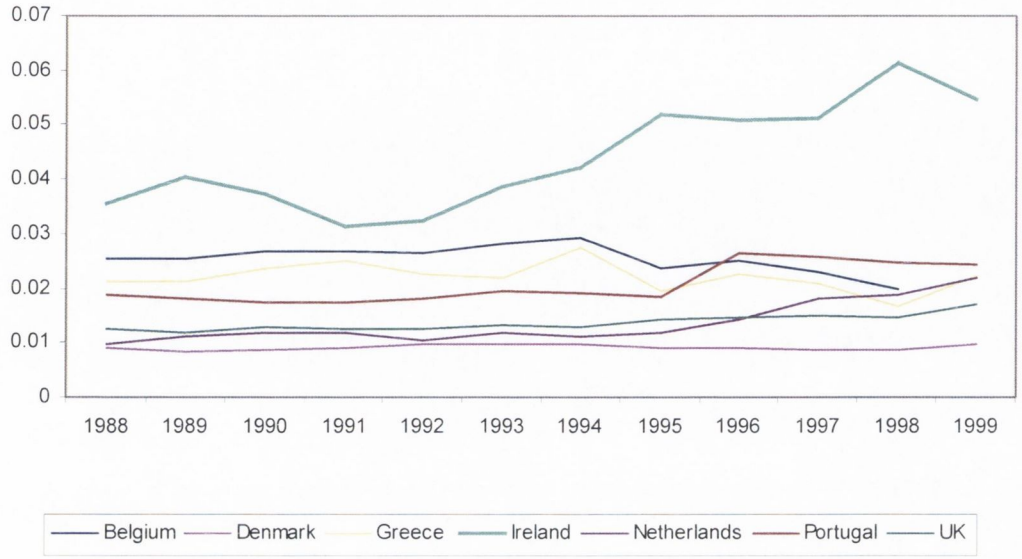


Figure 2.5: Market Specialisation (HH)

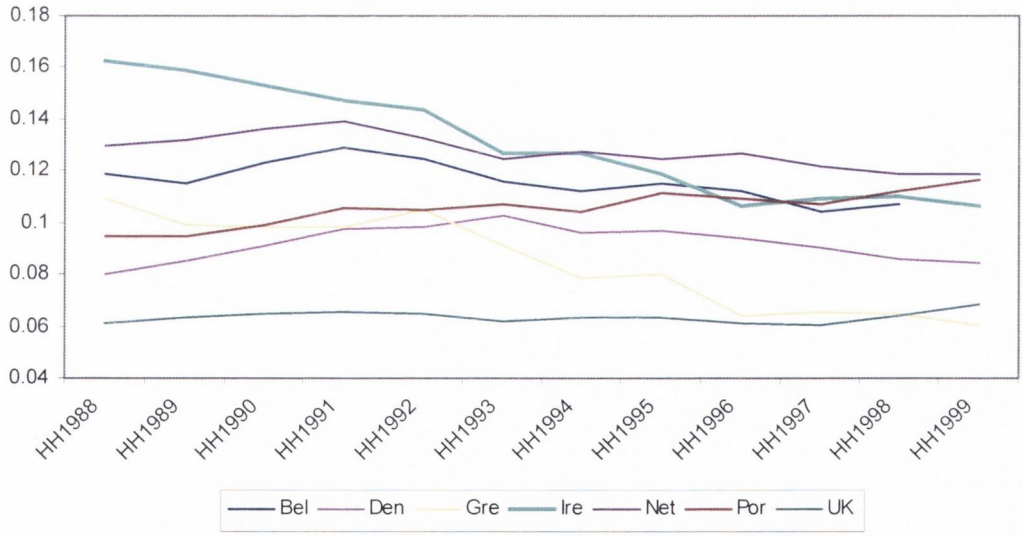


Figure 2.6: Belgium - Exports by OECD Process Classification

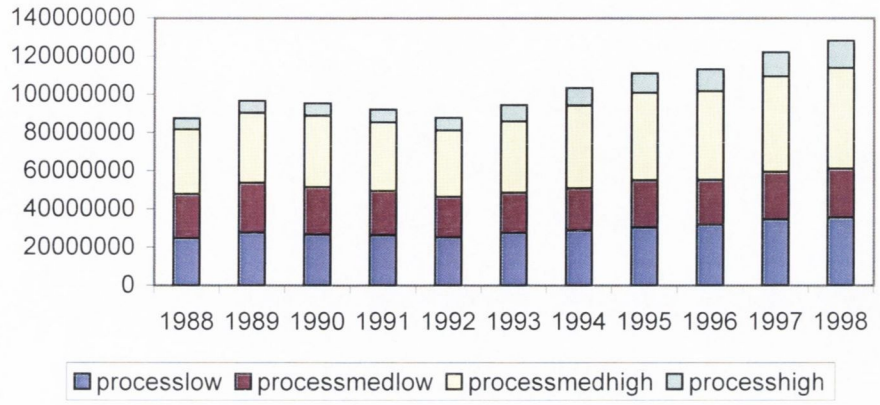


Figure 2.7: Denmark - Exports by OECD Process Classification

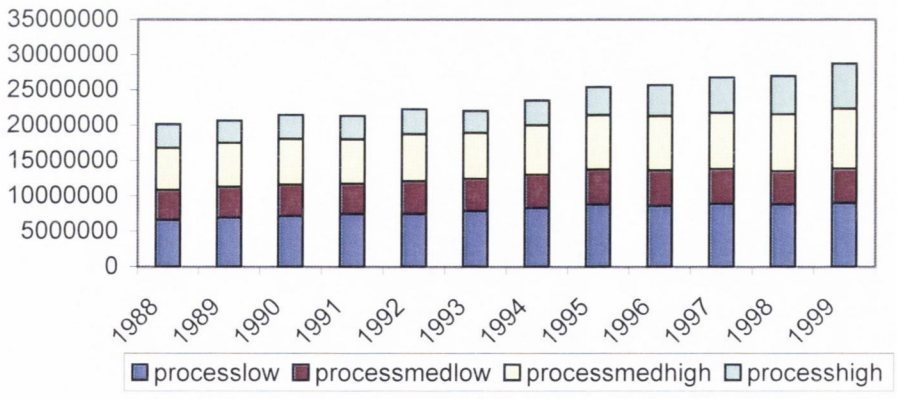


Figure 2.8: Greece - Exports by OECD Process Classification

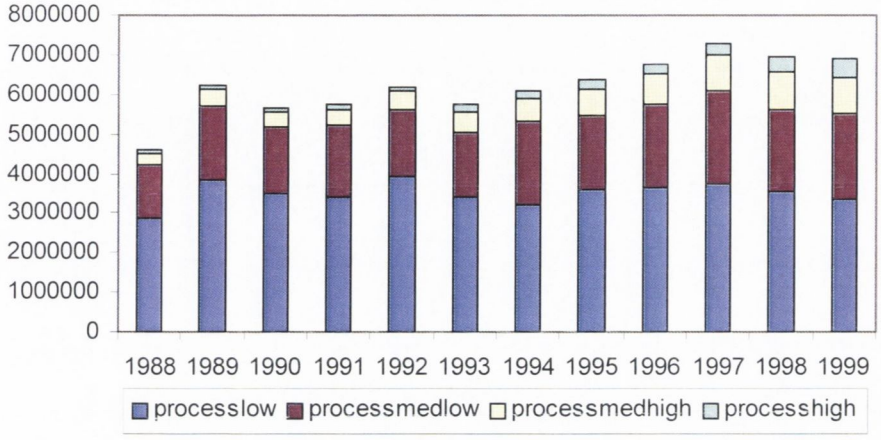


Figure 2.9: Ireland - Exports by OECD Process Classification

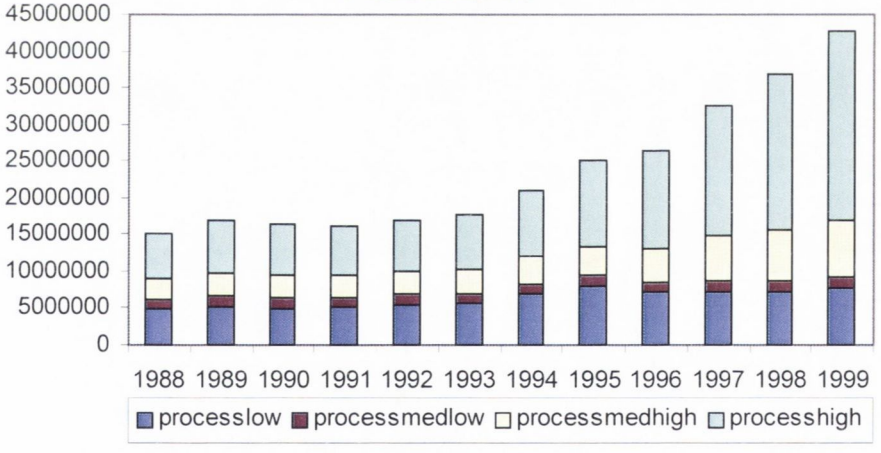


Figure 2.10: Netherlands - Exports by OECD Process Classification

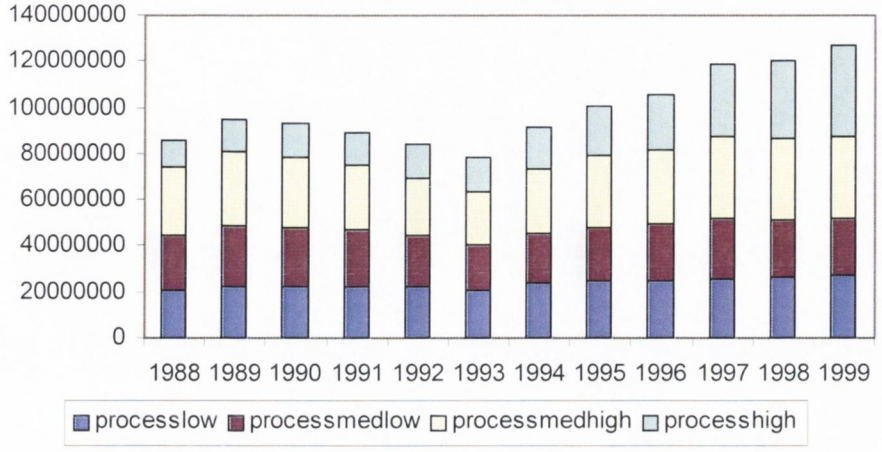


Figure 2.11: Portugal - Exports by OECD Process Classification

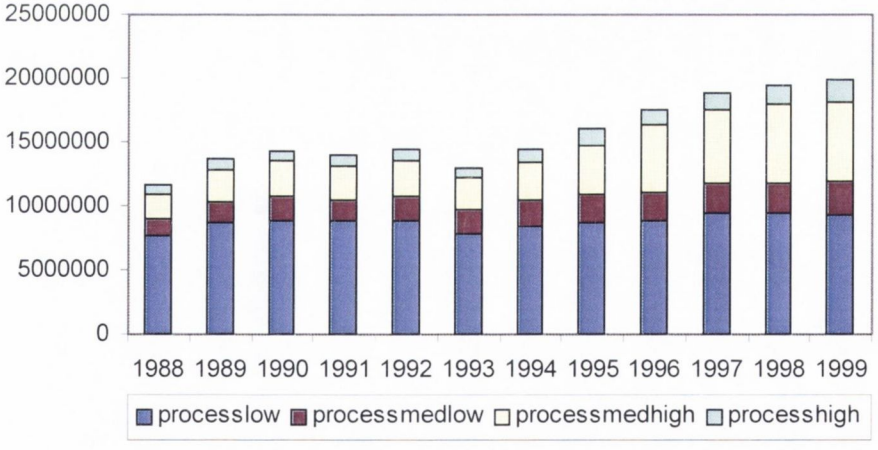


Figure 2.12: UK - Exports by OECD Process Classification

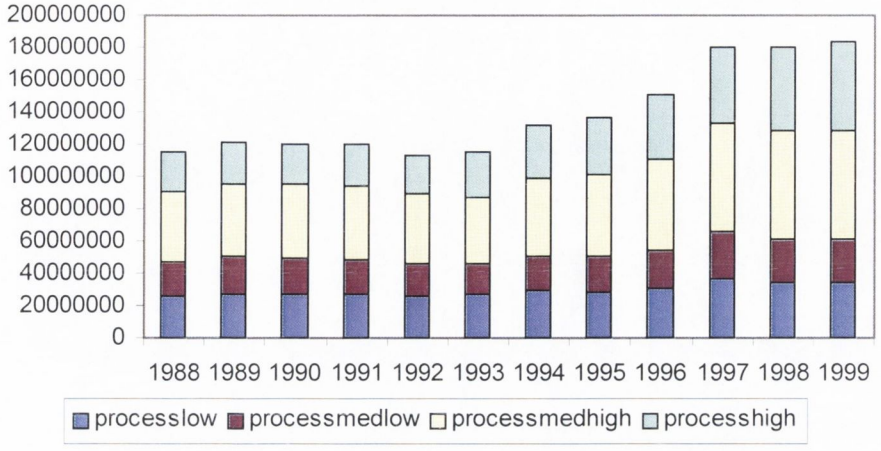


Figure 2.13: Belgium - Exports by Neven Classification

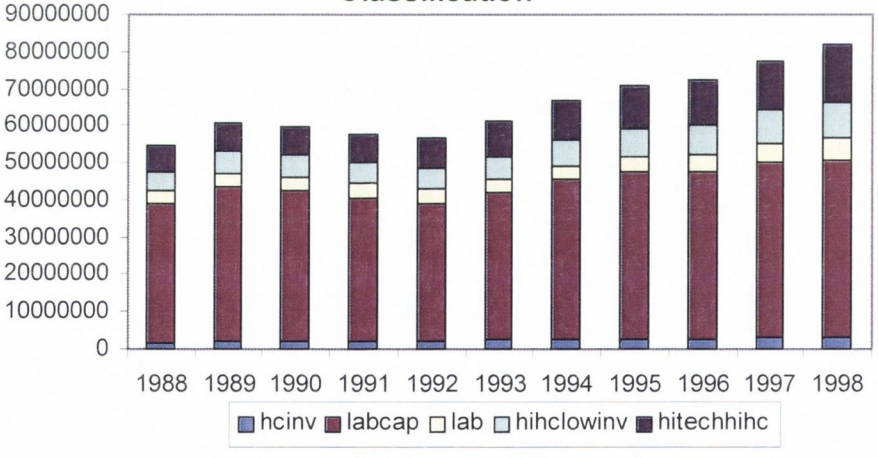


Figure 2.14: Denmark - Exports by Neven Classification

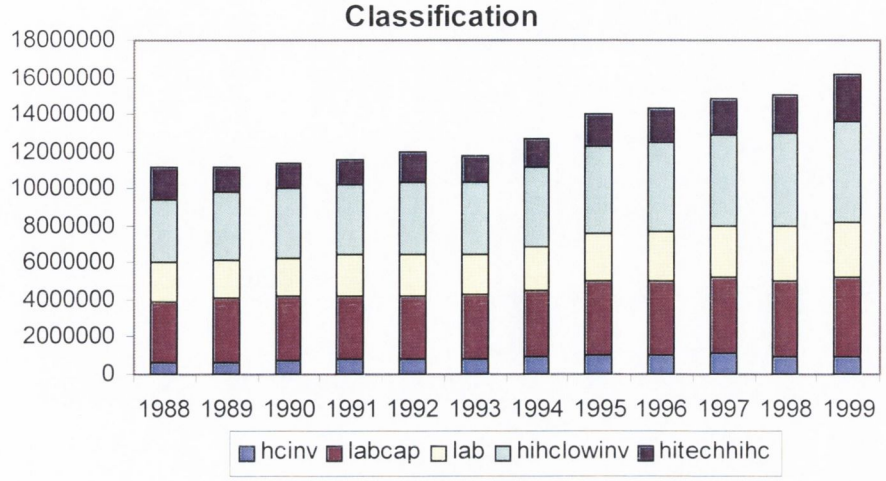


Figure 2.15: Greece - Exports by Neven Classification

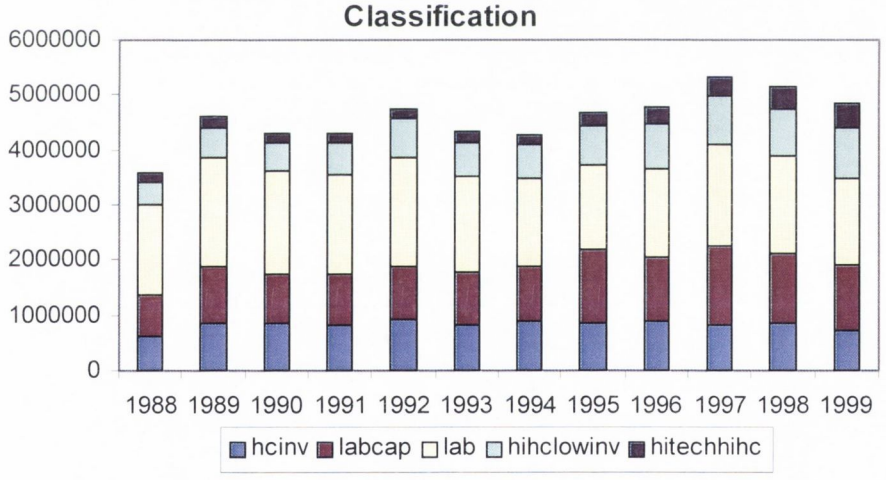


Figure 2.16: Ireland - Exports by Neven Classification

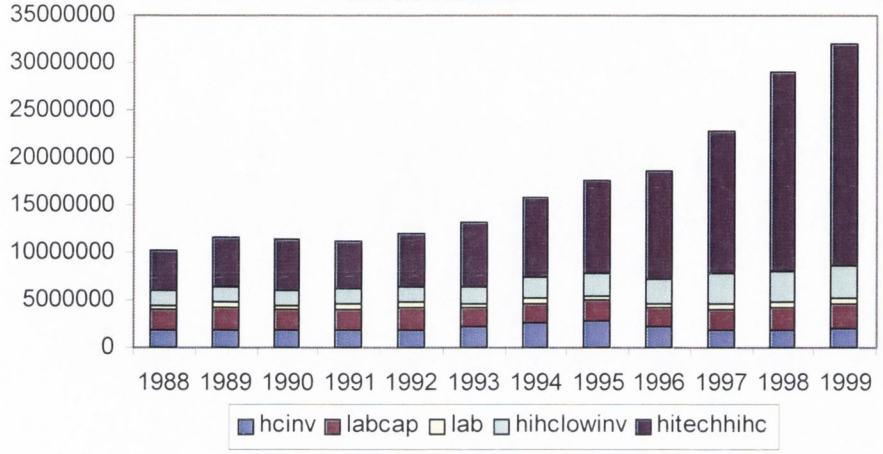


Figure 2.17: Netherlands - Exports by Neven Classification

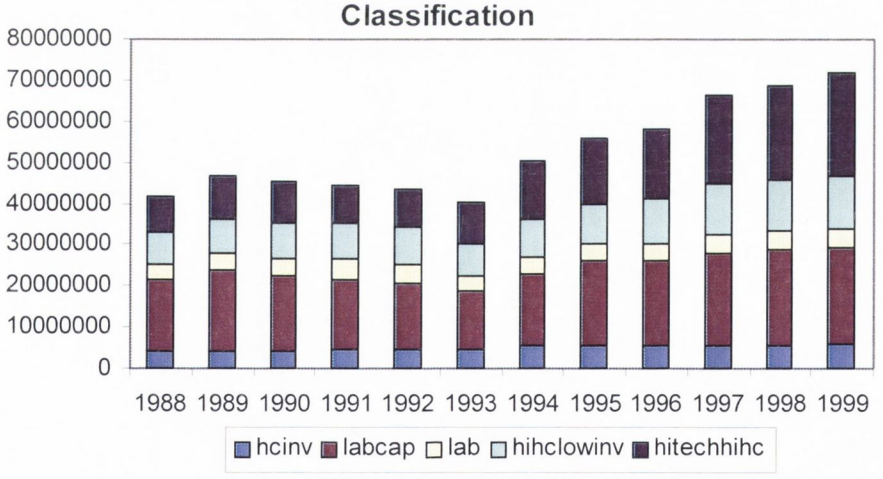


Figure 2.18: Portugal - Exports by Neven Classification

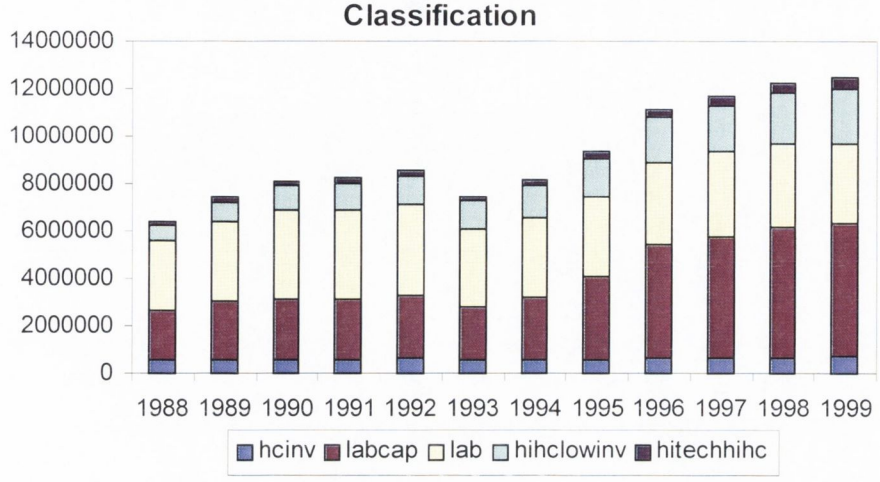


Figure 2.19: UK - Exports by Neven Classification

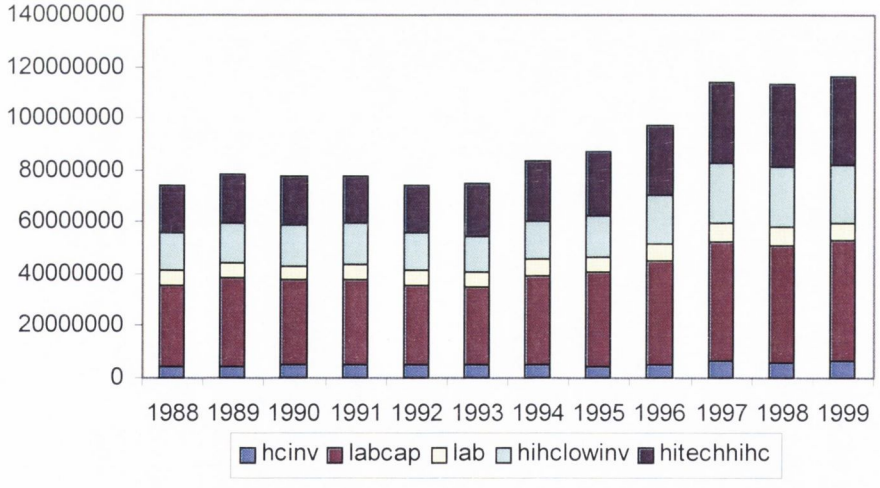


Figure 2.20: Belgium - Sector HH by OECD Process Classification

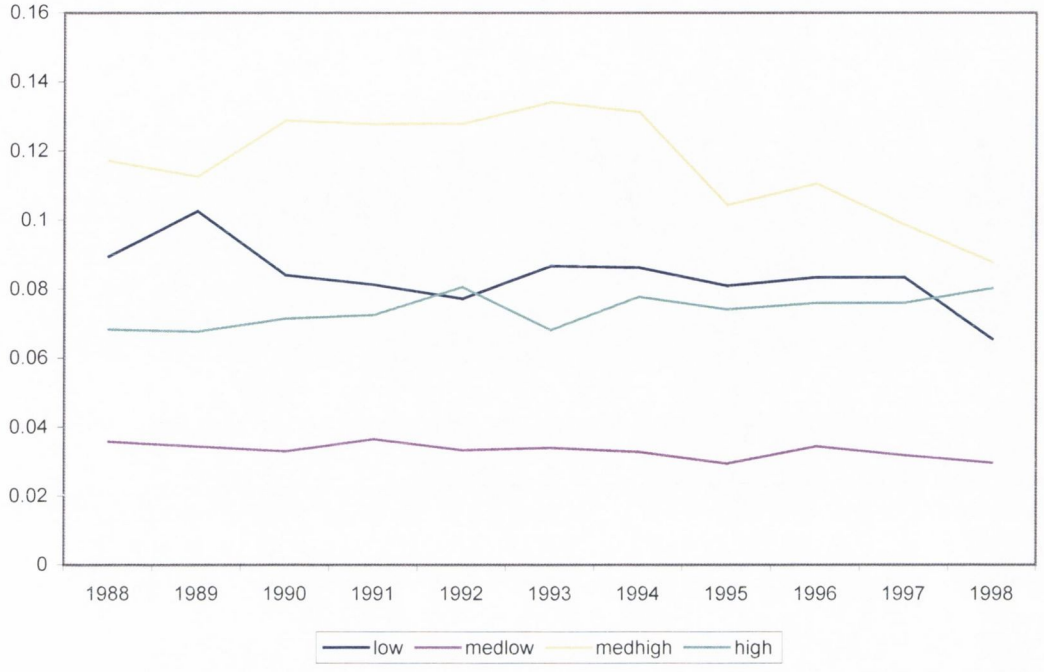


Figure 2.21: Belgium - Geographic HH by OECD Process Classification

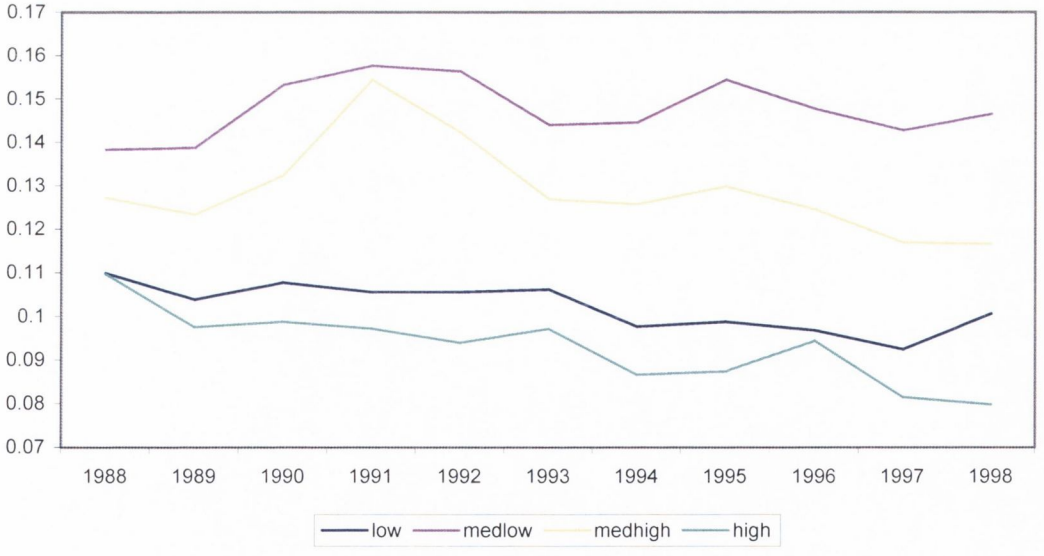


Figure 2.22: Denmark - Sector HH by OECD Process Classification

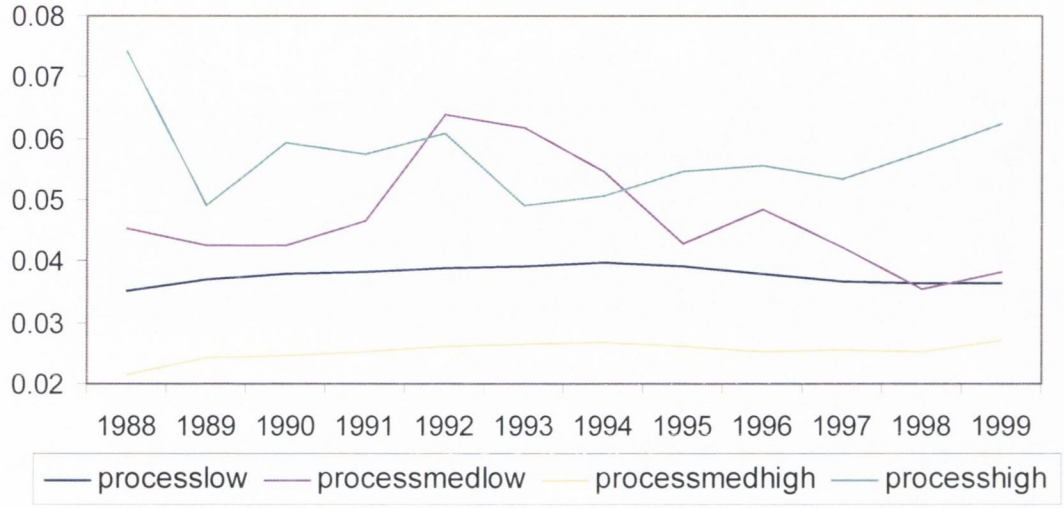


Figure 2.23: Denmark - Geographic HH by OECD Process Classification

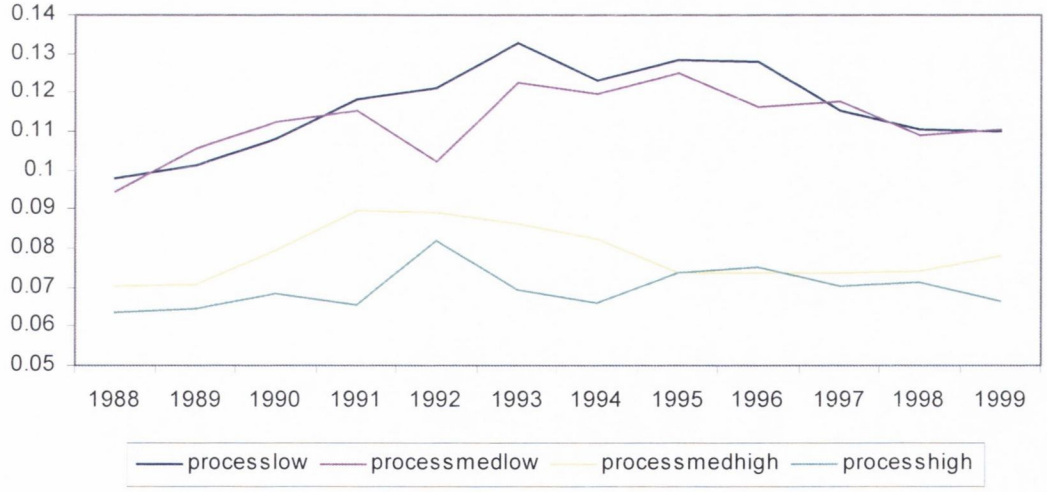


Figure 2.24: Greece - Sector HH by OECD Process Classification

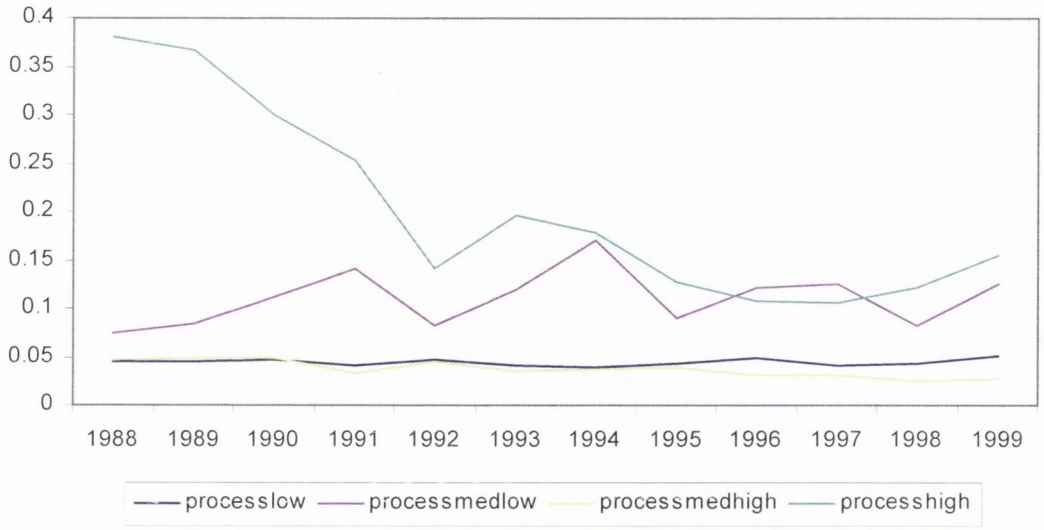


Figure 2.25: Greece - Geographic HH by OECD Process Classification

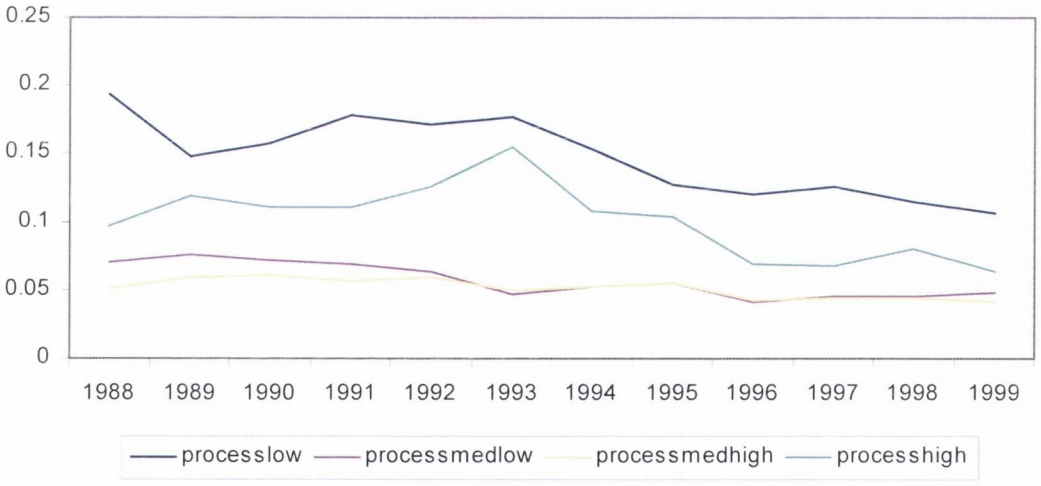


Figure 2.26: Ireland - Sector HH by OECD Process Classification

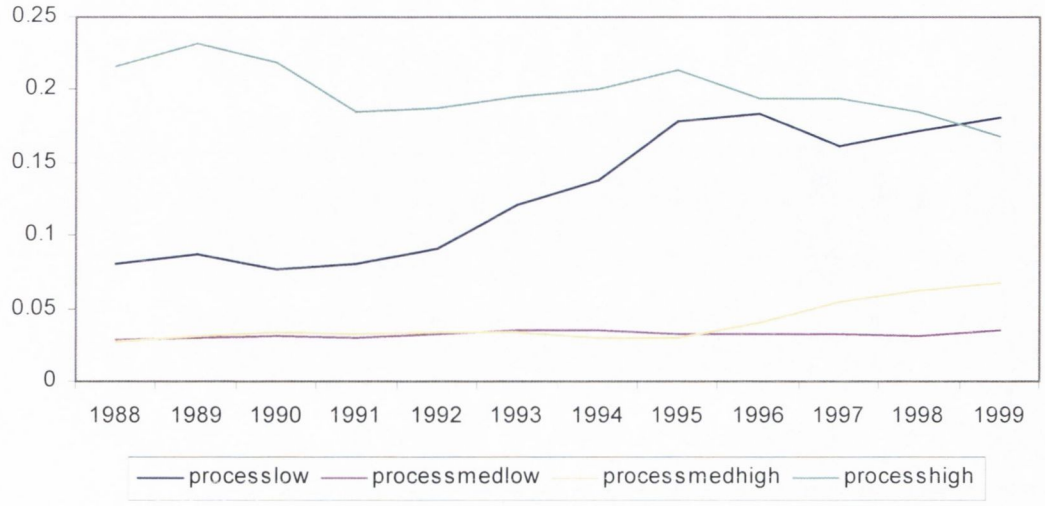


Figure 2.27: Ireland - Geographic HH by OECD Process Classification

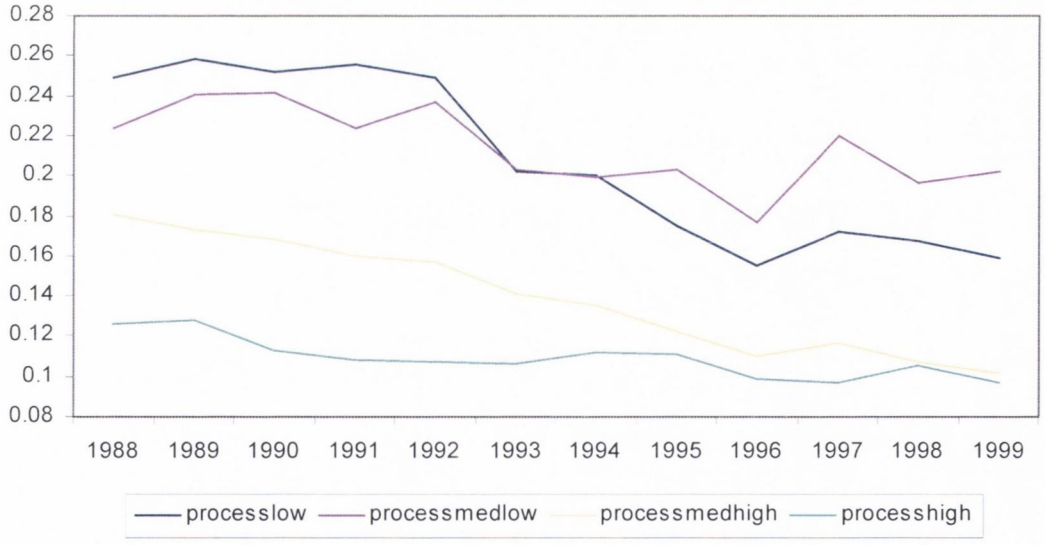


Figure 2.28: Netherlands - Sector HH by OECD Process Classification

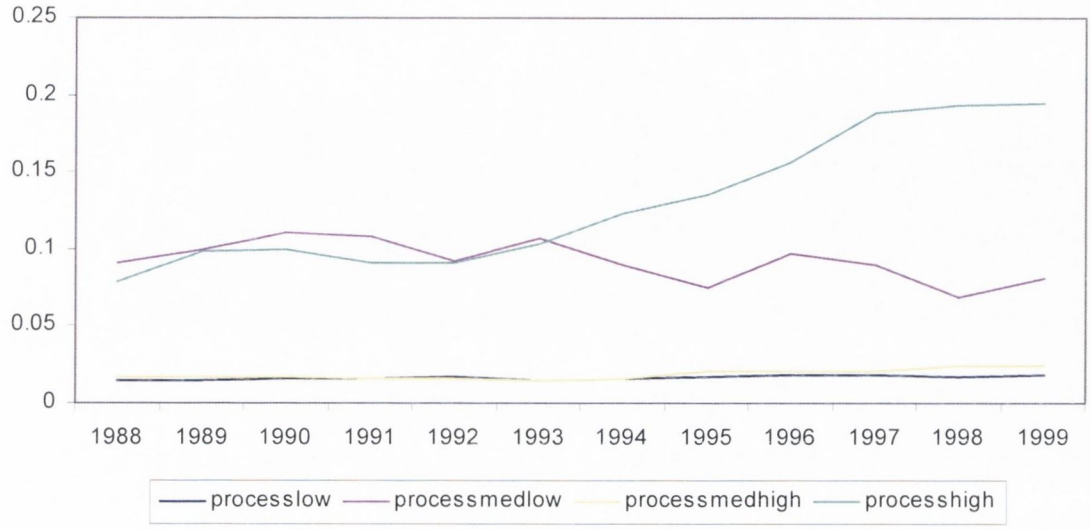


Figure 2.29: Netherlands - Geographic HH by OECD Process Classification

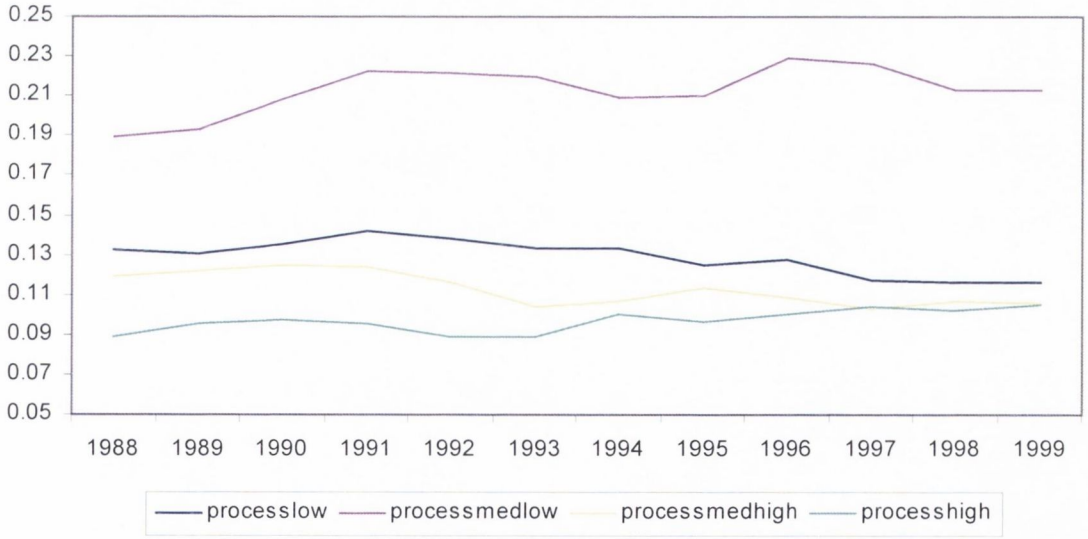


Figure 2.30: Portugal - Sector HH by OECD Process Classification

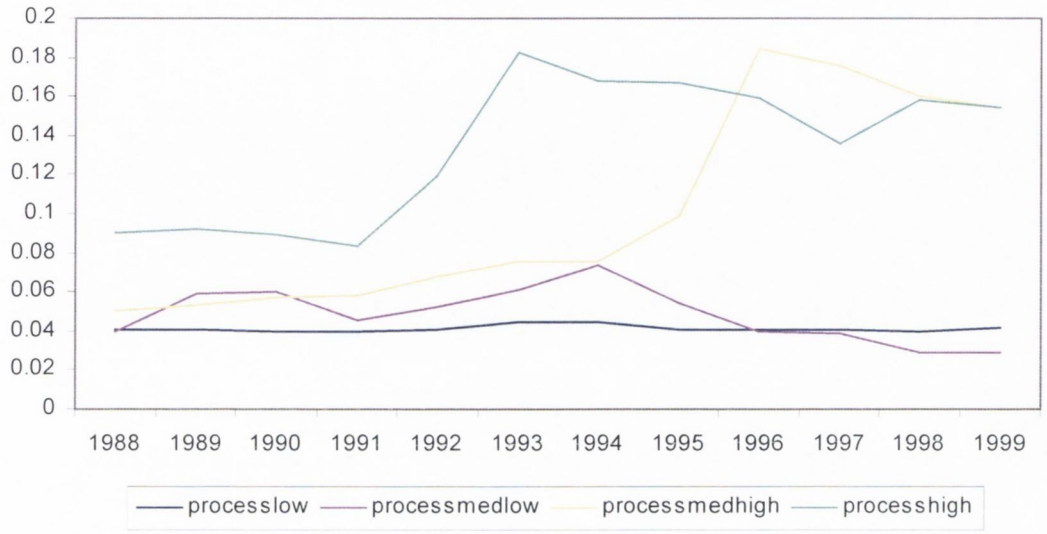
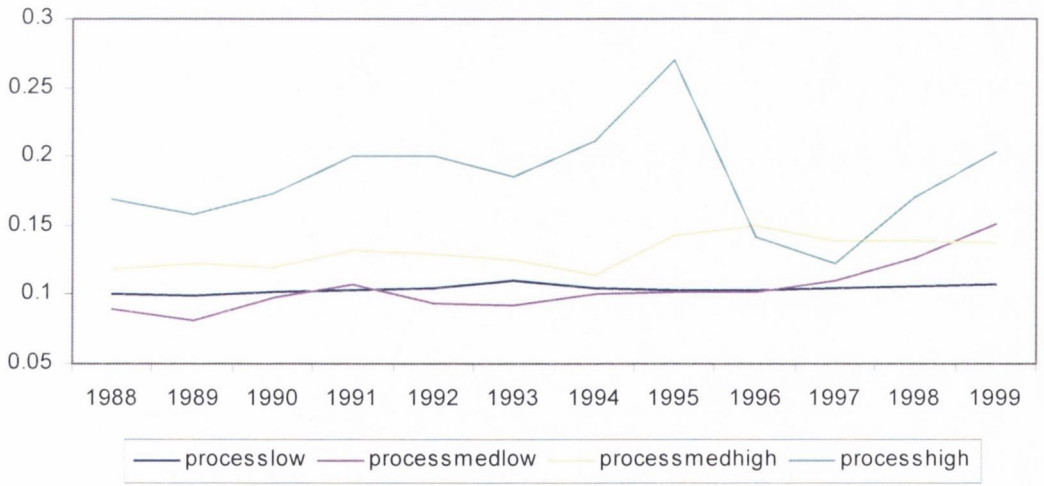


Figure 2.31: Portugal - Geographic HH by OECD Process Classification



2.32: UK - Sector HH by OECD Process Classification

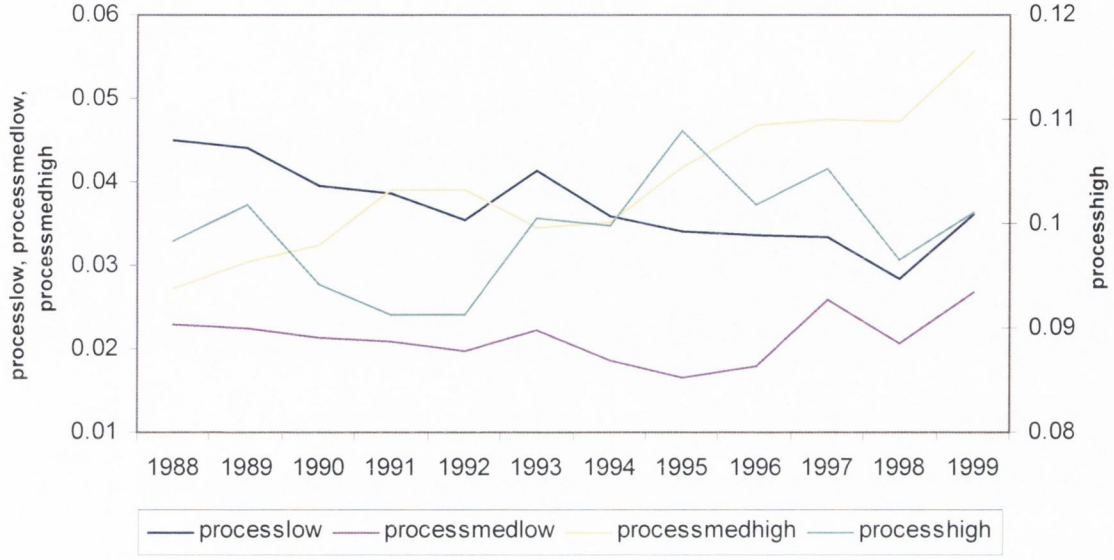


Figure 2.33: UK - Geographic HH by OECD Process Classification

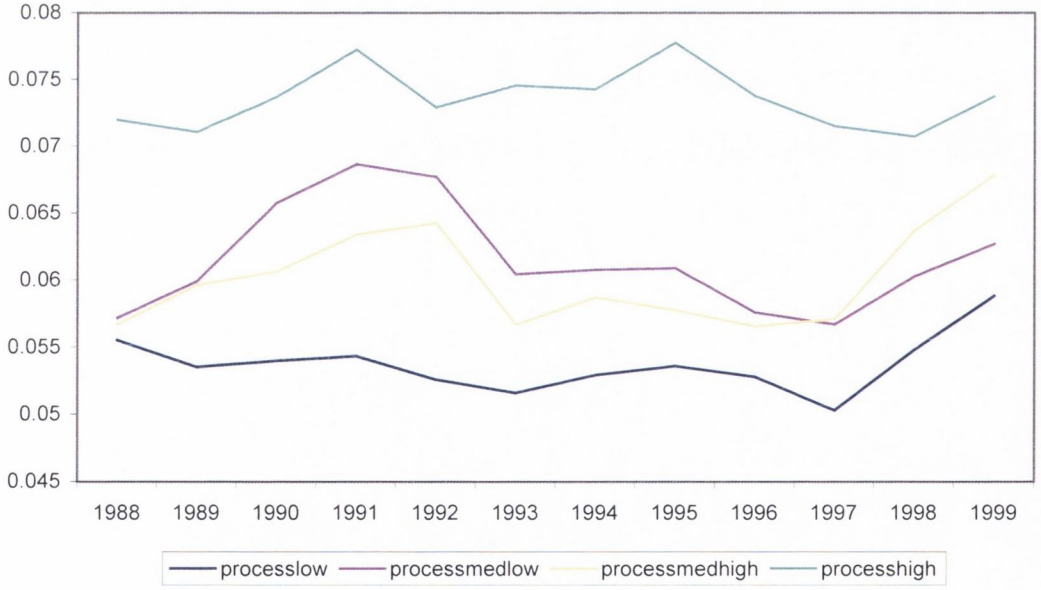


Figure 2.34: Belgium - Sector HH by Neven Classification

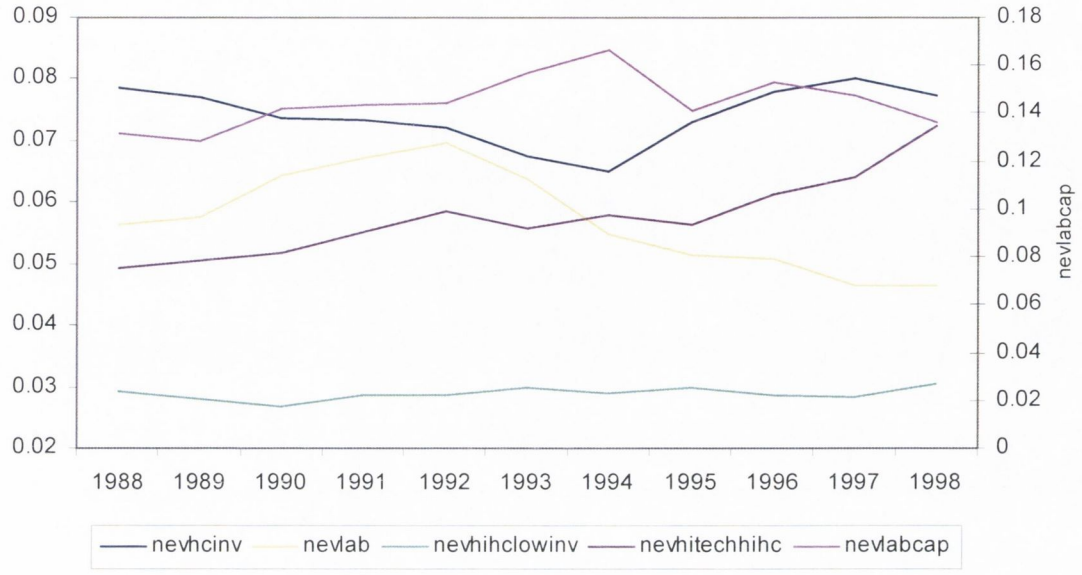


Figure 2.35: Belgium - Geographic HH by Neven Classification

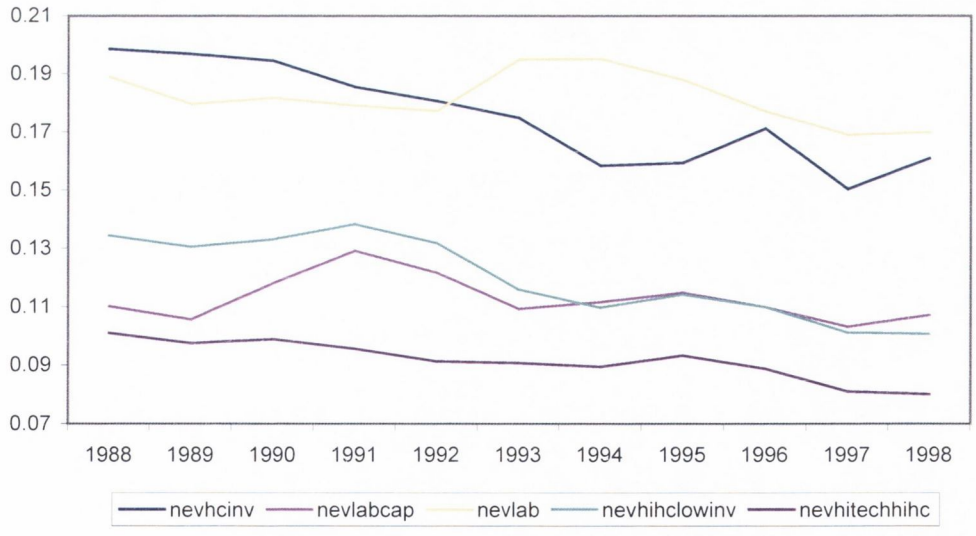


Figure 2.36: Denmark - Sector HH by Neven Classification

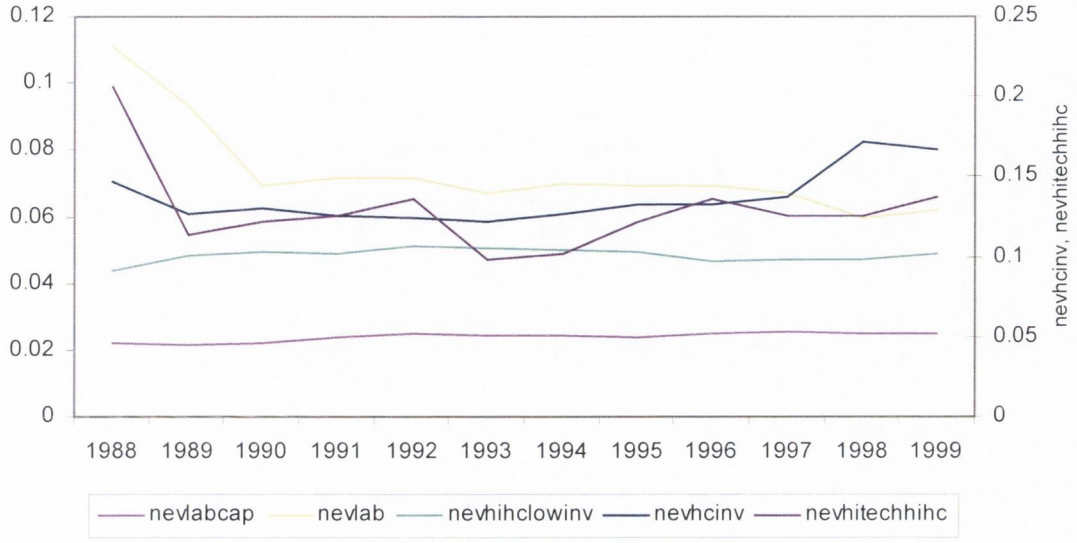


Figure 2.37: Denmark - Geographic HH by Neven Classification

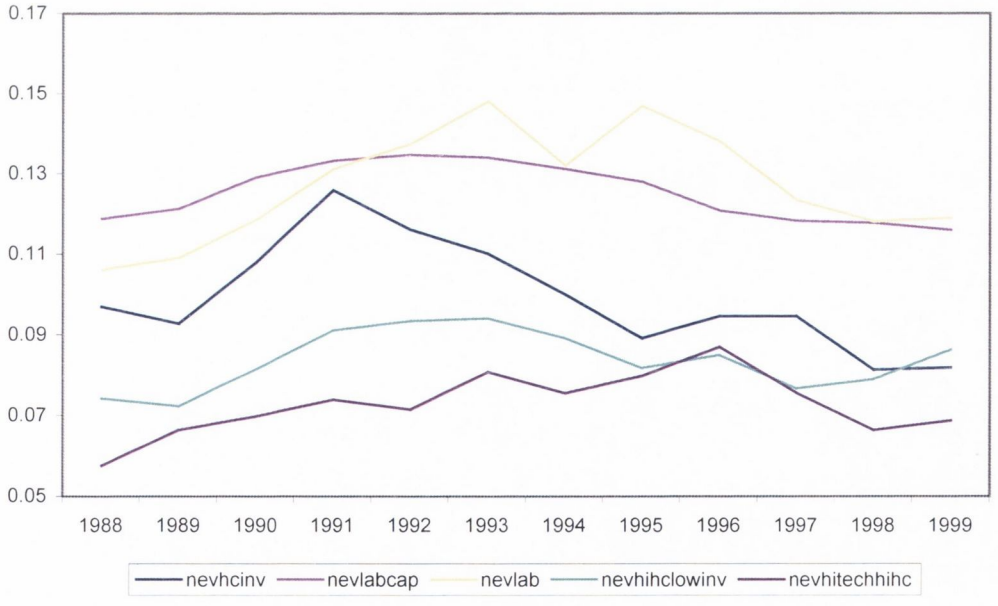


Figure 2.38: Greece - Sector HH by Neven Classification

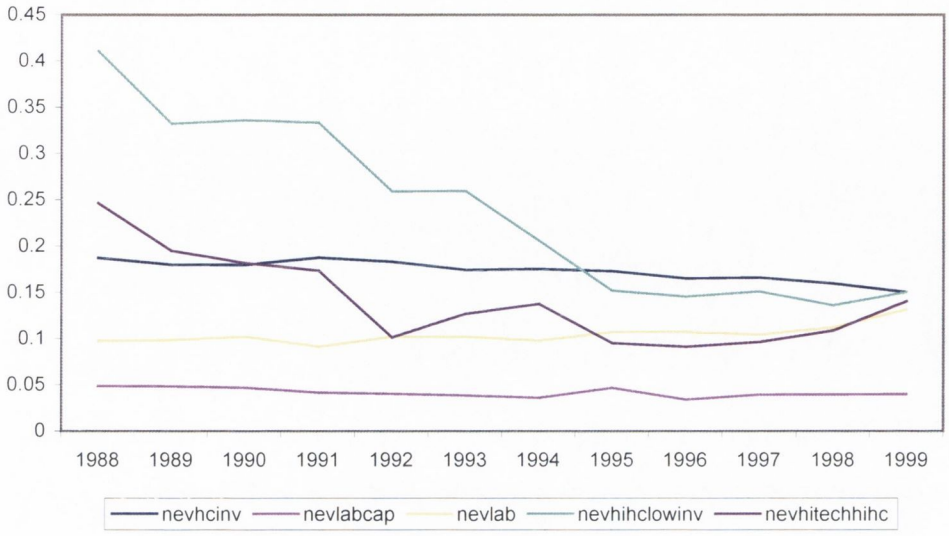


Figure 2.39: Greece - Geographic HH by Neven Classification

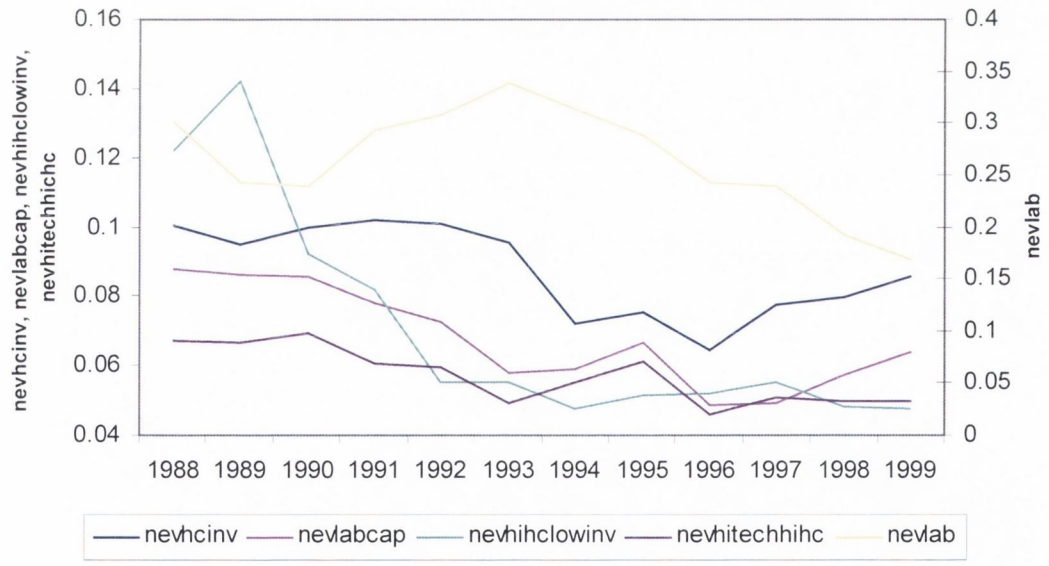


Figure 2.40: Ireland - Sector HH by Neven Classification

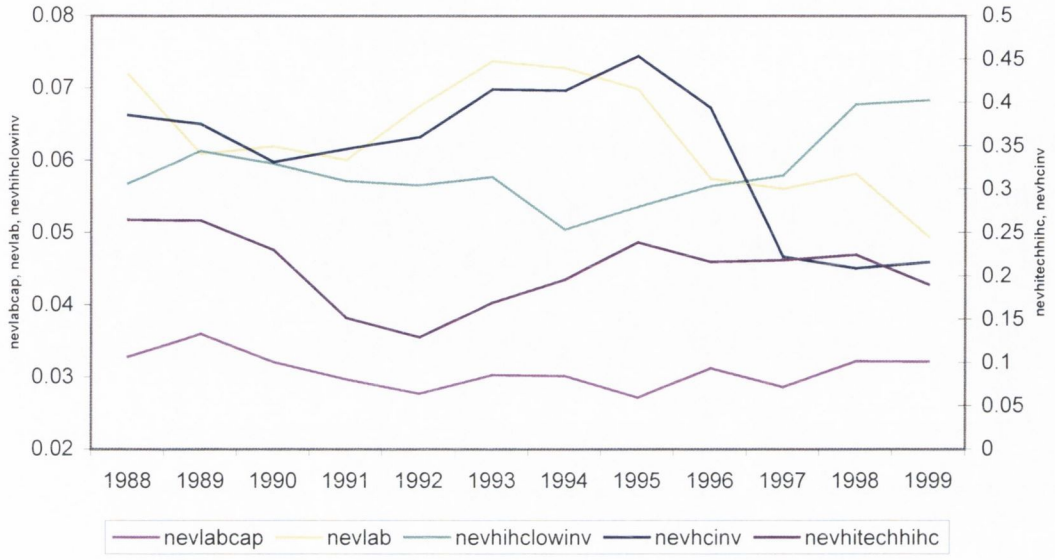


Figure 2.41: Ireland - Geographic HH by Neven Classification

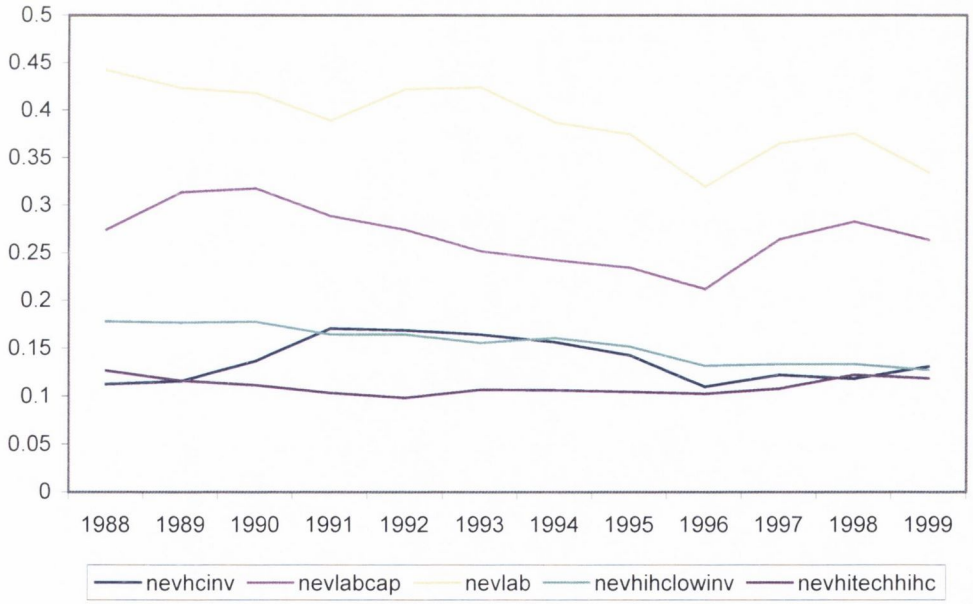


Figure 2.42: Netherlands - Sector HH by Neven Classification

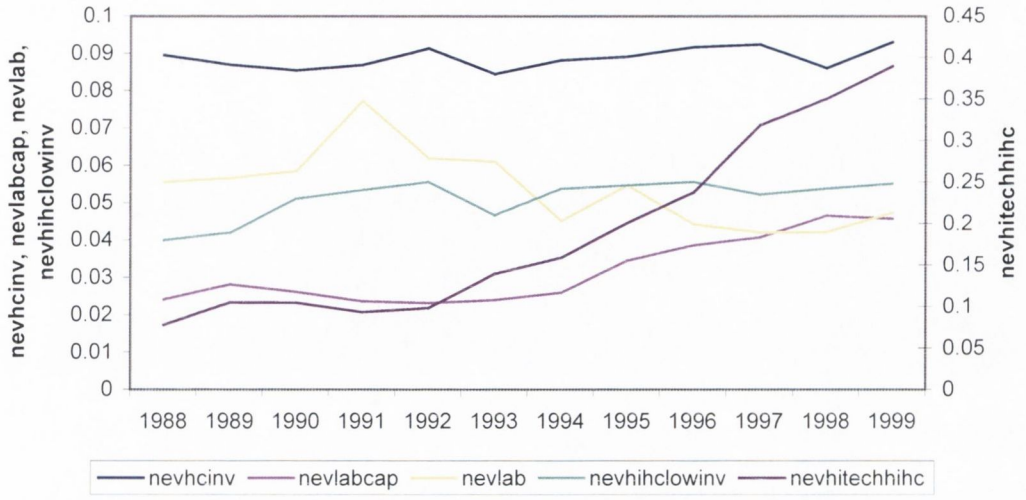


Figure 2.43: Netherlands - Geographic HH by Neven Classification

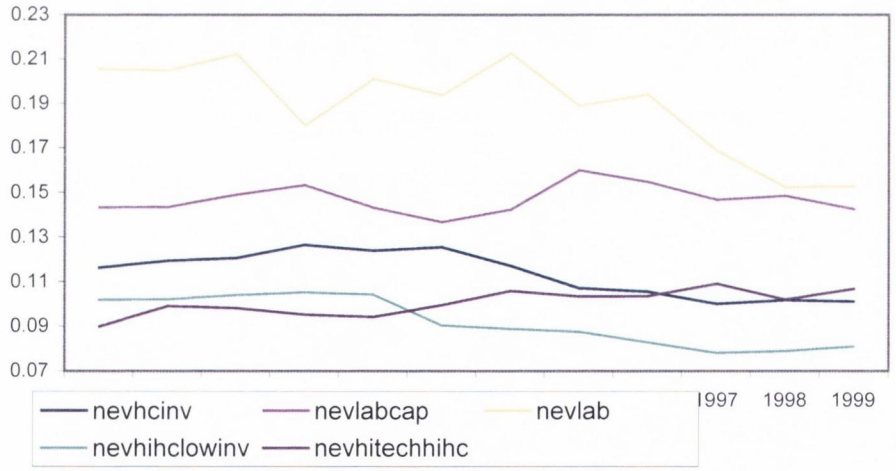


Figure 2.44: Portugal - Sector HH by Neven Classification

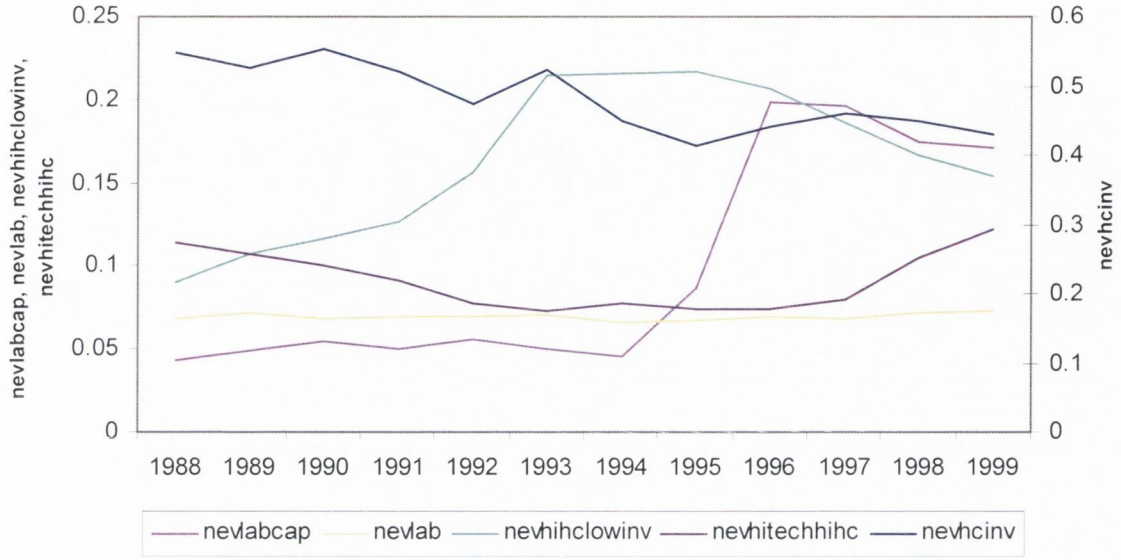


Figure 2.45: Portugal - Geographic HH by Neven Classification

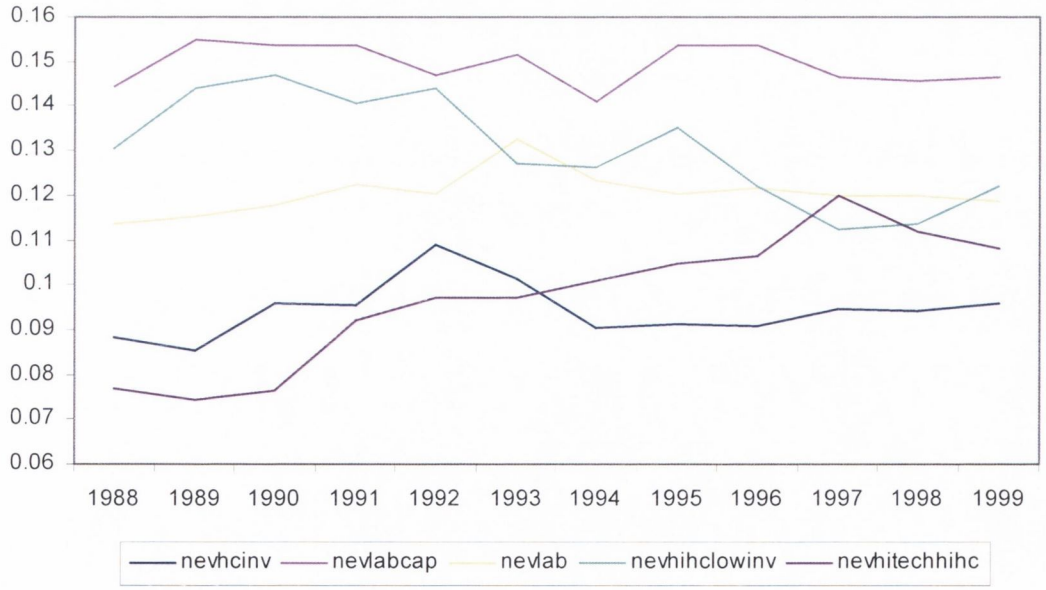


Figure 2.46: UK - Sector HH by Neven Classification

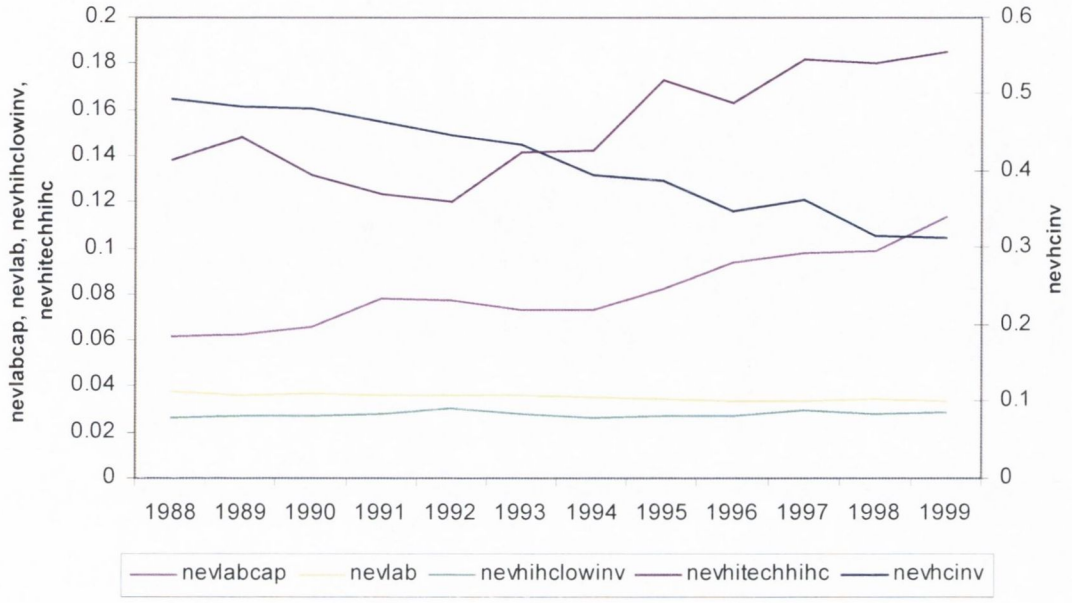
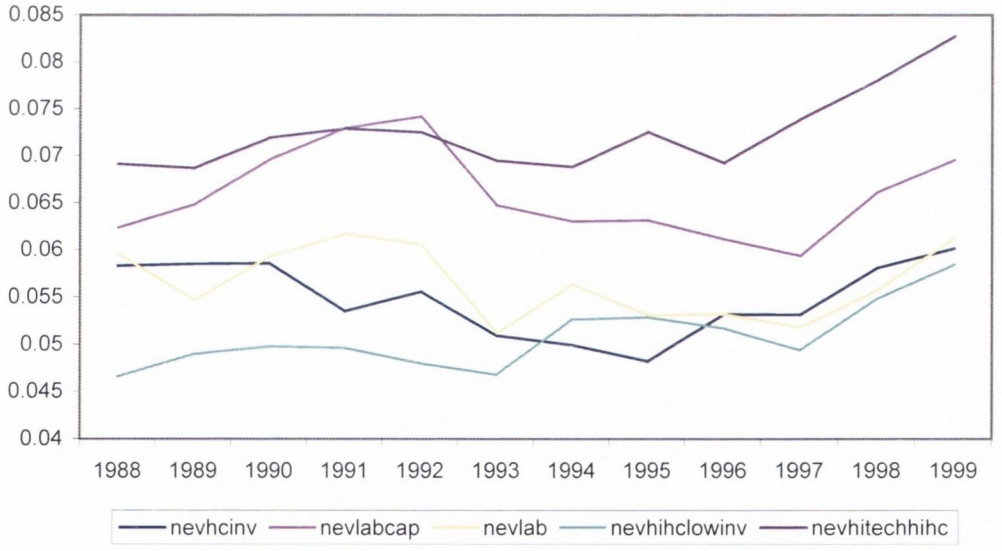


Figure 2.47: UK - Geographic HH by Neven Classification



Appendix 2.1: Description of 2-Digit Combined Nomenclature Sectors (from Eurostat COMEXT CD-ROM)

15	Animal Or Vegetable Fats And Oils And Their Cleavage Products; Prepared Edible Fats; Animal Or Vegetable Waxes
16	Preparations Of Meat, Fish Or Crustaceans, Molluscs Or Other Aquatic Invertebrates
17	Sugars And Sugar Confectionery
18	Cocoa And Cocoa Preparations
19	Preparations Of Cereals, Flour, Starch Or Milk; Pastrycooks' Products
20	Preparations Of Vegetables, Fruit, Nuts Or Other Parts Of Plants
21	Miscellaneous Edible Preparations
22	Beverages, Spirits And Vinegar
23	Residues And Waste From The Food Industries; Prepared Animal Aquatic Invertebrates
24	Tobacco And Manufactured Tobacco Substitutes
25	Salt; Sulphur; Earths And Stone; Plastering Material, Lime And Cement
26	Ores, Slag And Ash
27	Mineral Fuels, Mineral Oils And Products Of Their Distillation; Bituminous Substances; Mineral Waxes
28	Inorganic Chemicals: Organic Or Inorganic Compounds Of Precious Metals, Of Rare-Earth Metals, Of Radioactive Elements Or Isotopes
29	Organic Chemicals
30	Pharmaceutical Products
31	Fertilizers
32	Tanning Or Dyeing Extracts; Tannins And Their Derivatives; Dyes, Pigments And Other Colouring Matter; Paints And Varnishes; Putty And Other Mastics; Inks
33	Essential Oils And Resinoids; Perfumery, Cosmetic Or Toilet Preparations
34	Soaps, Organic Surface-Active Agents, Washing Preparations, Lubricating Preparations, Artificial Waxes, Prepared Waxes, Shoe Polish, Scouring Powder And The Like, Candles And Similar Products, Modelling Pastes, Dental Wax And Plaster-Based Dental Preparations
35	Albuminous Substances; Modified Starches; Glues; Enzymes
36	Explosives; Pyrotechnic Products; Matches; Pyrophoric Alloys; Combustible Materials
37	Photographic Or Cinematographic Products
38	Miscellaneous Chemical Products
39	Plastics And Plastic Products
40	Rubber And Articles Thereof
41	Hides And Skins (Other Than Furskins) And Leather
42	Articles Of Leather; Saddlery And Harness; Travel Goods, Handbags
43	Furskins And Artificial Fur; Articles Thereof
44	Wood And Articles Of Wood; Wood Charcoal
45	Cork And Articles Of Cork
46	Wickerwork And Basketwork
47	Pulp Of Wood Or Of Other Fibrous Cellulosic Material; Waste And

	Scrap Of Paper Or Paperboard
48	Paper And Paperboard; Articles Of Paper Pulp, Paper Or Paperboard
49	Books, Newspapers, Pictures And Other Products Of The Printing Industry; Manuscripts, Typescripts And Plans
50	Silk
51	Wool, Fine And Coarse Animal Hair; Yarn And Fabrics Of Horsehair
52	Cotton
53	Other Vegetable Textile Fibres; Paper Yarn And Woven Fabrics Of Paper Yarn
54	Man-Made Filaments
55	Man-Made Staple Fibres
56	Wadding, Felt And Nonwovens; Special Yarns; Twine, Cord, Rope And Cable And Articles Thereof
57	Carpets And Other Textile Floor Coverings
58	Special Woven Fabrics; Tufted Textile Products; Lace; Tapestries; Trimmings; Embroidery
59	Impregnated, Coated, Covered Or Laminated Textile Fabrics; Articles For Technical Use, Of Textile Materials
60	Knitted Or Crocheted Fabrics
61	Articles Of Apparel And Clothing Accessories, Knitted Or Crocheted
62	Articles Of Apparel And Clothing Accessories, Not Knitted Or Crocheted
63	Other Made Up Textile Articles; Sets; Worn Clothing And Worn Textile Articles; Rags
64	Footwear, Gaiters And The Like; Parts Of Such Articles
65	Headgear And Parts Thereof
66	Umbrellas, Sun Umbrellas, Walking-Sticks, Seat-Sticks, Whips, Riding-Crops And Parts Thereof
67	Prepared Feathers And Down And Articles Made Of Feathers Or Of Down; Artificial Flowers; Articles Of Human Hair
68	Articles Of Stone, Plaster, Cement, Asbestos, Mica Or Similar Materials
69	Ceramic Products
70	Glass And Glassware
71	Natural Or Cultured Pearls, Precious Or Semi-Precious Stones, Precious Metals, Metals Clad With Precious Metal, And Articles Thereof; Imitation Jewellery; Coin
72	Iron And Steel
73	Articles Of Iron Or Steel
74	Copper And Articles Thereof
75	Nickel And Articles Thereof
76	Aluminium And Articles Thereof
78	Lead And Articles Thereof
79	Zinc And Articles Thereof
80	Tin And Articles Thereof
81	Other Base Metals; Cermets; Articles Thereof
82	Tools, Implements, Cutlery, Spoons And Forks, Of Base Metal; Parts Thereof Of Base Metal
83	Miscellaneous Articles Of Base Metal
84	Nuclear Reactors, Boilers, Machinery And Mechanical Appliances

85	Electrical Machinery And Equipment And Parts Thereof; Sound Recorders And Reproducers, Television Image And Sound Recorders And Reproducers, And Parts And Accessories Of Such Articles
86	Railway Or Tramway Locomotives, Rolling-Stock And Parts Thereof; Railway Or Tramway Track Fixtures And Fittings And Parts Thereof; Mechanical, Including Electro-Mechanical, Traffic Signalling Equipment Of All Kinds
87	Vehicles Other Than Railway Or Tramway Rolling-Stock, And Parts And Accessories Thereof
88	Aircraft, Spacecraft, And Parts Thereof
89	Ships, Boats And Floating Structures
90	Optical, Photographic, Cinematographic, Measuring, Checking, Precision, Medical Or Surgical Instruments And Apparatus; Parts And Accessories Thereof
91	Clocks And Watches And Parts Thereof
92	Musical Instruments; Parts And Accessories For Such Articles
93	Arms And Ammunition; Parts And Accessories Thereof
94	Furniture; Medical And Surgical Furniture; Bedding, Mattresses, Mattress Supports, Cushions And Similar Stuffed Furnishings; Lamps And Lighting Fittings, Not Elsewhere Specified; Illuminated Signs, Illuminated Name-Plates And The Like; Prefabricated Buildings
95	Toys, Games And Sports Requisites; Parts And Accessories Thereof
96	Miscellaneous Manufactured Articles
97	Works Of Art, Collectors' Pieces And Antiques
99	Other Products

Appendix 2.2: OECD Process Taxonomy for 4-digit Sectors

High Technology			Medium High Technology							
2923	9001	9110	1518	2836	2929	3506	3910	8433	8479	8606
2935	9002	9111	1520	2837	2930	3507	3911	8434	8480	8607
2936	9003	9112	2601	2838	2931	3601	3912	8435	8481	8608
2937	9004	9114	2707	2839	2942	3602	3913	8436	8482	8609
2938	9005	9402	2708	2840	3101	3603	3914	8437	8483	8701
2939	9007		2801	2841	3102	3604	4002	8438	8484	8702
2940	9008		2802	2842	3103	3701	4402	8439	8501	8703
2941	9009		2803	2843	3104	3702	5404	8440	8502	8704
3001	9010		2804	2845	3105	3703	5405	8441	8503	8705
3002	9011		2805	2846	3201	3707	5501	8444	8504	8706
3003	9012		2806	2847	3202	3802	5502	8445	8505	8707
3004	9013		2807	2848	3203	3803	5503	8446	8506	8708
3005	9014		2808	2849	3204	3805	5504	8447	8507	8709
3006	9015		2809	2850	3205	3806	7321	8448	8508	8710
8469	9016		2810	2851	3206	3807	7417	8449	8509	8711
8470	9017		2811	2901	3207	3808	8403	8450	8510	8712
8471	9018		2812	2902	3208	3809	8405	8451	8511	8713
8472	9019		2813	2903	3209	3810	8406	8452	8512	8714
8473	9020		2814	2904	3210	3811	8408	8453	8513	8716
8517	9021		2815	2905	3211	3812	8410	8454	8514	
8518	9022		2816	2906	3212	3813	8413	8455	8515	
8519	9024		2817	2907	3213	3814	8414	8456	8516	
8520	9025		2819	2908	3214	3815	8415	8457	8523	
8521	9026		2820	2909	3215	3817	8416	8458	8530	
8522	9027		2821	2910	3301	3818	8417	8459	8531	
8525	9028		2822	2911	3302	3819	8418	8460	8535	
8526	9029		2823	2912	3303	3820	8420	8461	8536	
8527	9030		2824	2913	3304	3821	8421	8462	8537	
8528	9031		2825	2914	3305	3822	8422	8463	8538	
8532	9032		2826	2915	3306	3823	8423	8464	8539	
8533	9101		2827	2916	3307	3901	8424	8465	8543	
8534	9102		2828	2917	3401	3902	8425	8466	8544	
8540	9103		2829	2919	3402	3903	8426	8467	8545	
8541	9104		2830	2920	3403	3904	8427	8468	8548	
8542	9105		2831	2921	3404	3905	8428	8474	8601	
8801	9106		2832	2925	3405	3906	8429	8475	8602	
8802	9107		2833	2926	3407	3907	8430	8476	8603	
8803	9108		2834	2927	3503	3908	8431	8477	8604	
8805	9109		2835	2928	3504	3909	8432	8478	8605	

Appendix 2.2: OECD Process Taxonomy for 4-digit Sectors

Medium-Low Technology						
2520	6802	7012	7226	7414	8003	8307
2522	6803	7013	7227	7415	8004	8308
2523	6804	7014	7228	7416	8005	8309
2704	6805	7015	7229	7418	8006	8310
2706	6806	7016	7301	7419	8007	8311
2710	6807	7017	7302	7501	8101	8402
2711	6808	7018	7303	7502	8102	8404
2712	6809	7019	7304	7504	8103	8901
2713	6810	7020	7305	7505	8104	8902
2715	6811	7106	7306	7506	8105	8903
2844	6812	7107	7307	7507	8106	8904
3801	6813	7108	7308	7508	8107	8905
3816	6814	7109	7309	7601	8108	8906
3916	6815	7110	7310	7603	8109	8907
3917	6901	7111	7311	7604	8110	9406
3918	6902	7201	7312	7605	8111	
3919	6903	7202	7313	7606	8112	
3920	6904	7203	7314	7607	8113	
3921	6905	7205	7316	7608	8201	
3922	6906	7206	7317	7609	8202	
3923	6907	7207	7318	7610	8203	
3924	6908	7208	7319	7611	8204	
3925	6909	7209	7320	7612	8205	
3926	6910	7210	7323	7613	8206	
4003	6911	7211	7324	7614	8207	
4005	6912	7212	7325	7615	8208	
4006	6913	7213	7326	7616	8209	
4007	6914	7214	7401	7801	8210	
4008	7001	7215	7402	7803	8211	
4009	7002	7216	7403	7804	8212	
4010	7003	7217	7405	7805	8213	
4011	7004	7218	7406	7806	8214	
4012	7005	7219	7407	7901	8215	
4013	7006	7220	7408	7903	8301	
4014	7007	7221	7409	7904	8302	
4015	7008	7222	7410	7905	8303	
4016	7009	7223	7411	7906	8304	
4017	7010	7224	7412	7907	8305	
6801	7011	7225	7413	8001	8306	

Appendix 2.2: OECD Process Taxonomy for 4-digit Sectors

Low Technology									
1501	2003	4108	4703	5004	5408	5903	6213	7115	9612
1502	2004	4109	4704	5005	5506	5904	6214	7116	9613
1503	2005	4111	4705	5006	5507	5905	6215	7117	9614
1504	2006	4201	4706	5007	5508	5907	6216	7118	9615
1505	2007	4202	4801	5101	5509	5908	6217	8524	9616
1506	2008	4203	4802	5103	5510	5909	6302	8715	9617
1507	2009	4204	4803	5105	5511	5910	6303	8804	9618
1508	2101	4205	4804	5106	5512	5911	6304	9023	
1509	2102	4206	4805	5107	5513	6001	6305	9201	
1510	2103	4302	4806	5108	5514	6002	6306	9202	
1511	2104	4303	4807	5109	5515	6101	6307	9203	
1512	2105	4304	4808	5110	5516	6102	6308	9204	
1513	2106	4401	4809	5111	5601	6103	6309	9205	
1514	2201	4403	4810	5112	5602	6104	6310	9206	
1515	2202	4405	4811	5113	5603	6105	6401	9207	
1516	2203	4406	4812	5203	5604	6106	6402	9208	
1517	2204	4407	4813	5204	5605	6107	6403	9209	
1521	2205	4408	4814	5205	5606	6108	6404	9401	
1522	2206	4409	4815	5206	5607	6109	6405	9403	
1601	2207	4410	4816	5207	5608	6110	6406	9404	
1602	2208	4411	4817	5208	5609	6111	6501	9501	
1603	2209	4412	4818	5209	5701	6112	6502	9502	
1604	2301	4413	4819	5210	5702	6113	6503	9503	
1605	2304	4414	4820	5211	5703	6114	6504	9504	
1701	2305	4415	4821	5212	5704	6115	6505	9505	
1702	2306	4416	4822	5301	5705	6116	6507	9506	
1703	2309	4417	4823	5302	5801	6117	6601	9507	
1704	2402	4418	4901	5303	5802	6201	6602	9508	
1803	2403	4419	4902	5304	5803	6202	6603	9601	
1804	3406	4420	4903	5305	5804	6203	6701	9602	
1805	3605	4421	4904	5306	5805	6204	6702	9603	
1806	3606	4501	4905	5307	5806	6205	6703	9604	
1901	4101	4502	4907	5308	5807	6206	6704	9605	
1902	4102	4503	4908	5309	5808	6207	7101	9606	
1903	4103	4504	4909	5310	5809	6208	7102	9607	
1904	4104	4601	4910	5311	5810	6209	7103	9608	
1905	4105	4602	4911	5401	5811	6210	7105	9609	
2001	4106	4701	5002	5406	5901	6211	7113	9610	
2002	4107	4702	5003	5407	5902	6212	7114	9611	

Appendix 2.3: Neven's Taxonomy for 4-digit Sectors

High Technology, High Human Capital		
1518	3210	3819
1520	3211	3820
2804	3212	3821
2808	3213	3822
2811	3214	8471
2814	3215	8523
2827	3303	
2834	3304	
2836	3305	
2851	3306	
2905	3307	
2918	3401	
2922	3402	
2923	3403	
2924	3404	
2932	3405	
2933	3407	
2934	3503	
2935	3504	
2936	3506	
2937	3601	
2938	3602	
2939	3603	
2940	3604	
2941	3701	
3001	3702	
3002	3703	
3003	3707	
3004	3802	
3005	3808	
3006	3809	
3101	3810	
3102	3811	
3103	3812	
3104	3813	
3105	3814	
3207	3815	
3208	3817	
3209	3818	

High Human Capital, Low Investment		
1510	8455	8536
1516	8456	8537
1517	8457	8538
1521	8458	8543
1522	8459	8544
1902	8460	8545
1905	8461	8548
2401	8462	8709
2402	8463	9001
2403	8464	9002
3704	8465	9003
3705	8466	9004
4906	8467	9005
6808	8468	9007
6809	8475	9008
6810	8476	9010
6811	8477	9011
8405	8478	9013
8406	8480	
8410	8481	
8413	8484	
8414	8501	
8415	8502	
8416	8503	
8417	8504	
8418	8505	
8420	8506	
8421	8507	
8422	8508	
8423	8509	
8425	8510	
8426	8511	
8427	8512	
8435	8514	
8438	8515	
8439	8516	
8440	8530	
8441	8531	
8454	8535	

Appendix 2.3: Neven's Taxonomy for 4-digit Sectors

Labour and Capital Intensive							
1501	4017	4823	6812	7117	7416	8002	8705
1502	4101	4907	6813	7118	7417	8003	8706
1601	4102	4908	6814	7211	7418	8004	8708
1603	4401	4909	7001	7212	7419	8005	9501
1704	4403	4910	7002	7215	7501	8006	9502
1802	4405	4911	7003	7217	7502	8007	9503
1803	4406	5101	7004	7220	7503	8101	9504
1804	4407	5601	7005	7223	7504	8102	9603
1805	4408	5602	7006	7226	7505	8103	
1806	4409	5603	7007	7229	7506	8104	
2006	4410	5604	7008	7310	7507	8105	
2618	4411	5605	7009	7312	7508	8106	
2619	4412	5606	7010	7313	7601	8107	
2620	4413	5607	7011	7314	7602	8108	
2715	4415	5608	7012	7316	7603	8109	
2818	4416	5609	7013	7317	7604	8110	
3801	4707	5804	7014	7318	7605	8111	
3916	4801	5806	7015	7319	7606	8112	
3917	4802	5807	7016	7320	7607	8113	
3918	4803	5808	7017	7321	7608	8210	
3920	4804	5809	7018	7323	7609	8211	
3921	4805	5810	7019	7324	7612	8212	
3922	4806	5811	7020	7325	7614	8213	
3923	4807	5901	7101	7326	7615	8214	
3925	4808	5902	7102	7401	7616	8215	
4003	4809	5903	7103	7402	7801	8301	
4004	4810	5905	7104	7403	7802	8302	
4005	4811	5906	7105	7404	7803	8303	
4006	4812	5907	7106	7405	7804	8304	
4007	4813	5908	7107	7406	7805	8305	
4008	4814	5909	7108	7407	7806	8306	
4009	4815	5910	7109	7408	7901	8307	
4010	4816	5911	7110	7409	7902	8308	
4011	4817	6310	7111	7410	7903	8309	
4012	4818	6801	7112	7411	7904	8310	
4013	4819	6802	7113	7412	7905	8311	
4014	4820	6803	7114	7413	7906	8702	
4015	4821	6806	7115	7414	7907	8703	
4016	4822	6807	7116	7415	8001	8704	

Appendix 2.3: Neven's Taxonomy for 4-digit Sectors

Human Capital and Investment	Labour Intensive	
1901	3816	6210
1904	4201	6211
2001	4202	6212
2002	4204	6213
2003	4205	6214
2004	4301	6215
2005	4302	6216
2007	4303	6217
2008	4304	6309
2009	4418	6501
2101	5001	6502
2102	6001	6503
2103	6002	6504
2104	6101	6505
2106	6102	6507
2201	6103	6901
2202	6104	6902
2203	6105	6903
2204	6106	6907
2205	6107	6908
2206	6108	6909
2207	6109	6910
2208	6110	6911
2209	6111	6912
2302	6112	6913
2307	6113	6914
2308	6114	7303
2309	6115	7304
2520	6116	7305
2522	6117	7306
2523	6201	7307
	6202	7308
	6203	7610
	6204	8609
	6205	8707
	6206	9605
	6207	
	6208	
	6209	

Chapter 3

The Evolution of Specialisation in Irish Exports and Employment

3.1 Introduction

This chapter, and the rest of the thesis, focuses on Ireland. Changes in specialisation patterns of employment and exports are examined, drawing attention to the differing evolutions of high and low technology sectors. In the Irish context an important element has been the emergence of a substantial high-technology sector, particularly though FDI inflows. We look at the increased specialisation in these high technology sectors and at the structural adjustment that had taken place in the 'low technology', or 'traditional', sectors of the economy.

The main elements of this chapter are to document the growth of employment and exports in Ireland since the mid-1970s, especially in terms of changing sector shares. It then asks if the patterns of Irish specialisation fit the predictions of Imbs and Wacziarg (2003), who recently demonstrated the existence of a U-shape in specialisation across countries as income increases. This U-shape comprised an initial high level of specialisation, with a move to greater diversification in

production and employment structures as countries developed. Eventually, a turning point emerged, after which countries again moved to a more specialised structure. In the Irish context, this pattern fits the evolution of employment in low technology sectors, but high technology sectors and exports have increased concentration throughout the time period analysed.

This chapter is organised as follows. Section 3.2 extends the literature on specialisation discussed in Chapter 2, introducing the empirical regularity of a U-shape in employment and production specialisation observed by Imbs and Wacziarg (2003). Section 3.3 examines the Irish data on employment and trade, giving a descriptive overview of growth and changing sector shares since the 1970s. Section 3.4 then examines the evolution of specialisation, identifying a U-shaped pattern in employment, but a picture of increasing specialisation in exports. Section 3.5 concludes.

3.2 Literature

Imbs and Wacziarg (2003) present an empirical regularity whereby the employment and production structure exhibits a U-shape in specialisation as income increases. Countries begin with a fairly high level of specialisation (most employment is in a few sectors), and as income increases there is a move to diversification. However, at higher levels of income countries begin to move

once again to a more specialised structure. This pattern was found by Imbs and Wacziarg in three separate data sources and using a variety of measures of specialisation. They use employment data from the International Labour Office (ILO) and the United National Industrial Development Organisation (UNIDO). The ILO data covers all economic activities at the 1-digit sector level. The UNIDO data is more disaggregated, at the 3-digit level, but covers only manufacturing. In addition to using employment data, they use value added from fourteen countries, using OECD data at the 2-digit level for manufacturing and non-manufacturing. The data covered slightly different time periods (1969-1997 for the ILO data; 1963-1996 for UNIDO and 1960-1993 for the OECD). Brülhart (1998, 2001) also finds this empirical pattern identified by Imbs exists in the employment and production structure of EU countries. The puzzle of these findings is that empirically the specialisation of the trade structure discussed in Chapter Two does not follow the same pattern as the employment specialisation.

Countries at the lower end of the income distribution may begin by being very specialised, perhaps in primary commodities. As they become richer, they may begin to diversify, either to satisfy domestic demand for increased variety as a result of higher incomes or due to portfolio concerns related to spreading risk over a wider range of sectors. This latter proposition is put forward by Saint-Paul (1992), where incomplete financial markets make diversification of domestic production the only option for spreading risk. Imbs and Wacziarg point out that this theory could also be used to explain the subsequent increase in specialisation

as richer countries gain access to deeper financial markets that reduce the need to spread risk through production diversification. Other motives, resulting in greater specialisation, could then become more dominant for better-off economies. These range from the traditional Ricardian comparative advantage theory to more recent economic geography literature explaining agglomeration. Krugman (1991) and Krugman and Venables (1995) focus on transport costs and market size as determinants of firm location, predicting the emergence of a core-periphery pattern. Krugman and Venables (1996) undertake a similar analysis but focus on backward linkages, such as supplier relationships, which operate as a lock-in effect for the initial location.

Walsh and Whelan (1999) looked at labour reallocation in Ireland and found that within low-technology sectors reallocation could be linked to the gradual displacement of initially domestically orientated sectors by the growth in export orientated sectors. Repkine and Walsh (1999) found initial export orientation an important factor in the performance of firms in Transition economies. Other recent contributions on Ireland include Barry, Bradley and O'Malley (1999) on the performance of Irish and foreign owned industry, Roper and Love (2001) on export performance and Ruane and Görg (1997) on FDI inflows and spillover effects.

3.3 Growth in Exports and Employment

The data used will be the Forfás Employment survey, which covers the entire population of manufacturing firms. This contains information on employment, ownership and sector, and is available from 1972 to 2000. Only permanent full-time employment is used[1]. The trade data is taken from Eurostat COMEXT CD-ROM as in Chapter Two. However, as we do not require the same detailed 8-digit level of disaggregation, the data is available for a longer time span, 1976-2000. The sector definitions used are three-digit NACE-CLIO and are explained in Appendix 3.1. The export data is deflated to 1985 ECU.

Figures 3.1 and 3.2 show the contributions to the employment of the high and low technology sectors. The dramatic increase associated with the growth of the high technology sectors is evident. However, we also see that the low technology sectors have maintained their level of employment, only declining very slightly at the end of the sample period. Figure 3.1 shows the evolution of total employment over the period, with a dip evident in the mid-1980s and strong growth throughout the 1990s. Figure 3.2 shows the changes in relative importance of high and low technology sectors. In 1972, the vast majority of employment, close to 80%, was in low technology, or 'traditional' sectors of the economy. This has declined

[1] Information on temporary and part-time employment is available only from 1988 and is therefore excluded. Although this type of employment has increased significantly in recent years, its growth has been largely in the services sectors. As we focus on manufacturing employment, its exclusion should not unduly influence our findings.

steadily over the 28-years of the sample, while being gradually replaced by high technology sectors. These accounted for just over 20% of employment in 1972, and now make up over 50%. Despite this large decline relative to high technology sectors, the absolute level of employment in low technology sectors has not fallen to nearly the same extent.

The story of Irish exports is one of almost incredibly dramatic growth, particularly since the early 1990s. Figure 3.3 shows that this is due almost entirely to growth in high technology exports, with exports from low technology sectors growing only modestly. Figure 3.4 translates this into changes in the relative importance of high and low technology sectors in total exports. Low technology has fallen from approximately 70% of exports in 1976 to under 20%, and high technology has increased accordingly. Growth in exports occurs in almost every individual sector, as shown in Appendix 3.2. A single proviso is in order; it has been suggested that this pattern may be due in part to transfer pricing by multinationals in high technology industries; unfortunately, the extent of this cannot be estimated with the current data[2].

Export growth rates over five-year intervals are presented in Table 3.2 for sectors defined at the 2-digit NACE-CLIO level. Between 1976 and 1981, exports declined in a number of sectors, including falls of 46 percent in Other Transport Equipment and of 32 percent in Leather Goods. There were slight declines in Meat Products and Dairy Products, which in 1976 were the two largest exporting

[2] The issue of transfer pricing is discussed further in the Conclusions (Chapter 6)

sectors, accounting for approximately 30 percent of exports (Table 3.4). During this period, there were some dramatically growing export sectors. These were mainly the higher technology, FDI dominated sectors of Chemicals, Computers and Electrical Equipment, the sectors the IDA had just begun to target for inward investment in the early 1970s. The Chemical Products sector's exports grew by 154 percent between 1976 and 1981, taking it from 8.1 percent of Irish exports to 15.4 percent over the five years. Computers and Precision Instruments grew at a similar rate (153 percent). This sector had made up 6.9 percent of exports in 1976; by 1981, this had increased to 13.2 percent. Electrical goods also experienced strong growth over this period, and made up 8 percent of exports by 1981.

The performance of these three sectors between 1976 and 1981 is interesting, as it demonstrates that the emergence of the high technology exporting sectors is not simply a phenomenon of the 1990s as many commentators have supposed. Instead, we find strong growth evident in their export performance dating back to the 1970s. Other sectors growing in this period were Motor Vehicles (197 percent), although this remained a small sector in terms of share of total exports, going from under one percent of exports in 1976 to almost two percent in 1981. Of the more traditional Irish sectors, Beverages recorded the strongest growth (91 percent), although again this was from a low base level (1.8 percent of exports in 1976).

Positive export growth is observed in most sectors over the next five year period, 1981-1986. This growth in exports is in contrast to the general economic performance at the time, which was one of stagnation, with low or negative growth and high unemployment. Despite this, exports declined in only three sectors: Motor Vehicles with a fall of 70 percent contrasted with its previous performance, while Leather Products and Dairy Products continued to decline. The highest rate of growth was in Computers and Precision Instruments (171 percent), continuing its striking growth of the first period. By 1986, this single sector made up almost one quarter of exports.

During the late 1980s and 1990s, export growth in observed in most sectors, but this is dominated by the high rates in Chemical Products, Electrical Goods and Computers and Precision Instruments. By 2000, these sectors account for the vast majority, 83.1 percent, of the country's exports. The largest sector is Chemical Products, which makes up 37.4 percent of exports. This is followed by Computers and Precision Instruments with a share of 29.8 percent and Electrical Goods with a share of 15.9 percent.

Other sectors have experienced growth in their exports, but at a much lower rate, with the result that their relative importance has diminished. This is presented graphically in Figure 3.5, which compares sector shares of exports in 1976, 1986 and 2000. The importance of Chemical Products, Computers and Precision Instruments and Electrical Goods is already evident in 1986, and their dominance

of exports overwhelming by 2000. In the main, this has been at the expense of the food-related sectors (Meat Products, Dairy Products and Other Food Products), which in 1976 made up forty percent of exports. Growth in these sectors was negative during 1976-1981 and positive thereafter, but at much more moderate rates than the higher technology sectors. By 2000, their share of total exports had declined to 7.2 percent. Textiles and Clothing was another sector whose relative importance declined greatly since 1976, when it accounted for just over six percent of exports. This had been reduced to less than one percent in 2000.

The change in the specialisation pattern of Irish exports is very striking when demonstrated by comparing the pie charts representing export shares in 1976 (Figure 3.7) and 2000 (Figure 3.8). In 1976, the largest sector was Meat Products with a 16.6 percent share in total exports, followed by Dairy Products with a 13.1 percent share. By 2000, it is evident that a major structural change has occurred in the country's exports. Three sectors now account for over 80 percent of exports, a massive increase in specialisation that will be looked at in more detail in the next section.

One point that can be drawn from the preceding discussion of sector export growth is that this shift in export structure did not occur as quickly as some may have supposed. The sectors now dominating exports were observed as the fastest growing as far back as 1976-1981. It is worth recalling, however, that these sectors were starting from a low base in the 1970s. By the 1990s, the same

growth rates were having a much greater impact in absolute terms. The current specialisation pattern of Irish exports has evolved over twenty-five years. While the pace of export growth may have accelerated somewhat in the 1990s, explanations for the current export structure lie in conditions and policies (such as that of concentrating the attraction of FDI to certain sectors) already in place in the 1970s.

Having looked at the growth experience of exports, we now ask how this compares with changes in employment. Table 3.3 shows the growth rates of employment in the same 2-digit sectors over five-year periods from 1972, and Table 3.5 contains the sector share information for the same period. When compared to the export growth figures, the most noticeable aspect of Table 3.3 is the negative employment growth in 1981-1986. Sectors such as Wood Products, whose exports grew by 67 percent, had a fall in employment of 17 percent. The only sectors expanding employment in 1981-86 were Chemical Products (by 3 percent) and Computers and Precision Instruments (4 percent). This growth in exports but not in employment is addressed by Walsh and Whelan (1999), who attribute it in the main to the dual existence in all sectors of exporting and non-exporting firms, and to a pattern of reallocation within as well as between sectors.

Growth in employment picked up in the next period, 1986-1991, in line with improvements in the macroeconomic environment. As with export growth, the highest rates of employment growth were in Chemical Products, Computers and

Precision Instruments and Electrical Goods. Chemical Products grew by 14 percent over 1986-1991, and by approximately 25 percent in the 1990s. Employment in Computers and Precision Instruments grew by 26 percent in 1986-1991 and then by 66 percent in 1991-1996. Growth in employment in Electrical Goods was 27 percent in 1991-1996. The growth rates of these three sectors resulted in them comprising 37.9 percent of employment by 2000. This compares to a 14.2 percent share in 1976.

Changes in the contribution of sectors to overall employment are depicted in Figure 3.6 for three years, 1976, 1986 and 2000. The largest increase has been in Computers and Precision Instruments, which accounted for 3.2 percent of employment in 1976 and 17.5 percent in 2000. The most important relative declines were in Other Food Products and Textiles and Clothing. Other Food Products made up 14 percent of employment in 1976; this had fallen to just over 9 percent in 2000. Textiles and Clothing in 1976 accounted for 8.6 percent of employment; this share fell to 2.9 in 2000.

Comparing the pie charts of sector shares in 1976 and 2000 for employment (Figures 3.9 and 3.10 respectively), we do not observe the same drastic change in structure, as was the case for export shares. The growth in the shares of Chemical Products, Computers and Precision Instruments and Electrical Goods is evident, as is the decline of the food related sectors (Meat, Dairy and Other) and Textiles and Clothing. The three largest sectors do not dominate employment to the same

extent to which they dominate exports. These differences are examined further in the next section, which measures specialisation in exports and employment and looks at how they change over time.

3.4 Diversification and Specialisation in Ireland

A number of measures are available to assess concentration of sectors within the economy. Imbs and Wacziarg focus on the Gini coefficient for inequality of sector shares, but also present results for alternative measures such as the Herfindahl index for concentration of employment across sectors, the share of largest sector in employment, coefficient of variation, the spread between maximum and minimum shares and the inter-quartile range. With the exception of the inter-quartile range, all the measures are highly correlated amongst themselves.

The correlations between the measures used in this chapter are presented in Table 3.1. The coefficients found are all extremely high, as Imbs and Wacziarg found, again with the exception of the inter-quartile range. As the inter-quartile range and max-min spread only use two points to judge the level of dispersion, it is likely that they are not as accurate as measures such as the Gini and Herfindahl, which use all information available. The Gini index tends to be used in

measurement of income distributions and the Herfindahl index is more common in industrial organisation literature. The Herfindahl is chosen as the measure of specialisation, both due to its greater computational simplicity and because it takes into account changes in the number of sectors and countries covered when calculating the level of specialisation. The Gini is generally invariant to changes in the number of options available to the firm. For example, if an industry's exports are perfectly equally distributed across the only two products possible, the Gini coefficient will be the same as if income is equally distributed across the only three products possible. In both cases, the index will measure one even though the industry has in fact diversified its range of activities. The Herfindahl index on the other hand would fall reflecting the increased diversification of activities (Barrett and Reardon, 2000).

We look at how specialisation in employment has evolved, using a Herfindahl index as the measure of concentration[3]. This is shown in Figure 3.11 and we find evidence of the same U-shaped pattern observed by Imbs and Wacziarg. There is an initial decline in specialisation, from 1972 to 1982, followed by strong re-specialisation. Cross-country estimation by Imbs and Wacziarg shows evidence of U-relationship between specialisation and income with turning-point coming fairly late in development at approx. income level of $9575 (1985 dollars), which was approximately Ireland's per capita income in 1992. The turning point found in the current data appears much earlier than they suggest for Ireland.

[3] For comparison purposes, Appendix 3.4 graphs the Gini and coefficient of variation for exports and employment. The results are consistent with those discussed for the Herfindahl index.

This is evidently driven by the increased specialisation of high technology employment (Figure 3.12); these sectors show no apparent U-shape in their concentration. This can be explained because of Irish policy from the 1970s on, which focused on attracting U.S. multinationals in a small number of high technology sectors, primarily pharmaceuticals and electronics. This has resulted in increased specialisation as this small number of sectors has experienced the highest growth rates.

Dividing sectors into high and low technology; we can see a similar pattern of diversification followed by specialisation in the low technology sectors as for the economy overall (Figure 3.13). The high technology sectors however have been characterised by only a slight de-specialisation in the 1970s and a very strong specialisation trend since around 1981 (Figure 3.12). The evolution of specialisation in the low technology sectors is much more like the picture proposed by Imbs and Wacziarg (2003). Diversification occurs until the early 1980s followed by an increase in specialisation to approximately the same level at the end of the period as at the beginning.

We then examine how specialisation in exporting has changed since the 1970s. Figure 3.14 shows a Herfindahl index, based on the shares of each sector's exports in total exports, and we can see quite clearly that since the early 1990s there has been an increase in the specialisation of the country's exporting activity.

The evidence of a U-shape is very weak however, de-specialisation occurring only between 1978 and 1982. This would appear to be due to a large increase in specialisation in high technology exports, which occurred around 1982, as can be seen in Figure 3.15. The experience of the low technology exports is quite different. Figure 3.16 shows steady growth in exports from 1980, with an initial diversification shown by the Herfindahl index. This was followed by an increase in specialisation between 1986 and 1995, giving the U-shape observed in the employment data. In this case however, it was followed by a subsequent return to diversification from 1996 onwards, which does not fit with the predictions of the literature.

The result found by Walsh and Whelan (1999, 2004) indicated that the change in specialisation in the low technology sectors comes from reallocation across these sectors. They propose that although the beginning and end of the sample shows similar levels of specialisation, the key point is that the specialisation is now in *different* low-technology industries. If this is the case, then the U-shape we find in the low technology sectors has been generated by the adjustment process as export-orientated industries gradually began to replace the domestically orientated. Because this occurred gradually, both types of sector co-existed for a significant period. Therefore, we get a picture of diversification between two episodes of specialisation, reflecting a gradual structural change process.

3.5 Conclusions

This chapter examined the growth and changes in specialisation of employment and exports of the Irish economy over the past three decades. We find that the emergence of the high technology exporting sectors is not simply a phenomenon of the 1990s, and document the growth of exports in these sectors from 1981. For exports, specialisation has continuously increased, particularly in the high technology sectors. Throughout the 1980s and 1990s, export growth is strongest in three sectors: Chemical Products, Electrical Goods and Computers and Precision Instruments. By 2000, these sectors accounted for 83.1 percent of exports.

The largest declines in sector shares of exports have been in the food-related sectors (Meat Products, Dairy Products and Other Food Products), which in 1976 made up forty percent of exports. Although there was some growth in the exports of these sectors, their share of total exports had fallen to 7.2 percent in 2000.

Employment in high technology industry increased its concentration into a smaller number of sectors, following a similar pattern to exports. The picture for overall employment, and employment in low technology sectors is however quite different. We find evidence of a U-shape in specialisation, with initial diversification followed by a return to higher specialisation levels, an empirical

feature identified by Imbs and Wacziarg (2003) for a range of countries as incomes rise. No such evidence of a U-shape is found for exports, due to the continued growth of specialisation in high technology exports.

Table 3.1 Correlation between Inequality Measures

	Maximum	Variance	Coeff. Of Var.	Interquartile R.	Herfindahl	Gini
Maximum	1.000					
Variance	0.957	1.000				
Coefficient of Variation	0.948	0.983	1.000			
Skewness	0.952	0.857	0.846			
Interquartile Range	-0.497	-0.479	-0.587	1.000		
Herfindahl	0.959	1.000	0.988	-0.498	1.000	
Gini	0.913	0.924	0.946	-0.561	0.928	1.000

Table 3.2 Real Export Growth Rates (Percentage)

	1976-81	1981-86	1986-91	1991-96	1996-2000
Ores and Metals	-18	31	79	-10	48
Non-Metallic Mineral Products	13	17	-3	-7	33
Chemical Products	154	58	70	116	193
Metal Products	29	29	27	-13	-6
Agricultural & Industrial Machinery	52	24	-13	28	43
Computers & Precision Instruments	153	171	29	105	120
Electrical Goods	74	56	47	116	179
Motor Vehicles	197	-70	193	-21	186
Other Transport Equip.	-46	73	152	17	22
Meat Products	-1	3	14	3	15
Dairy Products	-4	-7	15	4	15
Other Food Products	4	50	63	36	-12
Beverages	91	30	47	9	32
Tobacco Products	-18	10	-17	43	41
Textiles & Clothing	-7	12	29	-17	-25
Leather Goods	-32	-45	16	57	9
Wood Products & Furniture	-10	67	45	4	15
Paper & Printing Products	-3	7	63	52	141
Rubber & Plastic Products	35	18	26	-6	14
Other Manufacturing	11	55	-68	29	40

Table 3.3 Employment Growth Rates (Percent)

	1972-76	1976-81	1981-86	1986-91	1991-96	1996-2000
Ores and Metals	-16	-3	-28	5	-18	13
Non-Metallic Mineral Products	2	12	-32	-7	-1	17
Chemical Products	11	17	3	14	26	24
Metal Products	19	11	-30	3	9	15
Agricultural & Industrial Machinery	27	38	-13	6	14	34
Computers & Precision Instruments	79	101	4	26	66	54
Electrical Goods	11	50	0	13	27	13
Motor Vehicles	-3	-6	-13	23	-10	11
Other Transport Equip.	18	1	-29	35	5	16
Meat Products	16	-12	-5	16	5	11
Dairy Products	18	8	-13	-13	-4	0
Other Food Products	5	-5	-17	-10	6	7
Beverages	-1	2	-20	-22	-11	5
Tobacco Products	8	-5	-20	-29	-35	-9
Textiles & Clothing	-15	-17	-21	5	-11	-33
Leather Goods	-21	-18	-55	-39	-14	-30
Wood Products & Furniture	6	9	-17	-4	9	13
Paper & Printing Products	8	-7	-11	6	-5	5
Rubber & Plastic Products	13	3	-5	17	10	9
Other Manufacturing	-4	28	-12	8	21	8

Table 3.4 Export Sector Shares

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Ores and Metals	3.6	3.4	3.5	3.6	3.2	2.2	2.0	2.4	2.6	2.2	2.0	1.7	3.1
Non-Metallic Mineral Products	2.9	2.7	2.2	2.5	2.4	2.4	3.0	2.3	2.2	2.1	1.9	1.7	2.0
Chemical Products	8.1	9.7	7.7	13.2	13.7	15.4	12.1	16.2	17.3	17.5	16.6	15.4	15.5
Metal Products	2.7	3.3	3.9	2.9	2.9	2.6	3.8	2.5	2.3	2.3	2.3	2.1	2.1
Agricultural & Industrial Machinery	4.5	4.5	5.2	4.5	5.1	5.1	6.7	4.6	3.9	4.2	4.3	4.2	3.4
Computers & Precision Instruments	6.9	8.3	3.0	8.6	9.2	13.2	4.4	18.7	22.1	23.4	24.4	25.2	25.3
Electrical Goods	6.1	6.2	5.0	6.3	7.3	8.0	11.9	8.1	8.6	8.4	8.6	8.4	8.9
Motor Vehicles	0.8	1.0	1.9	2.1	2.2	1.9	3.5	2.3	1.3	0.6	0.4	0.4	1.0
Other Transport Equip.	1.4	1.5	0.4	0.6	0.6	0.6	0.4	0.6	0.7	0.7	0.7	0.6	1.1
Meat Products	16.6	19.4	24.6	16.2	17.6	12.3	14.2	9.7	7.5	7.7	8.6	8.6	8.1
Dairy Products	13.1	9.2	0.5	11.1	8.5	9.5	6.4	7.1	7.9	6.8	6.0	6.9	7.1
Other Food Products	9.6	8.9	10.6	8.4	7.6	7.5	6.2	7.6	7.1	7.6	7.7	9.4	10.2
Beverages	1.8	1.5	0.6	1.8	2.0	2.6	3.4	2.6	2.3	2.4	2.3	2.1	2.2
Tobacco Products	0.9	0.7	0.0	0.6	0.5	0.5	0.8	0.5	0.4	0.4	0.4	0.3	0.3
Textiles & Clothing	6.2	5.7	9.6	5.1	4.5	4.3	5.6	3.5	3.1	3.1	3.3	3.0	2.9
Leather Goods	1.9	1.7	1.0	1.4	1.1	1.0	1.2	0.8	0.7	0.6	0.4	0.3	0.3
Wood Products & Furniture	1.2	1.0	1.1	0.8	0.8	0.8	1.2	0.8	0.8	0.9	0.9	1.0	1.1
Paper & Printing Products	2.2	2.1	2.9	1.9	1.8	1.6	1.8	1.2	1.1	1.1	1.2	1.4	1.3
Rubber & Plastic Products	3.6	3.3	2.8	3.5	3.9	3.6	5.1	3.2	2.8	2.7	2.9	2.9	2.5
Other Manufacturing	5.8	5.8	13.7	5.1	5.1	4.8	6.2	5.5	5.4	5.4	5.1	4.5	1.6

Table 3.4 Export Sector Shares (Continued)

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Ores and Metals	3.6	3.0	2.6	2.1	2.1	1.9	1.7	1.4	1.4	1.1	1.0	1.0
Non-Metallic Mineral Products	1.7	1.5	1.4	1.2	1.0	1.0	0.8	0.8	0.9	0.6	0.7	0.5
Chemical Products	16.7	19.0	21.1	23.3	23.9	24.8	22.9	27.6	30.6	37.2	36.8	37.4
Metal Products	1.9	2.2	2.2	2.2	1.6	1.5	1.3	1.2	1.1	0.8	0.7	0.5
Agricultural & Industrial Machinery	3.0	3.0	2.8	2.4	2.3	2.4	2.3	2.2	2.2	1.7	1.7	1.4
Computers & Precision Instruments	27.0	26.7	23.6	22.2	24.8	24.5	28.2	29.3	29.8	28.5	28.2	29.8
Electrical Goods	8.4	8.7	9.4	8.5	8.8	10.6	11.7	12.3	13.3	12.8	15.3	15.9
Motor Vehicles	1.0	0.7	0.8	0.7	0.6	0.7	0.5	0.4	0.6	0.7	0.7	0.5
Other Transport Equip.	1.1	1.2	1.2	0.8	0.8	0.7	0.9	0.9	1.0	0.9	0.6	0.5
Meat Products	7.9	7.4	7.4	7.6	7.6	6.9	5.8	4.6	3.9	3.2	3.2	2.4
Dairy Products	7.0	4.8	5.2	7.5	5.3	4.5	4.8	3.3	3.1	2.3	2.0	1.7
Other Food Products	9.2	9.3	9.4	9.3	10.2	10.0	9.9	7.7	4.9	4.2	3.8	3.1
Beverages	2.2	2.5	2.6	2.4	2.5	2.2	1.9	1.7	1.7	1.4	1.3	1.0
Tobacco Products	0.2	0.2	0.3	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1
Textiles & Clothing	2.7	3.1	3.2	3.0	2.6	2.3	1.9	1.6	1.4	1.1	0.9	0.6
Leather Goods	0.3	0.3	0.3	0.4	0.4	0.6	0.3	0.3	0.3	0.2	0.2	0.2
Wood Products & Furniture	1.0	1.0	1.0	1.0	0.8	0.8	0.7	0.6	0.7	0.5	0.4	0.3
Paper & Printing Products	1.5	1.4	1.4	1.3	1.2	1.4	1.3	1.3	0.8	0.7	0.7	1.5
Rubber & Plastic Products	2.3	2.6	2.8	2.7	2.2	2.0	1.8	1.6	1.4	1.2	1.0	0.8
Other Manufacturing	1.2	1.3	1.2	1.2	1.1	1.1	1.0	1.0	0.9	0.7	0.7	0.6

Table 3.5 Employment Sector Shares

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Ores and Metals	0.8	0.8	0.7	0.6	0.6	0.6	0.7	0.7	0.5	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Non-Metallic Mineral Products	5.9	6.0	5.8	5.9	5.7	6.1	6.3	6.2	6.1	6.0	5.6	5.2	5.2	5.1	4.8	4.6	4.3
Chemical Products	5.5	5.5	5.9	6.1	5.7	6.1	6.2	6.6	6.6	6.2	6.3	6.8	7.0	7.4	7.5	7.7	7.6
Metal Products	8.3	8.9	9.0	8.7	9.3	9.1	9.2	9.8	9.7	9.6	9.1	8.4	8.0	8.1	7.9	7.8	7.7
Agricultural & Industrial Machinery	2.3	2.4	2.4	2.5	2.7	3.1	3.2	3.4	3.4	3.5	3.6	3.7	3.8	3.9	3.6	3.5	3.6
Computers & Precision Instruments	1.9	2.3	2.3	2.8	3.2	3.6	4.2	4.6	5.3	6.0	6.5	6.8	7.1	7.1	7.3	7.8	8.1
Electrical Goods	5.1	5.0	4.8	4.9	5.3	5.4	5.7	6.2	6.8	7.4	8.0	7.9	8.4	8.5	8.7	8.7	8.9
Motor Vehicles	4.5	4.5	4.3	4.0	4.1	4.1	3.9	3.9	3.7	3.6	3.5	3.7	3.3	3.5	3.7	3.7	3.9
Other Transport Equip.	1.8	1.8	1.9	2.0	2.0	1.8	1.8	1.6	2.0	1.9	1.9	1.8	1.5	1.4	1.6	1.6	1.6
Meat Products	5.4	5.7	6.4	6.5	5.8	5.7	5.8	5.6	5.0	4.8	5.0	5.4	5.4	5.2	5.4	5.6	5.8
Dairy Products	4.6	4.8	4.9	4.9	5.2	5.2	5.1	5.0	5.0	5.2	5.3	5.5	5.4	5.3	5.3	5.3	5.2
Other Food Products	14.2	14.1	14.1	14.4	14.0	13.9	13.2	12.5	12.7	12.5	12.5	12.7	12.6	12.5	12.2	11.9	11.6
Beverages	4.9	4.7	4.8	4.9	4.6	4.3	4.3	4.2	4.3	4.4	4.4	4.3	4.2	4.1	4.2	4.0	3.7
Tobacco Products	1.2	1.1	1.2	1.2	1.2	1.1	1.1	1.1	1.0	1.1	1.1	1.1	1.0	1.0	1.0	1.0	0.9
Textiles & Clothing	10.8	10.1	9.3	8.6	8.6	8.2	8.1	8.0	7.6	6.7	6.2	6.0	6.3	6.3	6.2	6.2	6.4
Leather Goods	4.1	3.8	3.5	3.2	3.0	3.0	2.8	2.5	2.4	2.3	2.3	2.0	1.8	1.2	1.2	1.2	1.1
Wood Products & Furniture	5.1	5.1	4.9	5.0	5.1	4.9	5.0	5.0	5.0	5.2	5.4	5.4	5.5	5.5	5.1	4.9	4.8
Paper & Printing Products	8.3	8.1	8.5	8.5	8.5	8.4	8.1	7.6	7.6	7.3	7.3	7.4	7.4	7.5	7.7	7.8	7.9
Rubber & Plastic Products	3.6	3.6	3.7	3.7	3.8	3.7	3.7	3.7	3.5	3.7	3.6	3.5	3.7	4.0	4.1	4.2	4.3
Other Manufacturing	1.7	1.7	1.6	1.6	1.5	1.7	1.7	1.8	1.7	1.8	2.0	2.1	1.8	1.8	1.9	2.0	2.0

Table 3.5 Employment Sector Shares (Continued)

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Ores and Metals	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Non-Metallic Mineral Products	4.4	4.3	4.3	4.2	4.0	3.9	3.8	3.8	3.8	3.6	3.7	3.8
Chemical Products	7.8	7.9	8.2	8.6	8.9	9.1	9.0	9.3	9.2	9.5	9.9	9.9
Metal Products	8.1	8.1	7.8	7.8	7.5	7.5	7.6	7.6	7.7	7.9	7.9	7.6
Agricultural & Industrial Machinery	3.8	3.8	3.7	3.7	3.6	3.6	3.8	3.8	3.7	3.9	4.5	4.4
Computers & Precision Instruments	8.5	8.6	8.8	9.0	9.3	10.1	11.4	13.1	14.9	15.3	16.0	17.5
Electrical Goods	9.2	9.3	9.4	9.4	9.8	10.0	10.6	10.7	10.7	10.8	10.1	10.5
Motor Vehicles	4.1	4.4	4.3	4.3	4.3	4.4	4.1	3.5	3.4	3.5	3.4	3.4
Other Transport Equip.	1.5	1.8	2.1	2.2	2.2	1.9	2.0	1.9	1.8	1.9	1.9	2.0
Meat Products	5.4	5.6	6.0	6.2	6.3	6.0	5.8	5.7	5.8	5.7	5.8	5.4
Dairy Products	4.7	4.6	4.5	4.2	4.1	4.0	3.8	3.8	3.6	3.4	3.3	3.3
Other Food Products	11.0	10.7	10.5	10.6	10.6	10.5	10.2	10.0	9.5	9.5	9.4	9.3
Beverages	3.4	3.2	3.1	2.9	2.8	2.7	2.6	2.5	2.2	2.2	2.3	2.3
Tobacco Products	0.8	0.7	0.7	0.7	0.5	0.5	0.4	0.4	0.4	0.3	0.3	0.3
Textiles & Clothing	6.6	6.6	6.3	6.1	6.1	5.9	5.5	5.0	4.5	4.0	3.2	2.9
Leather Goods	1.0	0.8	0.7	0.6	0.7	0.7	0.6	0.6	0.5	0.5	0.4	0.3
Wood Products & Furniture	4.9	4.9	4.7	4.6	4.5	4.5	4.4	4.6	4.6	4.7	4.7	4.5
Paper & Printing Products	8.0	7.9	7.8	8.0	7.7	7.6	7.0	6.7	6.6	6.4	6.3	6.0
Rubber & Plastic Products	4.4	4.4	4.6	4.5	4.4	4.6	4.6	4.5	4.5	4.5	4.3	4.3
Other Manufacturing	2.0	2.0	2.0	2.0	2.1	2.2	2.3	2.1	2.1	2.1	2.1	2.0

Figure 3.1 Irish Employment, 1972-2000
Forfas Employment Survey

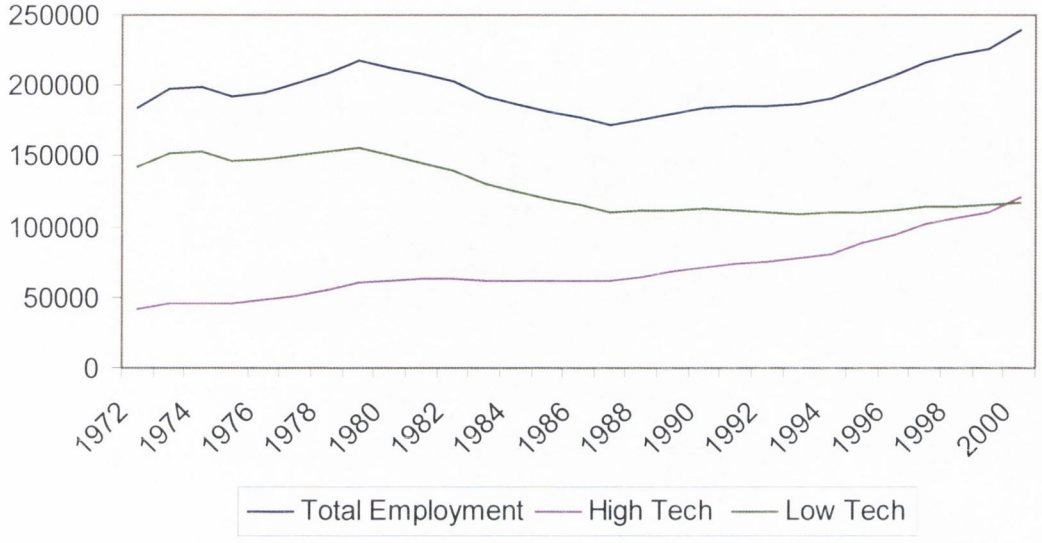


Figure 3.2 High and Low technology Employment, as percentage of total employment

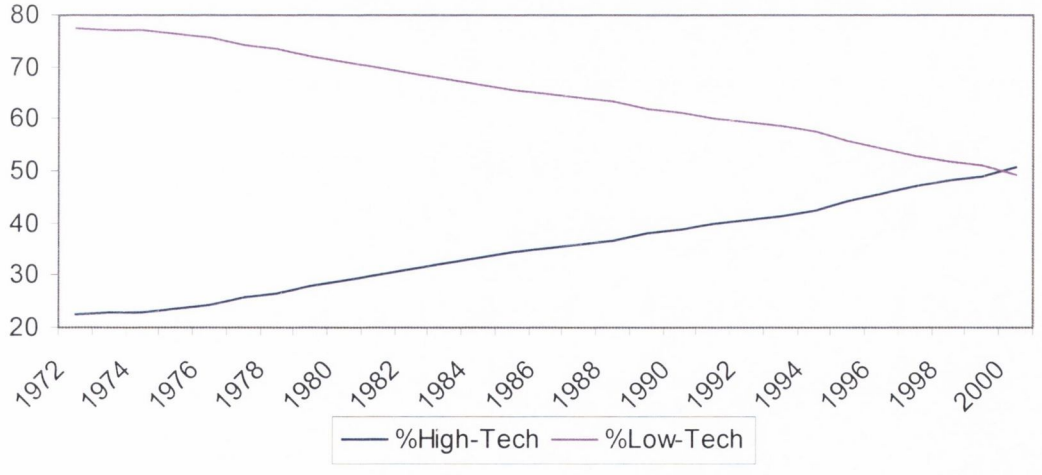


Figure 3.3 Irish Exports, 1976-2000
Eurostat

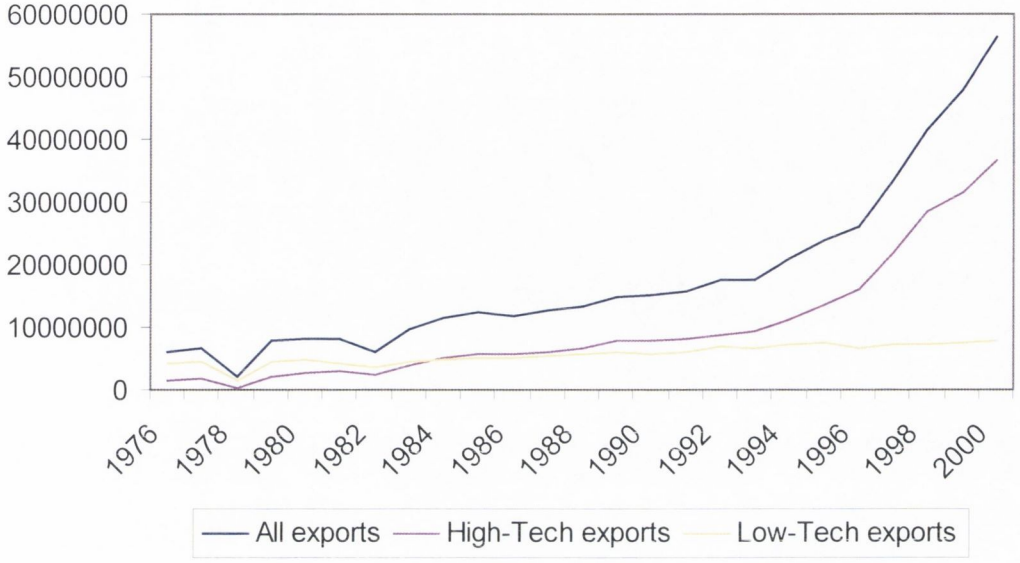


Figure 3.4 High and Low Technology Exports, as percentage of total exports

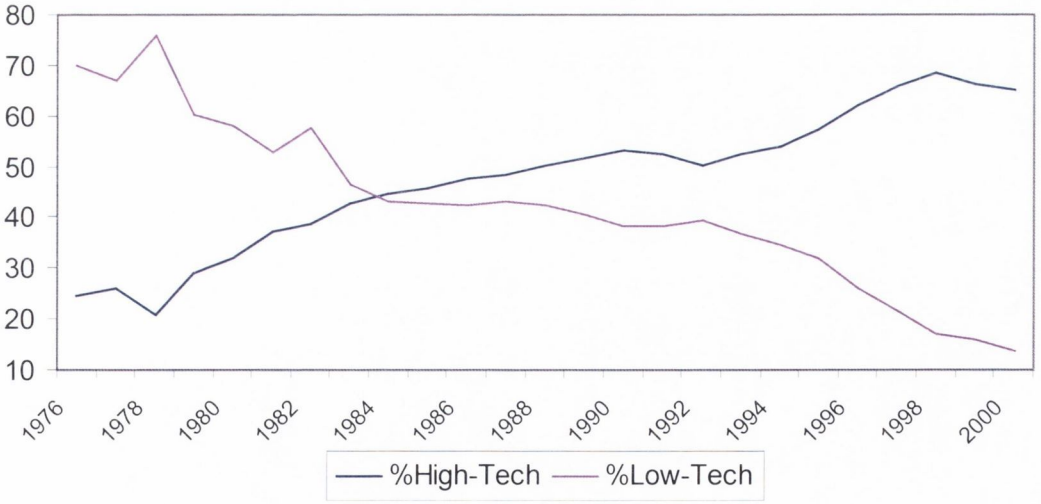


Figure 3.5 Export Sector Shares
1976, 1986 and 2000

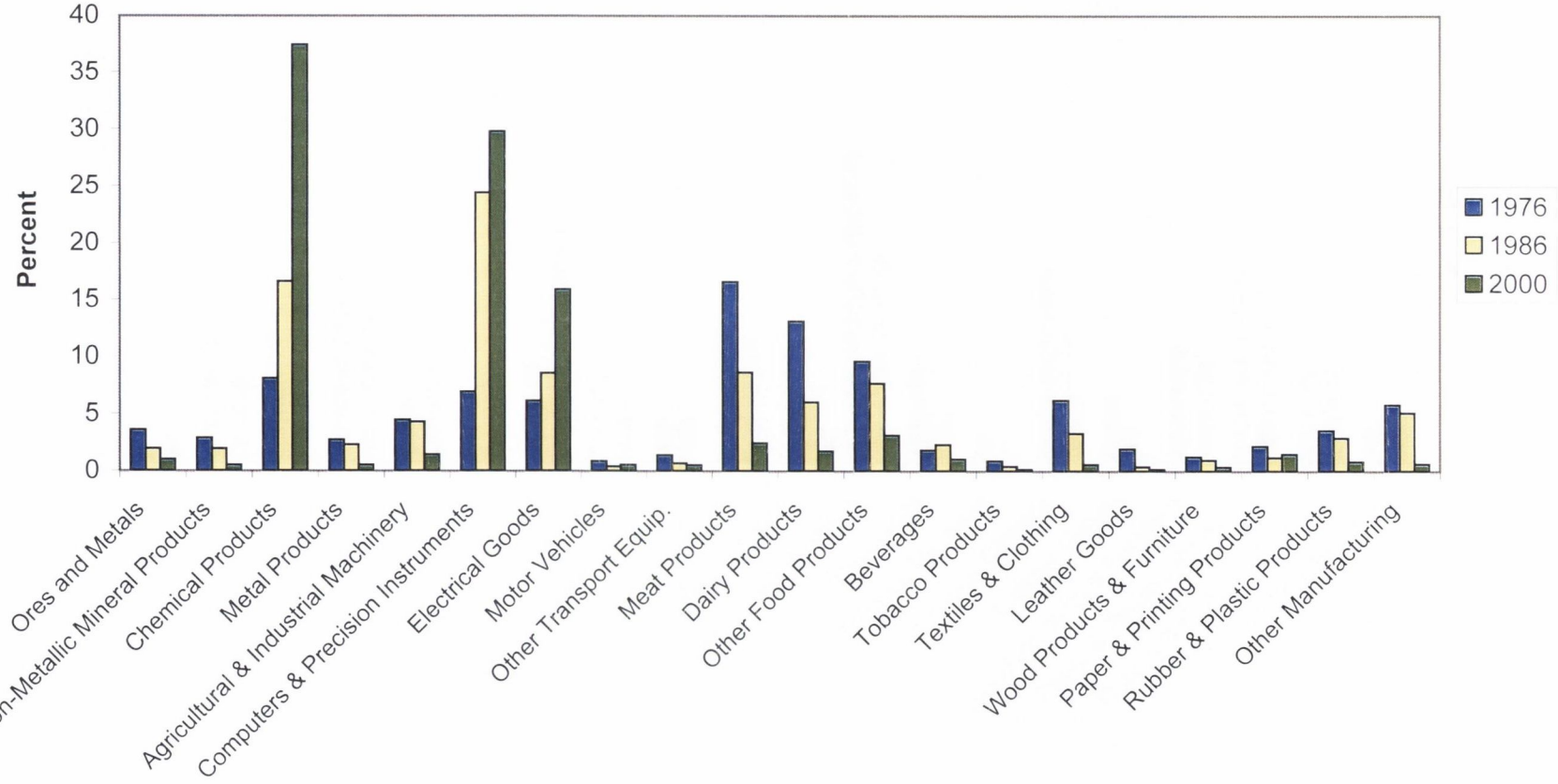


Figure 3.6 Employment Shares
1976, 1986 and 2000

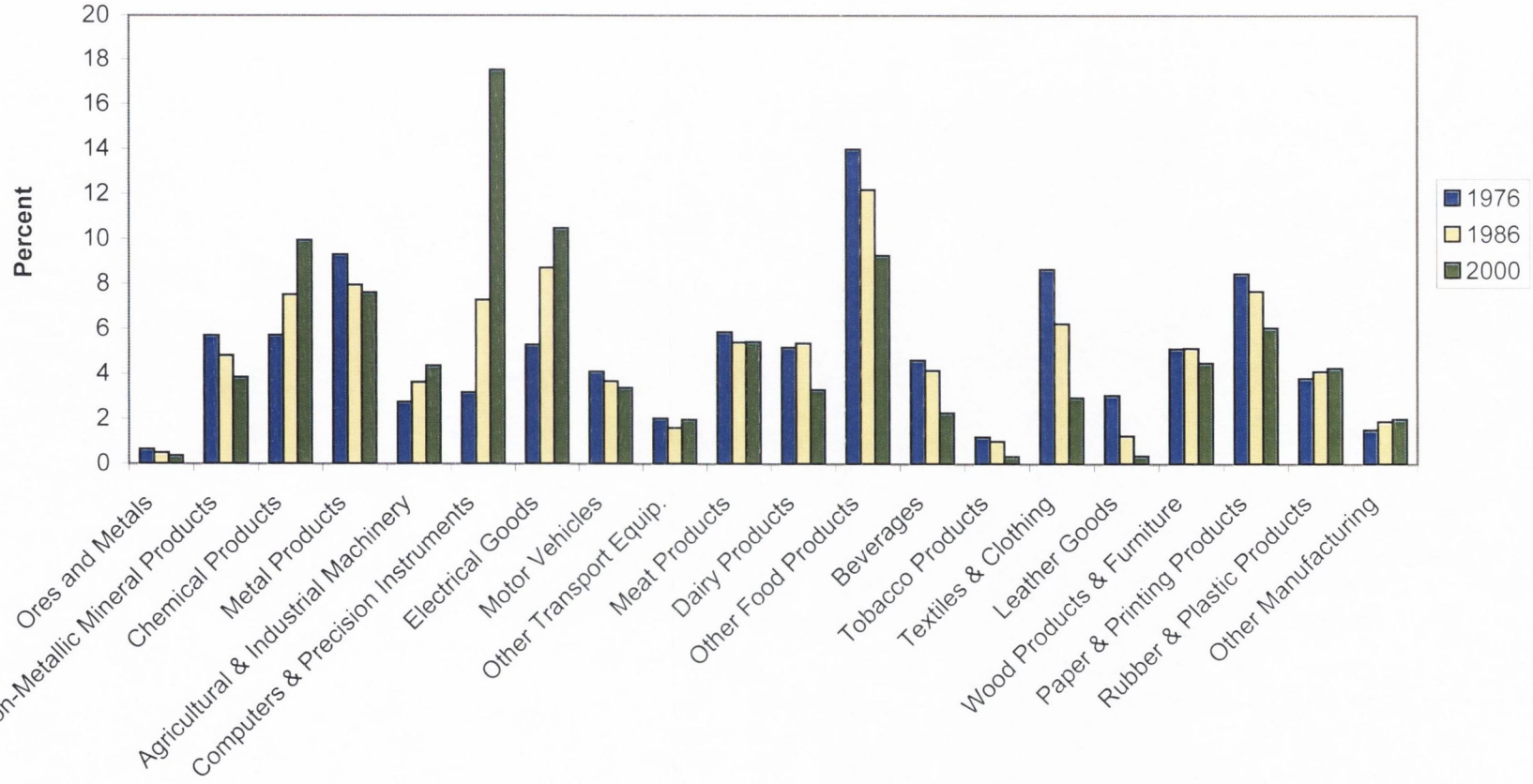


Figure 3.7 Export Shares Piechart 1976

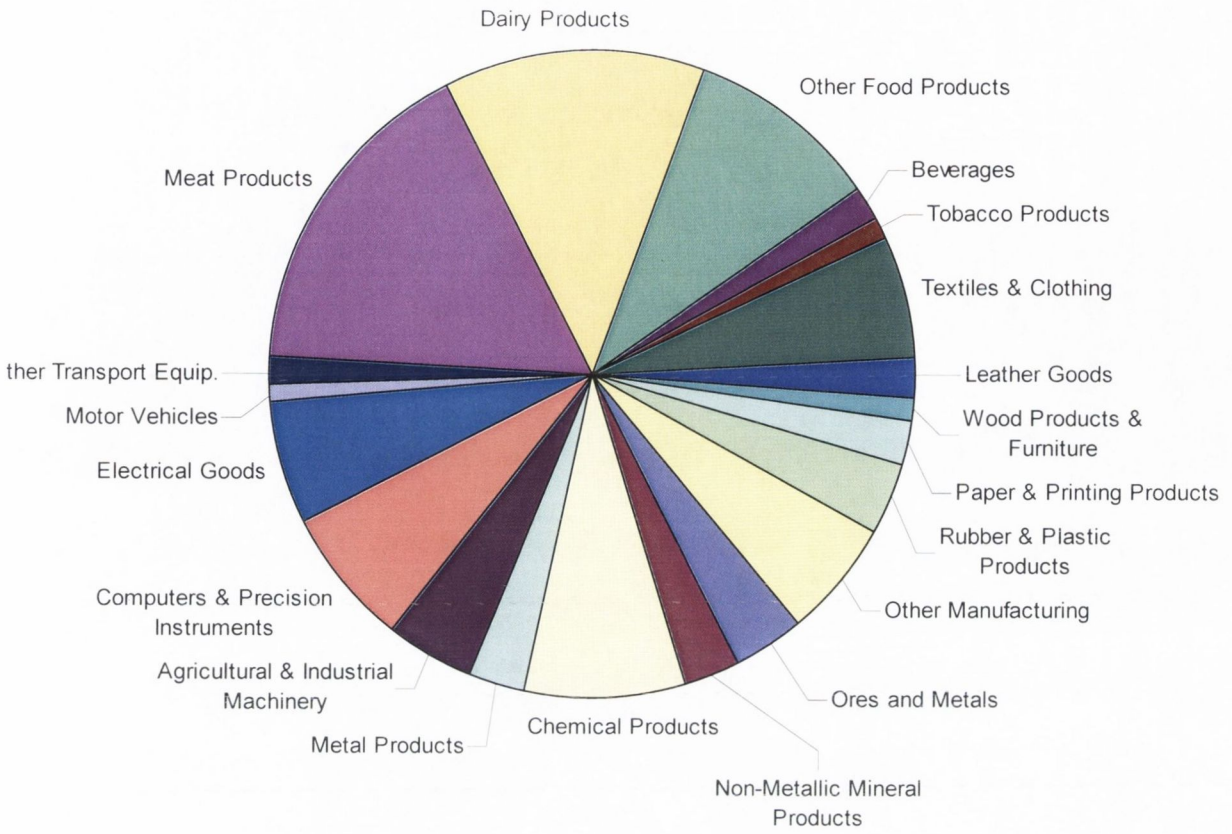


Figure 3.8 Export Shares Piechart 2000

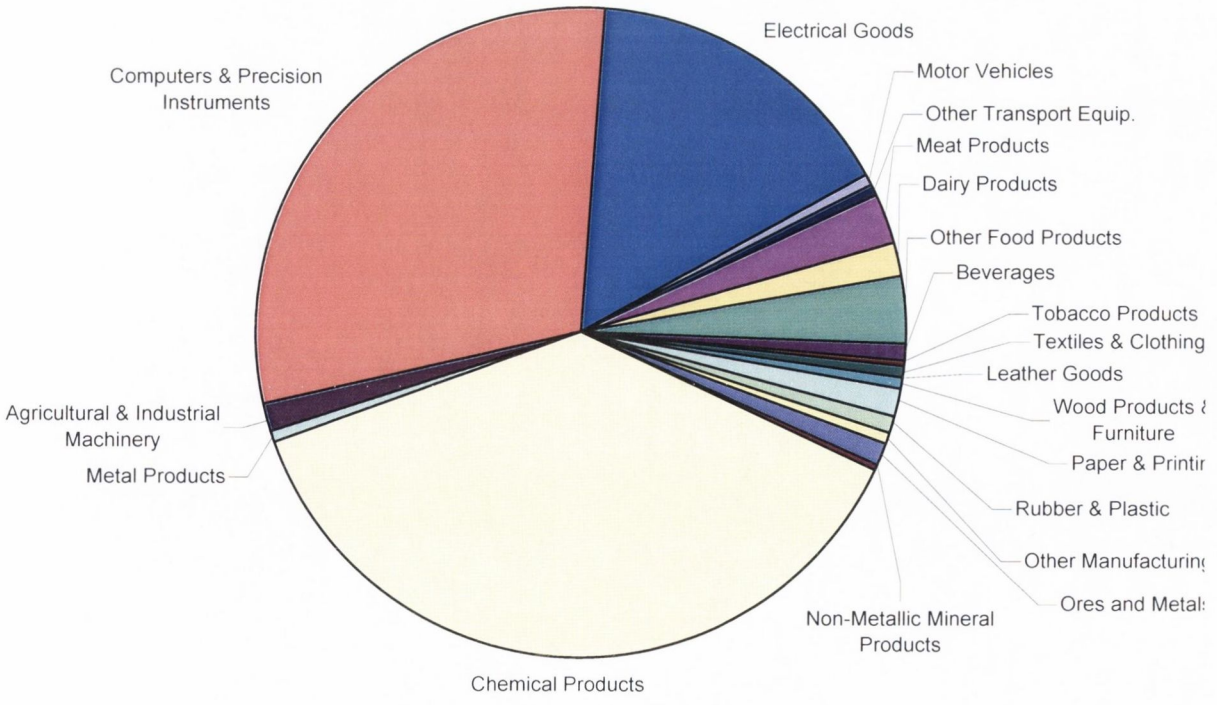


Figure 3.9 Employment Shares Piechart 1976

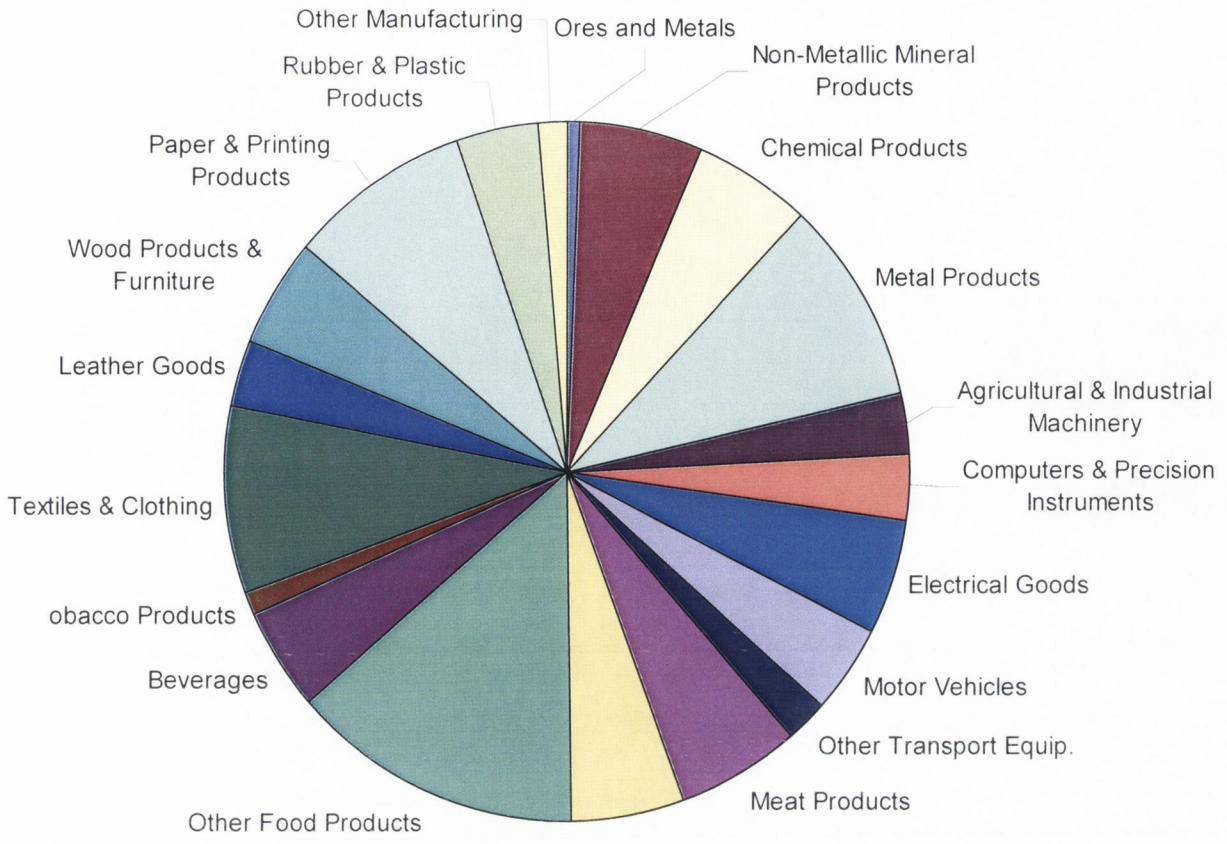


Figure 3.10 Employment Shares Piechart 2000

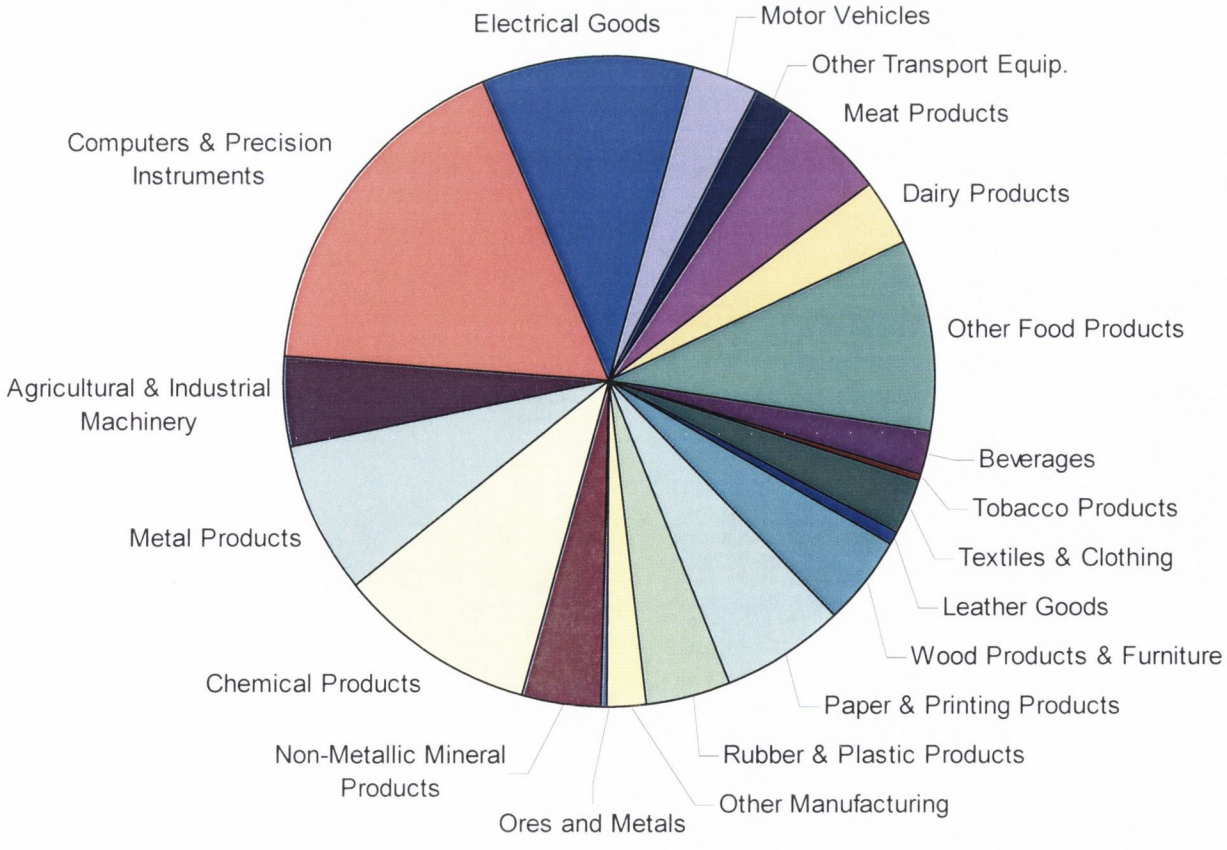


Figure 3.11 Employment and Specialisation (Herfindahl) All Sectors

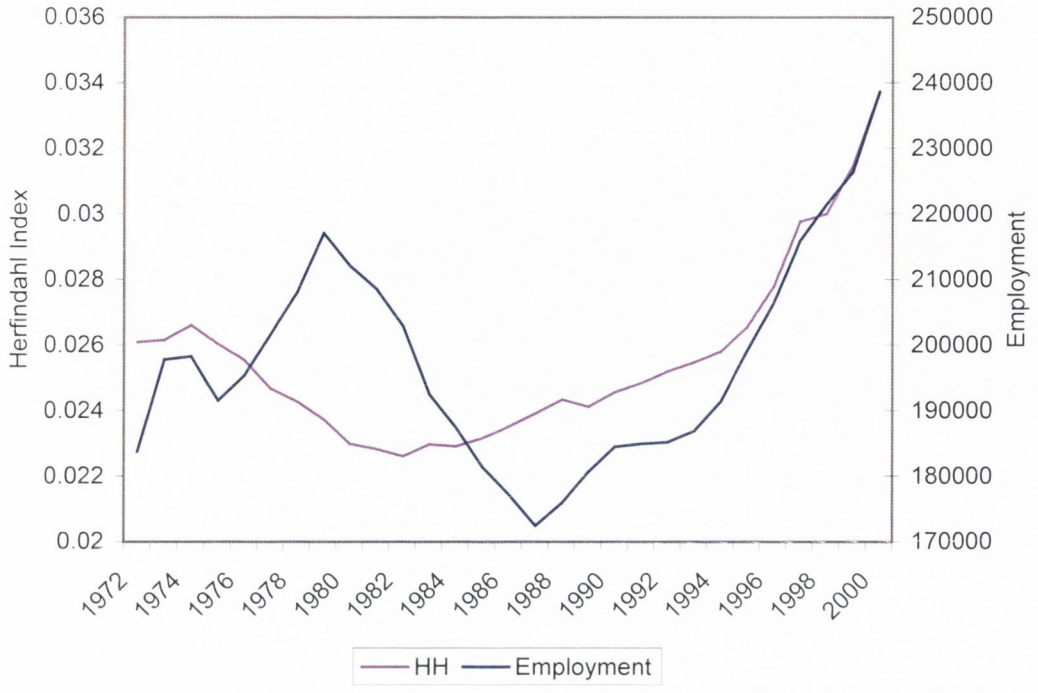


Figure 3.12 Employment and Specialisation (Herfindahl) High Technology Sectors

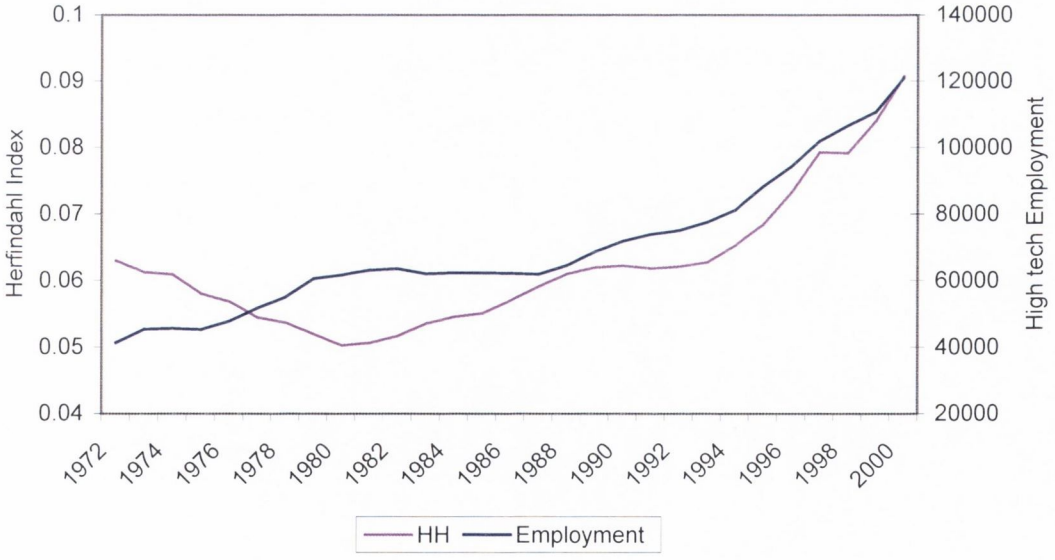


Figure 3.13 Employment and Specialisation (Herfindahl)
Low Technology Sectors

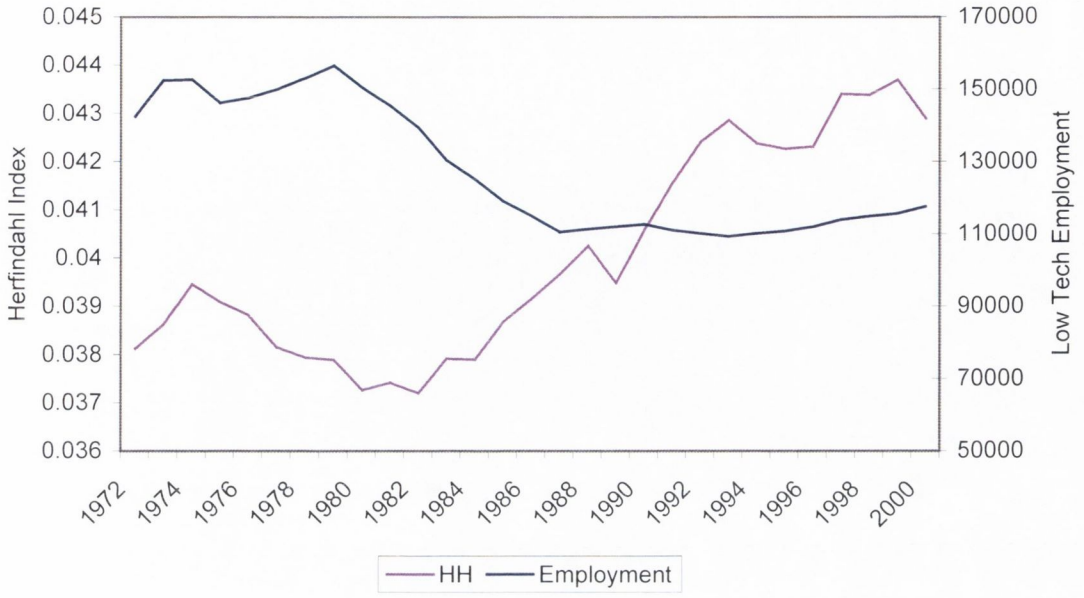


Figure 3.14 Exports and Specialisation (Herfindahl)
All Sectors

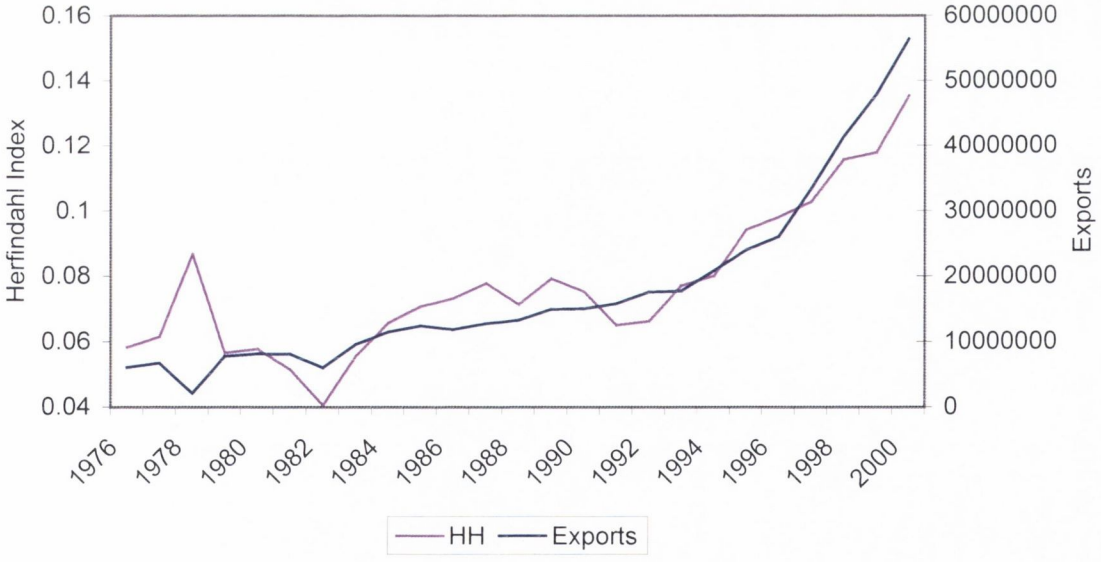
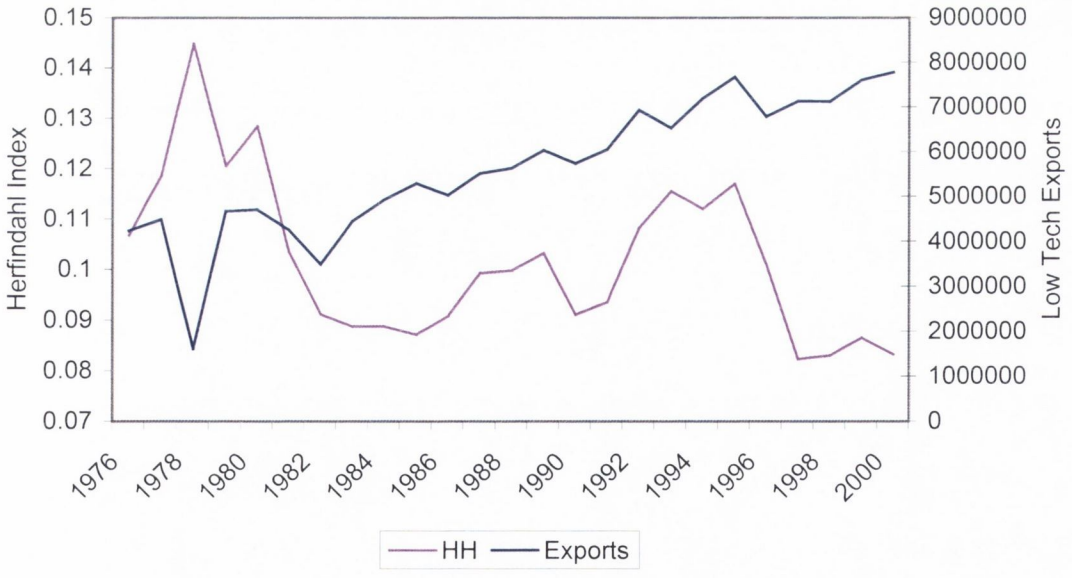


Figure 3.15 Exports and Specialisation (Herfindahl)
High Technology Sectors

Figure 3.16 Exports and Specialisation (Herfindahl)
Low Technology Sectors



Appendix 3.1: Description of NACE-CLIO 3-Digit Sectors

Low-Technology Industries

221 Pig-Iron, crude steel, hot/cold rolled sheets, coated metal sheets (ECSC products)
222 Steel tubes
223 Extruded and drawn metal, cold-rolled products, cold-formed steel parts and sections
224 Non-ferrous metals
231 Grave, stone, sand and clay
239 Other minerals, peat
241 Bricks and ponery products
242 Cement, lime, plaster
243 Building and construction materials made of concrete, cement or plaster
244 Articles made of asbestos (except articles of asbestos-cement)
245 Stones and other non-metallic mineral products
246 Millstones and other abrasive products
247 Glass (plate, hollow, technical, fibre glass)
248 Ceramic products
311 Foundry products
312 Metal products which are forged, stamped, embossed or cut
313 Products of secondary processing of metals
314 Structural metal products
315 Products of boilermaking
316 Tools and finished metal articles, except electrical equipment
324 Machinery for food and chemical industries; bottling, packaging, wrapping and related machinery; rubber & artificial plastics working machinery
325 Mining equipment machinery and equipment for metallurgy, for the preparation of building materials, for building and construction, for mechanical handling and lifting
361 Boats, steamers, warships, tugs, floating platforms and rigs, materials from broken boats
411 Vegetable and animal oils and fats
412 Meats, meat preparations and preserves, other products from slaughtered animals
413 Milk and dairy products
414 Fruit and vegetable preserves and juices
415 Fish preserves and other sea food for human consumption
416 Cereals, flour and flakes
417 Food pastes
418 Starch and starch products
419 Bread, rusks, biscuits, cakes and pastries
420 Sugar
421 Cocoa, chocolate, sweets, ice-creams
422 Animal and poultry feeding stuffs
423 Other food products

Appendix 3.1: Description of NACE-CLIO 3-Digit Sectors (Continued)

424	Ethyl alcohol from fermented vegetable products and products based on it
425	Champagne, sparking wines, wine-base aperitifs
426	Cider, perry, mead
427	Malt, beers, brewers' yeast
428	Mineral waters, soft drinks
429	Tobacco products
431	Processed textile fibres, products of spinning, thread-making
432	Woven and velvet materials
436	Products of the hosiery trade
438	Carpets, carpeting, oilcloth, linoleum and other coated fibres
439	Other textile products
441	Leathers, skins, hides, tanned or otherwise processed
442	Leather and skin goods
451	Footwear, slippers made wholly or partly of leather
453	Ready-made clothes and clothing accessories
455	Household linen, bedding, curtains, wall coverings and awnings, sails, flags, bags
456	Articles of fur
461	Sawn, planed, seasoned, steamed wood
462	Veneered and ply wood, fibre board and particle board, improved and preserved wood
463	Carpentry, wooden buildings, joinery, parquet flooring
464	Wooden containers
465	Wooden articles (other than furniture), sawdust and shavings
466	Articles of cork, straw, basketware (other than furniture), brooms, brushes
467	Furniture of wood and cane, mattresses
471	Wood pulp, paper, board
472	Products of pulp, paper and board
473	Products of printing
474	Products of publishing
491	Precious and costume jewellery, goldsmiths' and silversmiths' products, working of precious and semi-precious stones, diamond cutting and polishing, striking of coins and metals
492	Musical instruments
493	Products for printing and developing cinematographic and photographic films
494	Games, toys, sports goods
495	Fountain pens and ballpoint pens, seals. Other products n.e.c.

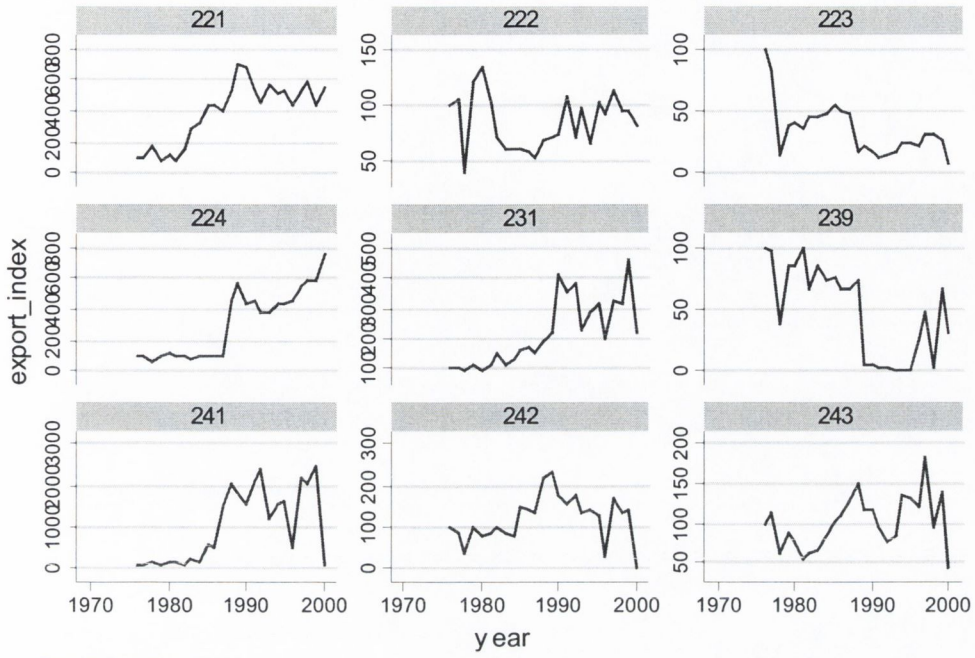
Appendix 3.1: Description of NACE-CLIO 3-Digit Sectors (Continued)

High-Technology Industries

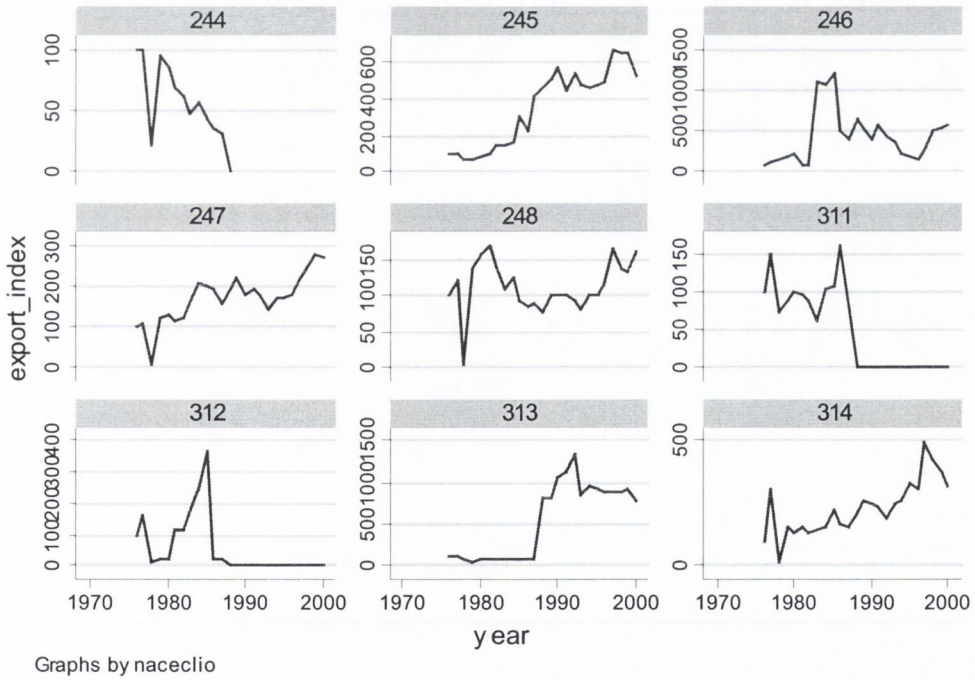
255	Paints, varnishes and printing inks
256	Other chemical products, mainly for industrial and agricultural purposes
257	Pharmaceutical products
258	Soaps, synthetic detergents, perfumes, cosmetics and toilet preparations
259	Other chemical products, mainly for household and office use
260	Artificial and synthetic fibres
321	Agricultural machinery and tractors
322	Machine tools for metal working, tools and equipment for machinery
323	Textile machinery and accessories, sewing machines
326	Gears and other transmission equipments
327	Machinery for working wood, paper, leather and footwear, laundering and dry-cleaning equipment
328	Other machinery and mechanical equipment
330	Office and data processing machines
341	Insulated wires and cables
342	Electric motors, generators transformers, switches etc.
343	Electrical equipment for industrial use, batteries and accumulators
344	Telecommunications equipment, meters and measuring equipment, electro-medical equipment
345	Electronic equipment, radio and television receiving sets, sound reproducing and recording equipment, gramophone records and pre-recorded tapes
346	Electric household appliances
347	Electric lamps and other forms of electric lighting
351	Motor vehicles and engines
352	Bodywork, trailers and caravans
353	Spare parts and accessories for motor vehicles
364	Aircraft, helicopters, hovercraft, missiles, space vehicles and other aeronautical equipment
365	Perambulators, invalid chairs, carts etc.
371	Measuring, precision and control instruments
372	Medico-surgical equipment, orthopaedic appliances
373	Optical instruments and photographic equipment
374	Clocks and watches
481	Rubber products
482	Re-treaded tires
483	Plastic products

Appendix 3.2 Index of Export Growth, 1976-2000

Low Technology Sectors

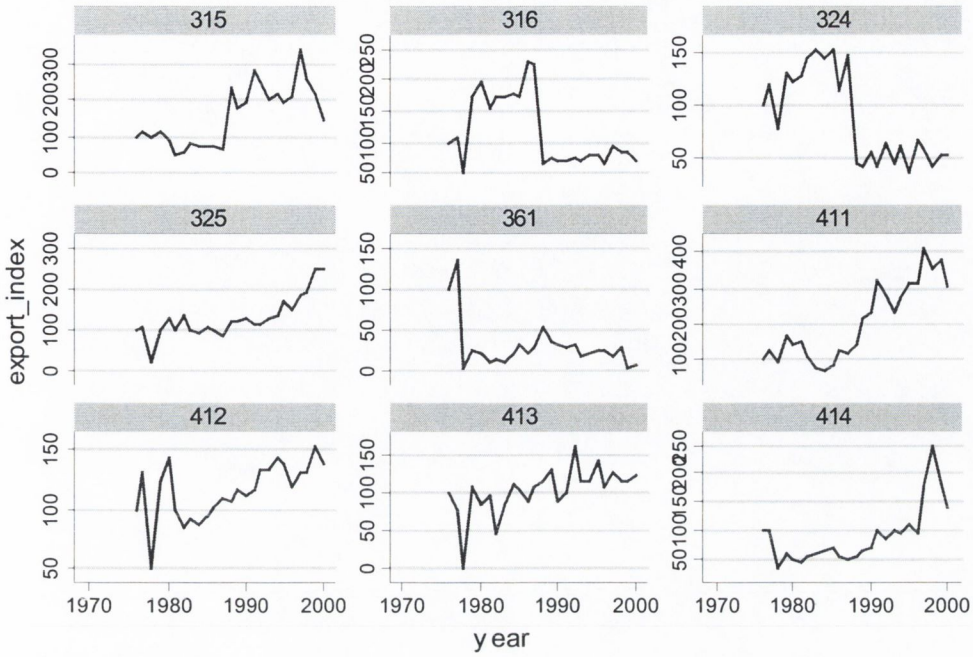


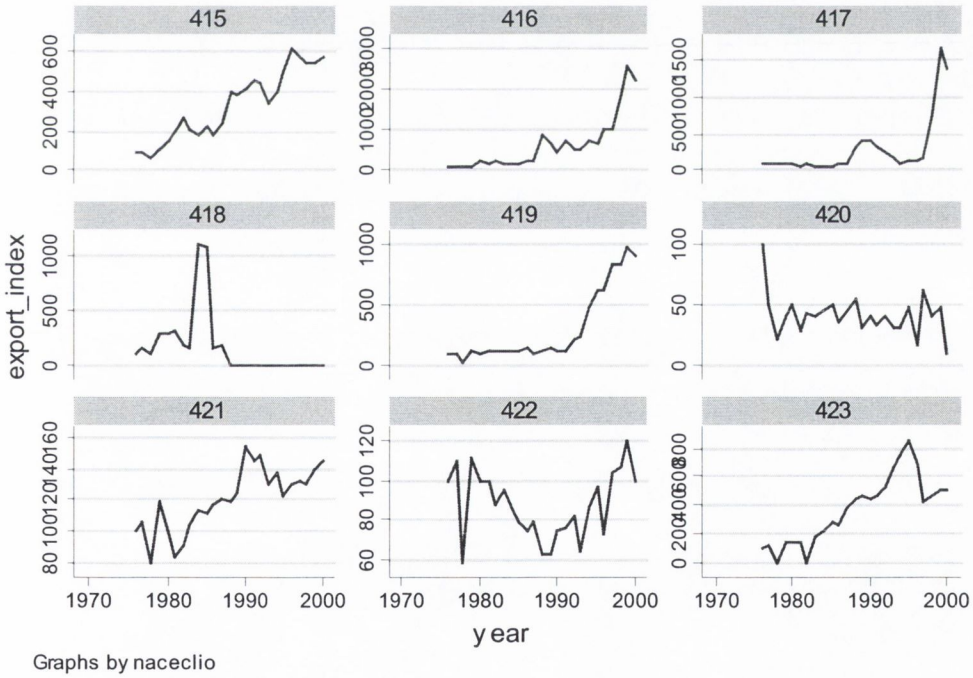
Graphs by naceclio



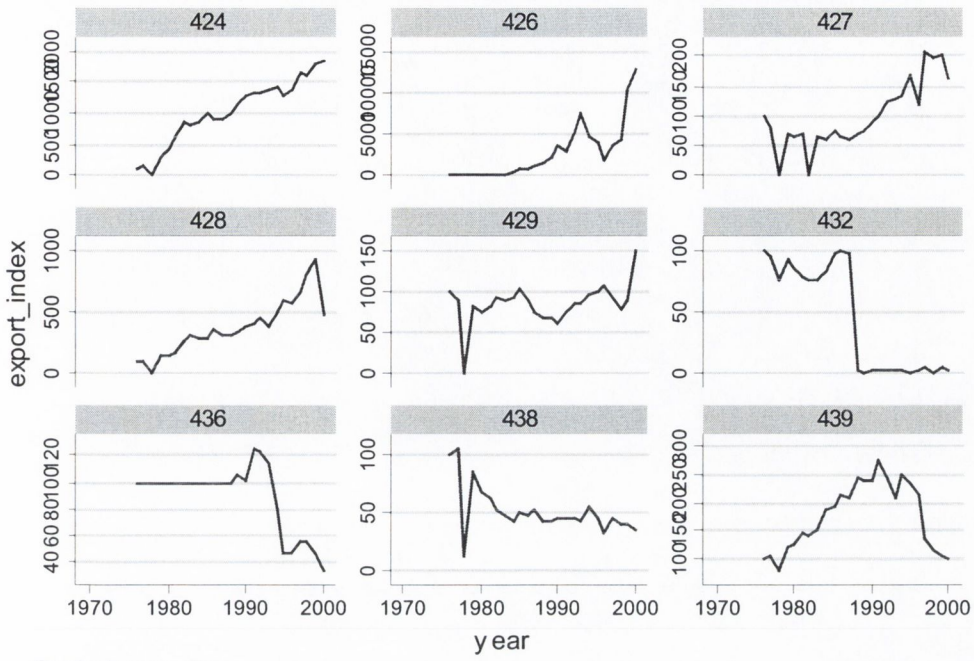
Graphs by naceclio

Appendix 3.2 Index of Export Growth, 1976-2000 (Continued)

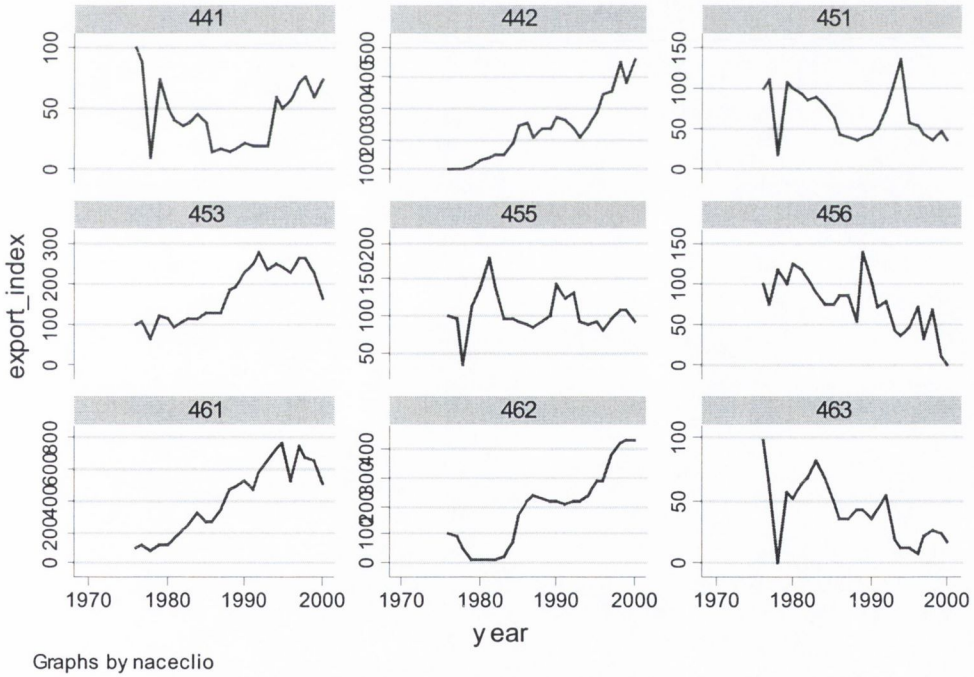




Appendix 3.2 Index of Export Growth, 1976-2000 (Continued)

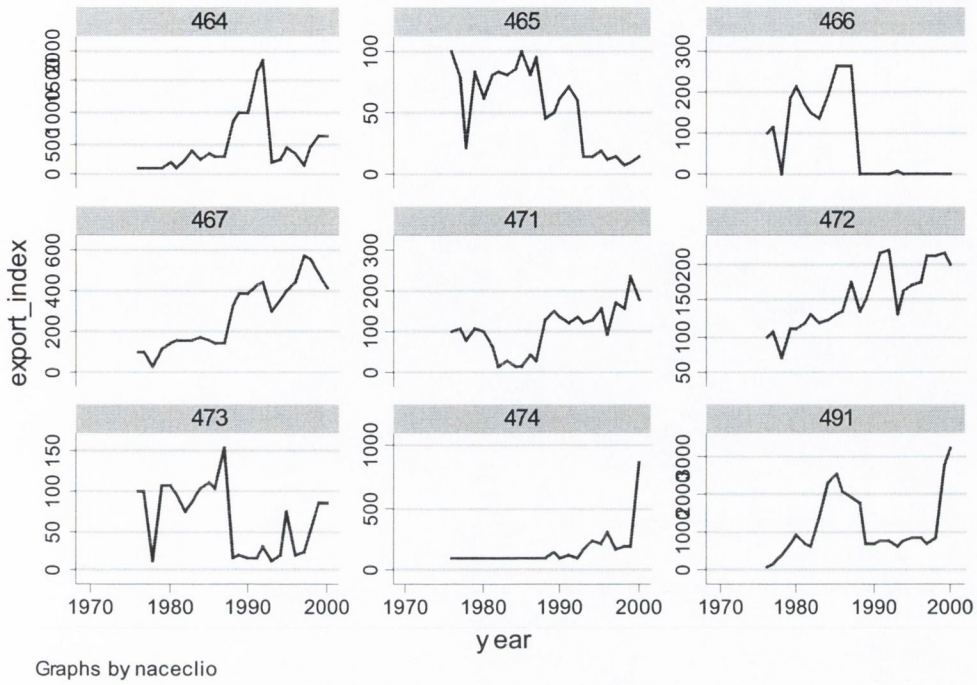


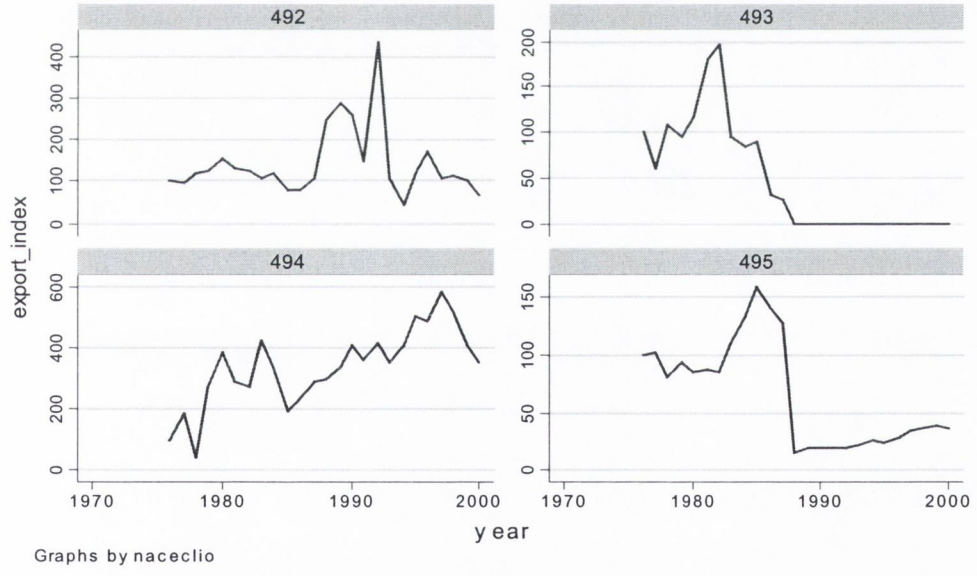
Graphs by naceclio



Graphs by naceclio

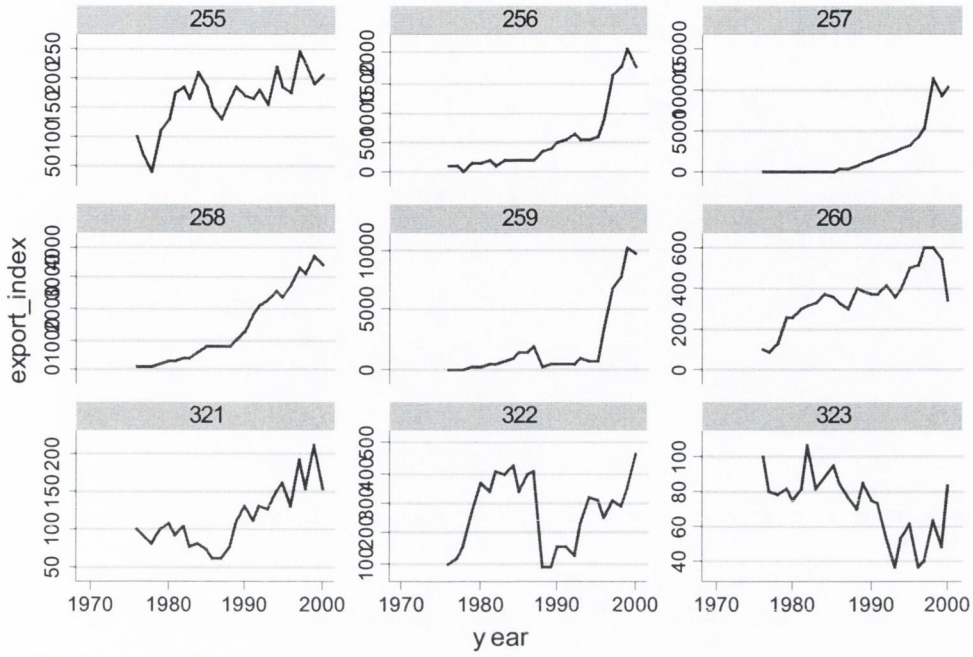
Appendix 3.2 Index of Export Growth, 1976-2000 (Continued)

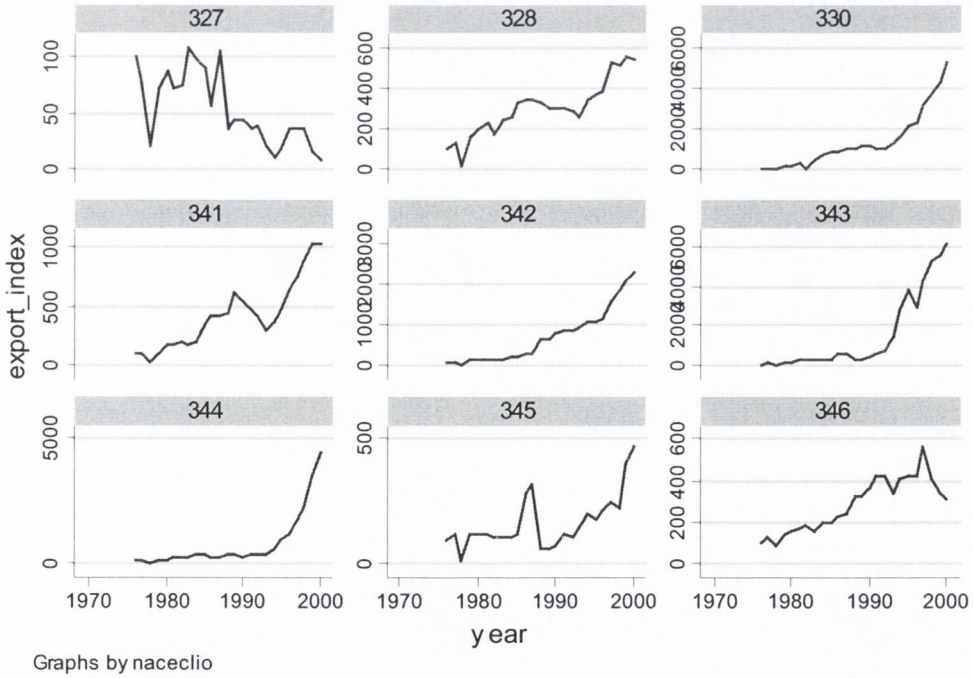




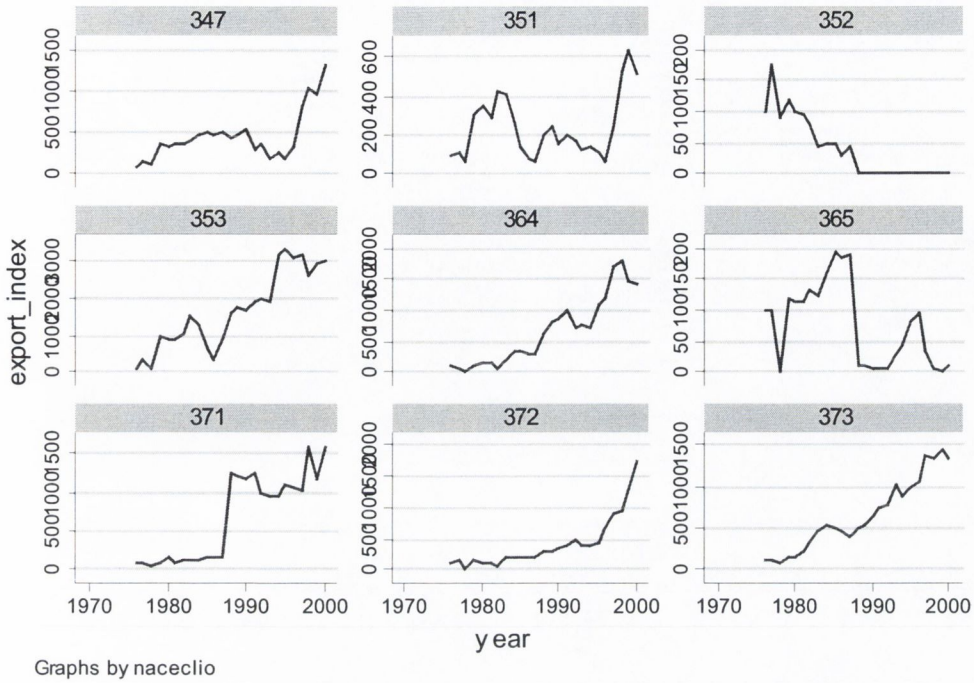
Appendix 3.2 Index of Export Growth, 1976-2000 (Continued)

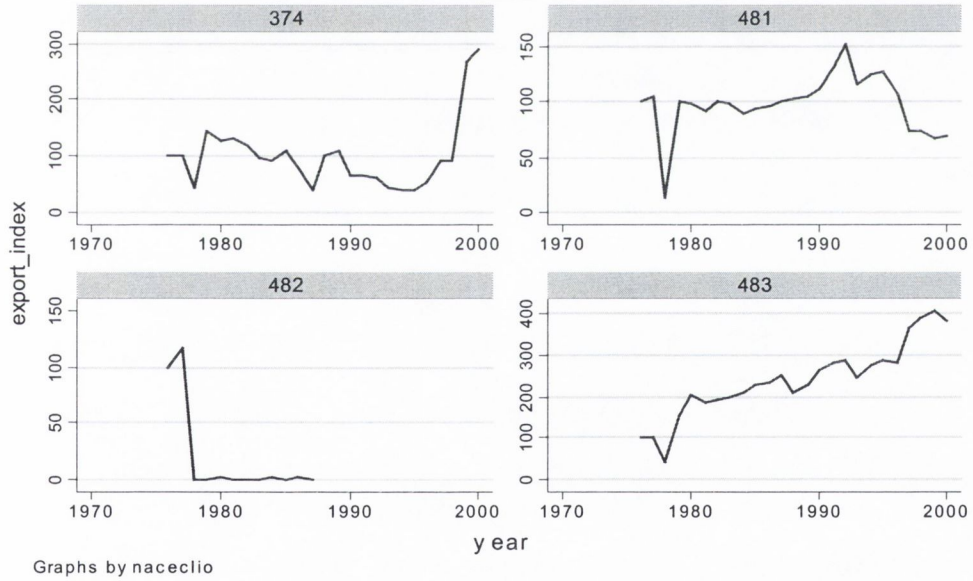
High Technology Sectors





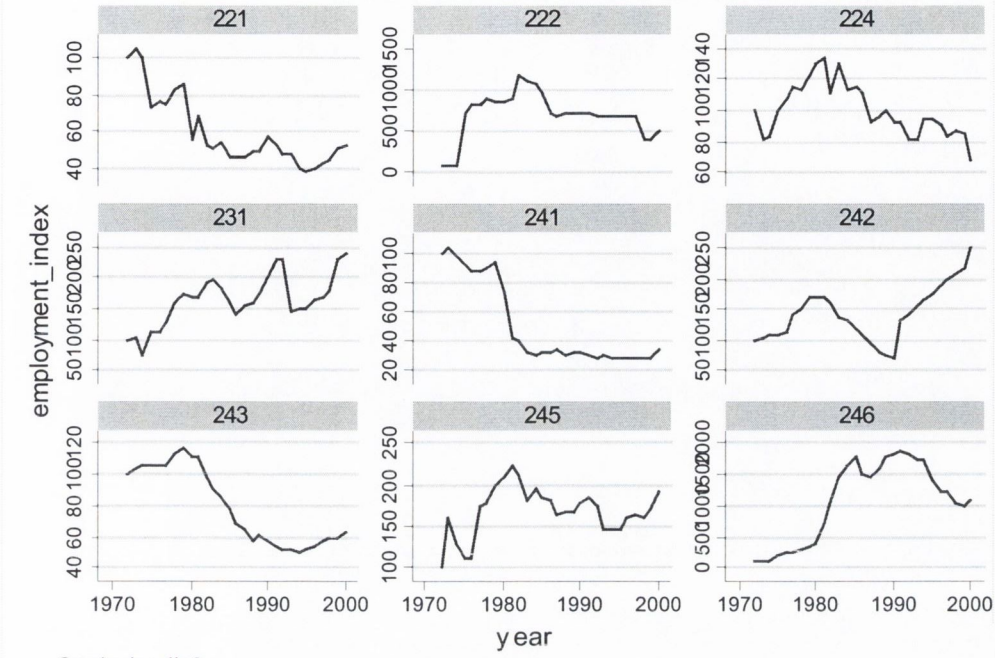
Appendix 3.2 Index of Export Growth, 1976-2000 (Continued)

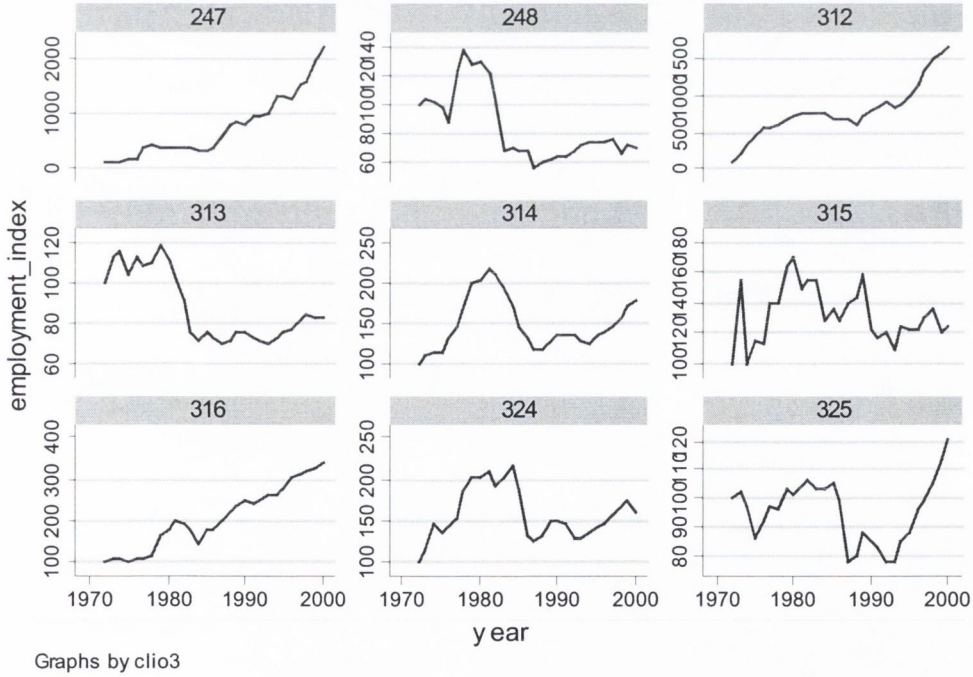




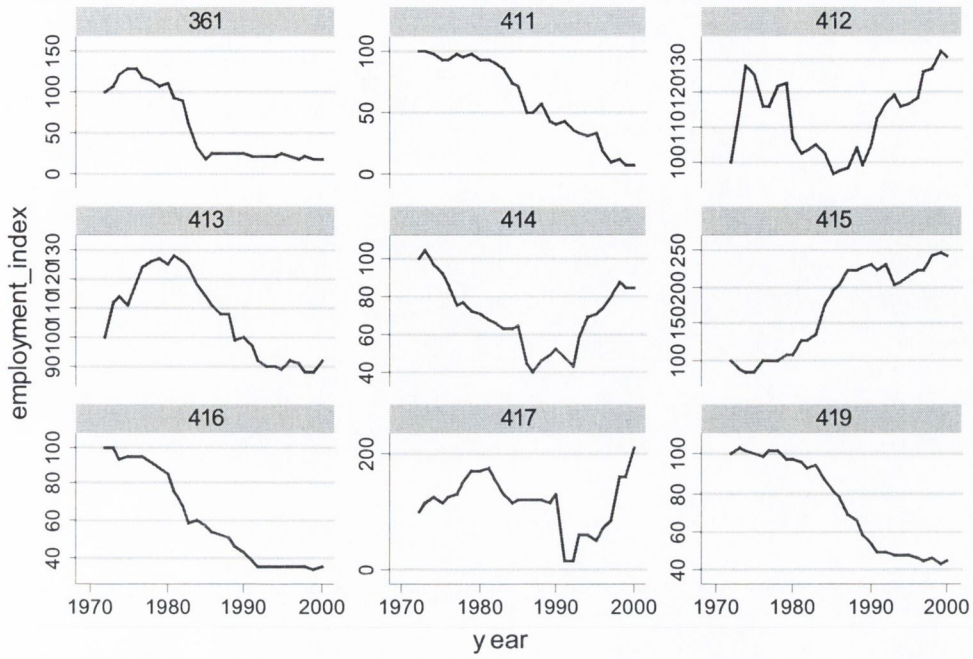
Appendix 3.3 Employment Change 1972-2000

Low-Technology Sectors

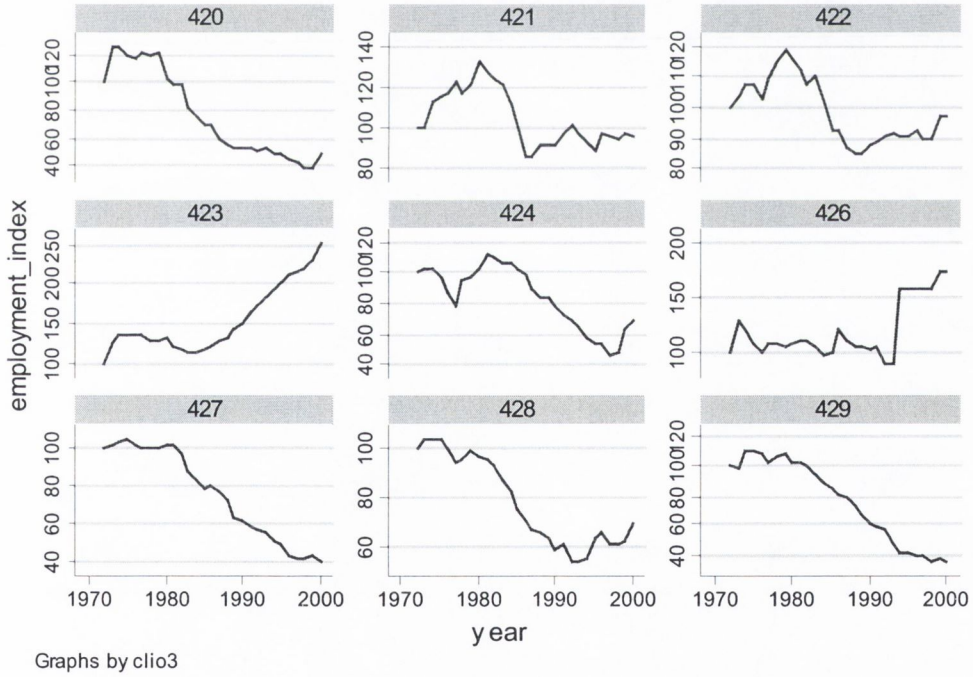




Appendix 3.3 Employment Change 1972-2000 (Continued)

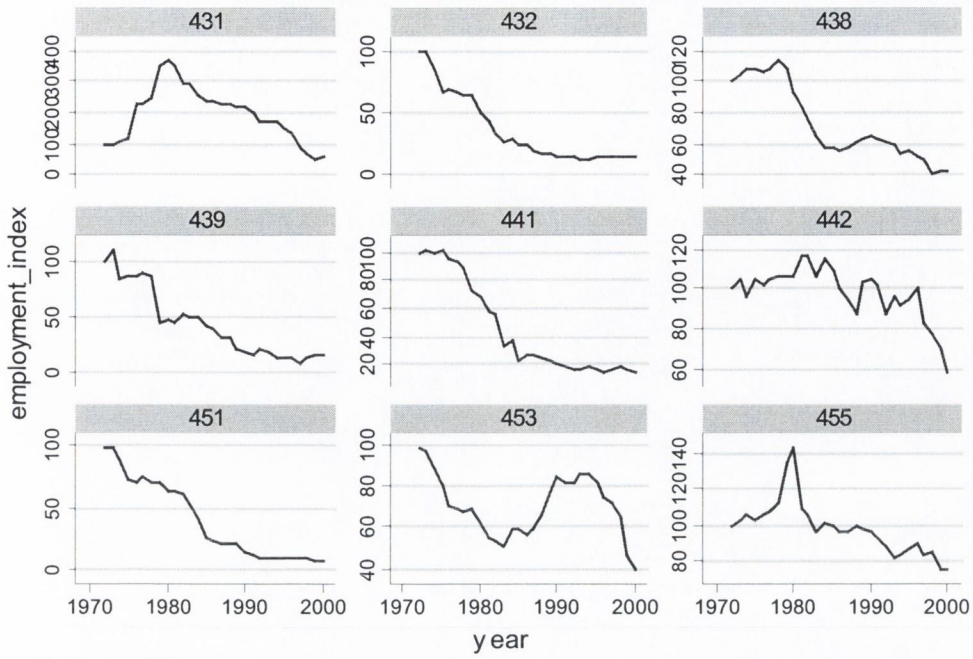


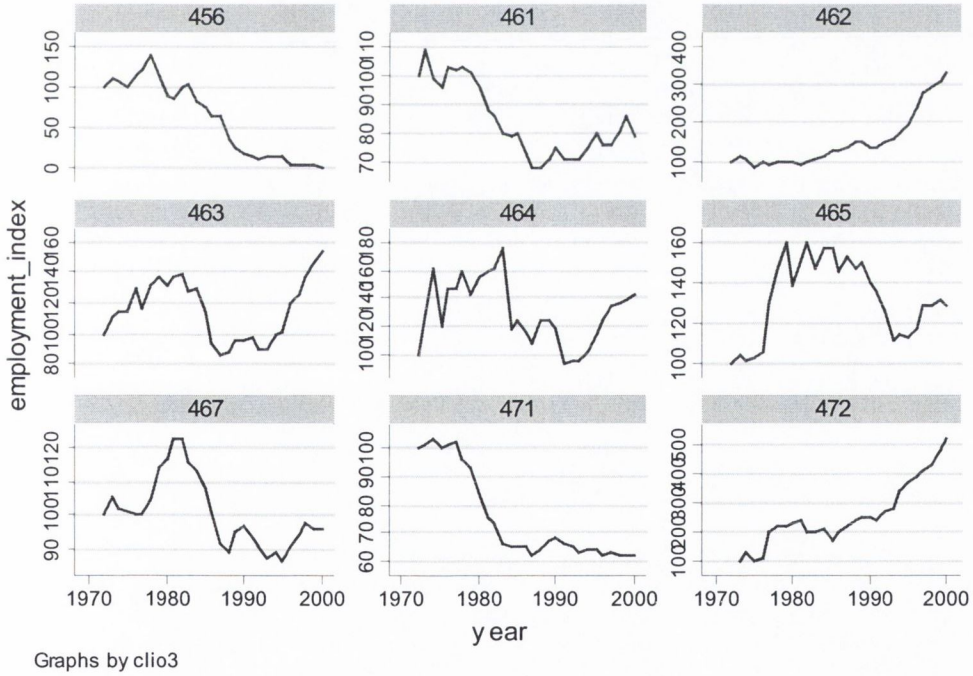
Graphs by clio3



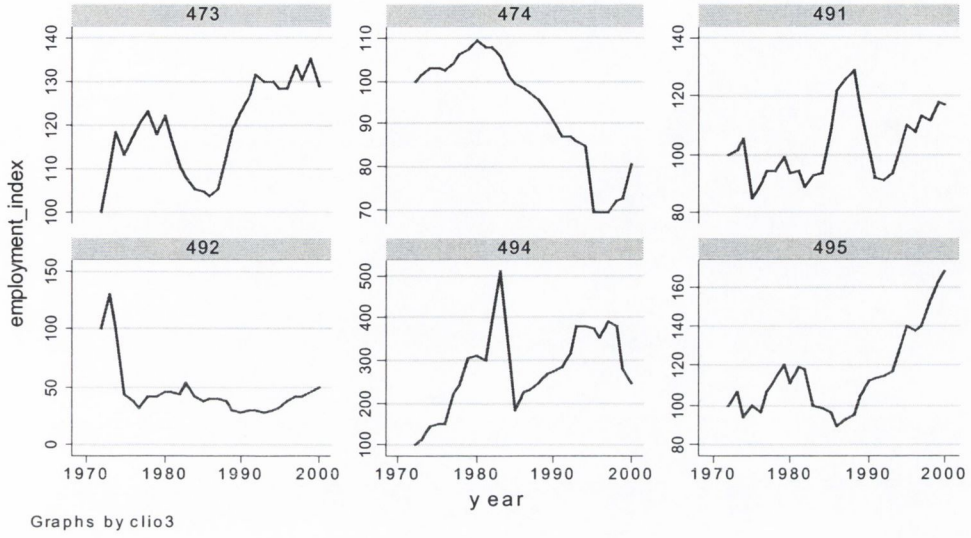
Graphs by clio3

Appendix 3.3 Employment Change 1972-2000 (Continued)



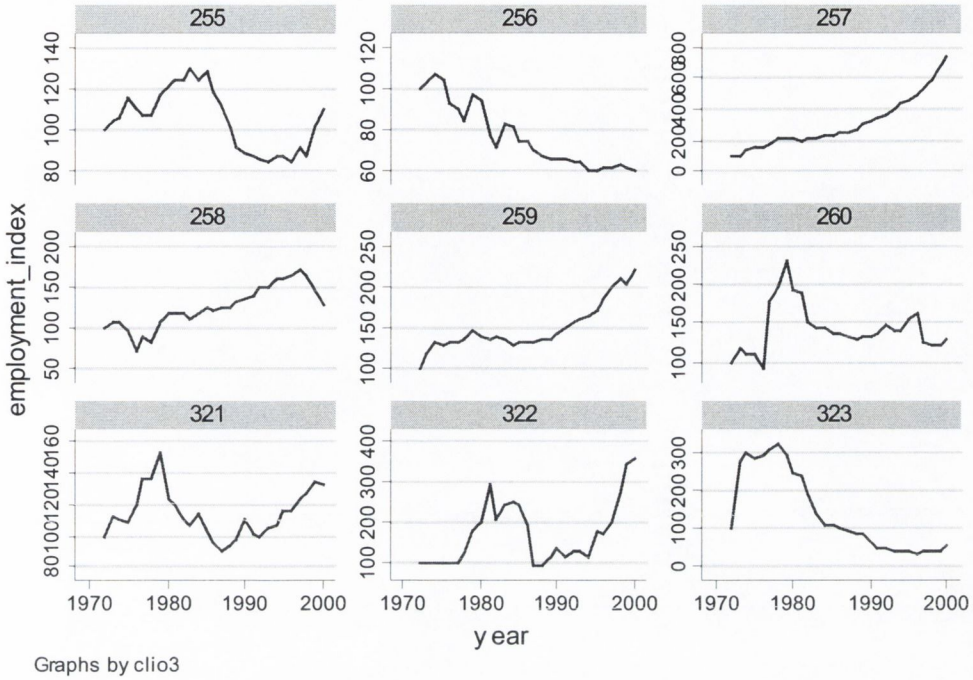


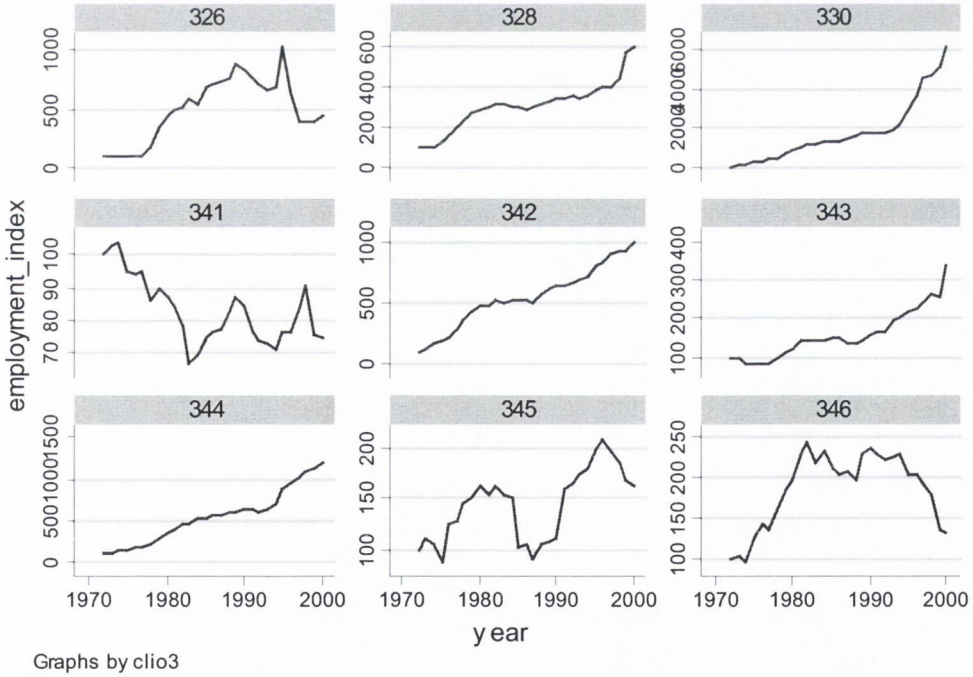
Appendix 3.3 Employment Change 1972-2000 (Continued)



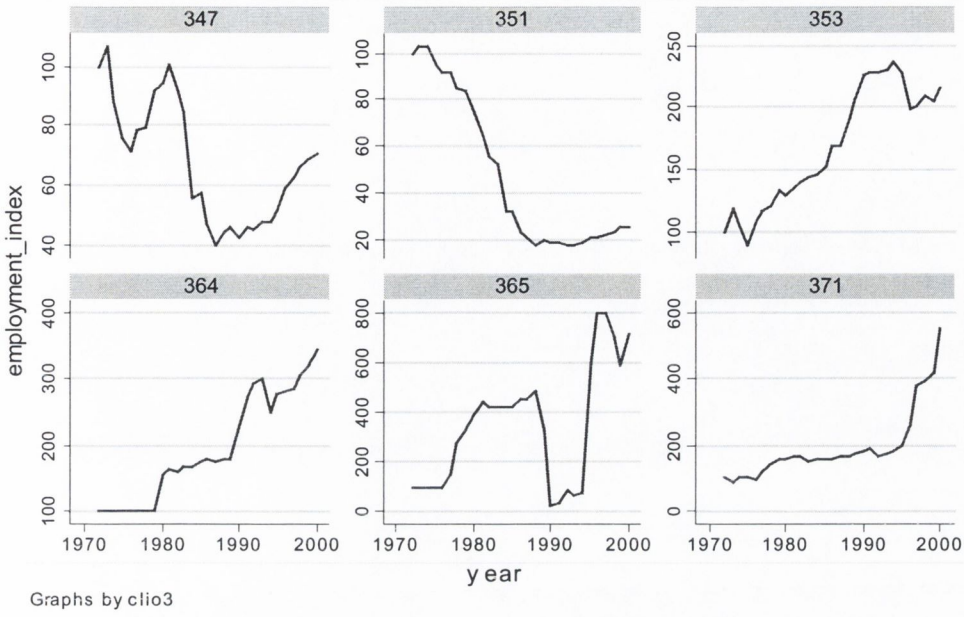
Appendix 3.3 Employment Change 1972-2000 (Continued)

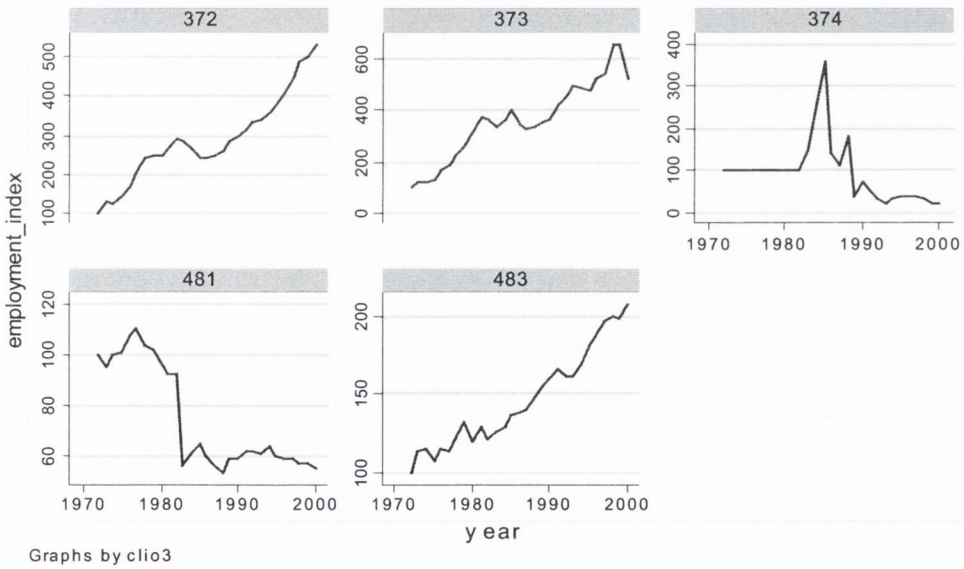
High-Technology Sectors



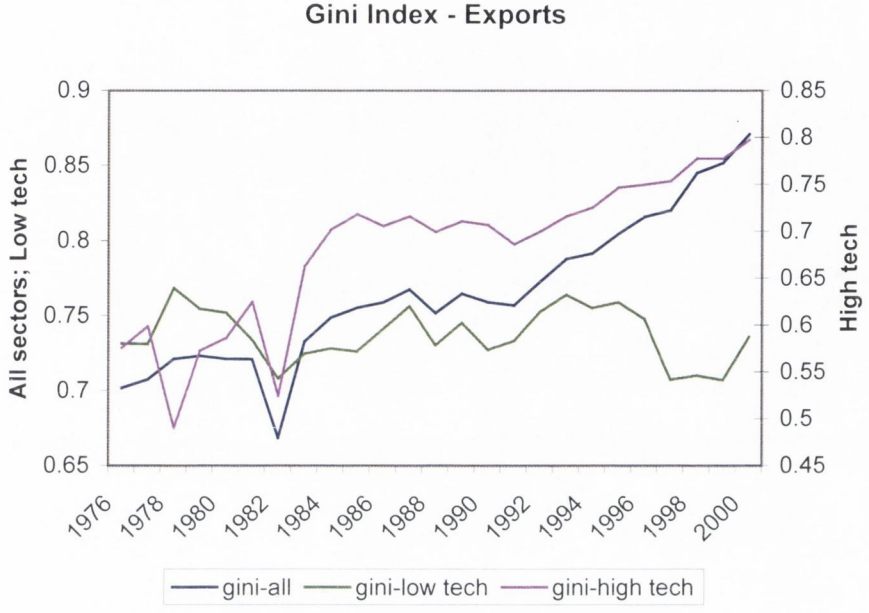


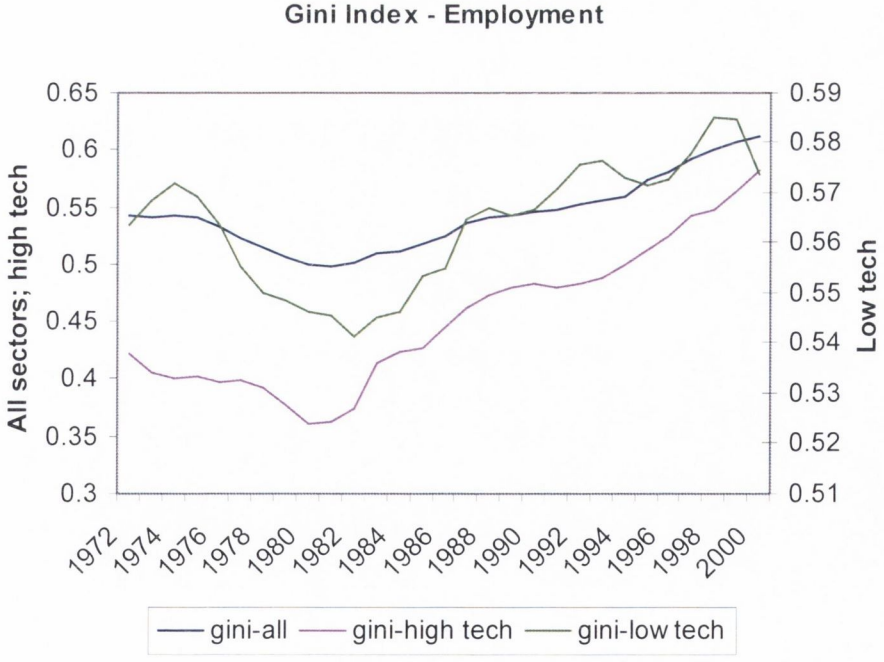
Appendix 3.3 Employment Change 1972-2000 (Continued)



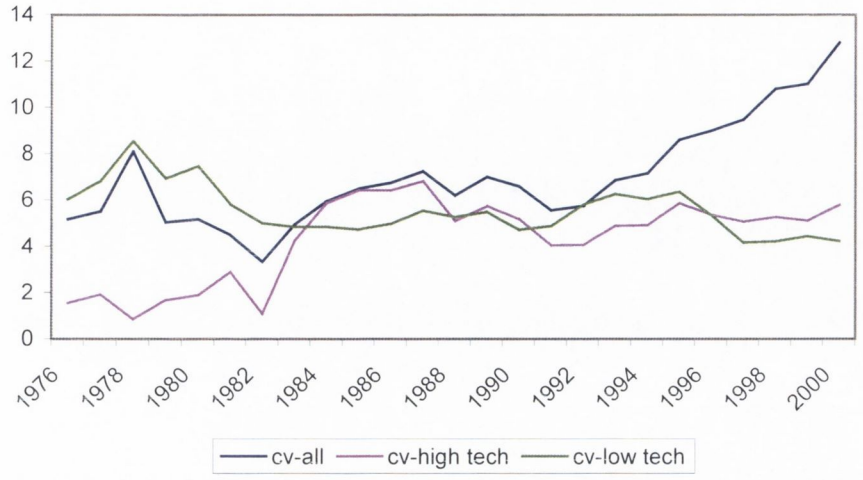


Appendix 3.4: Alternative Measures of Specialisation Graphs (Gini Index and Coefficient of Variation)

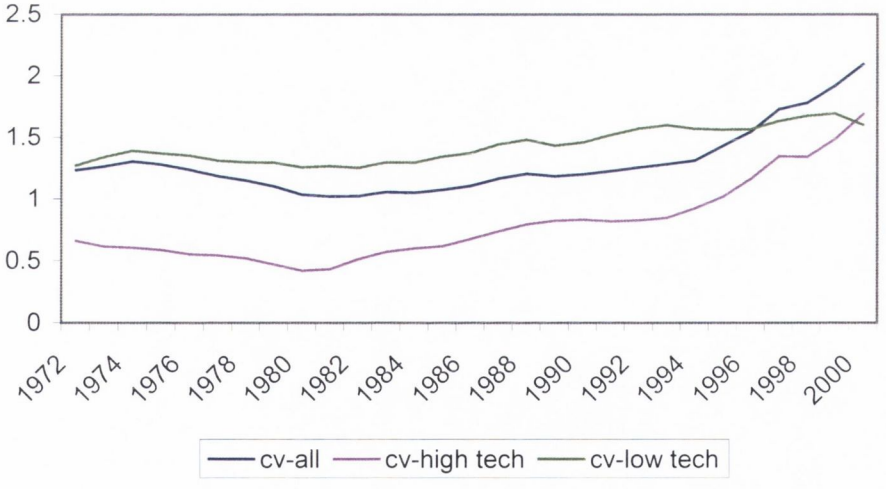




Coefficent of Variation - Exports



Coefficient of Variation - Employment



Chapter 4

Making the Decision to Export: An Empirical Analysis of Sunk Costs and Spillovers in Irish Firms' Export Activity

4.1 Introduction

The exceptional performance of the Irish economy in recent years and the associated export boom has been the subject of much analysis. Figure 4.1 shows just how dramatic the increase in exports has been throughout the nineties and much literature has been dedicated to this phenomenon. However, little research has been undertaken regarding the choices made by individual firms to enter the export market or on the influence existing exporters or foreign firms might have on this decision. An exception is Sutherland (2003) who recently analysed the export performance of Irish owned firms and their entry to the export market. Roper and Love (2001) provide an analysis of the factors contributing to the export intensity of firms in Ireland, but not of entry decisions.

Firm involvement in the export market is characterised by a degree of hysteresis, which Krugman (1989) assumed to be due to the existence of a sunk cost of

entry.[1] The increasing availability of firm level data has led to a number of papers testing the presence and extent of these sunk costs and firm decisions to export. Recent literature in this area has also suggested that the sunk costs identified in entering the export market may be reduced if there are other domestic or multinational firms actively exporting in the same sector (e.g. Aitken, Hanson and Harrison, 1997). Such positive spillovers[2] to firms entering the export market could arise from a variety of sources, such as knowledge spillovers relating to the structure and conditions of the foreign markets, or possibly even more directly through improved transport infrastructure and increasing access to distribution networks.

This chapter uses data on a sample of Irish firms over seventeen years to test the hypothesis that sunk costs influence the decision to enter or exit the export market. It also tests if these are affected by the export activity of other firms in the same sector. A probit specification tests the probability of exporting in the current period given past exporting experience, controlling for the firm's initial export status. We find significant inertia in firm movements in and out of exporting, with previous export activity a strong explanatory factor for current export market participation. The research question addressed is similar to Sutherland (2003), with the major differences being the longer time span of the data and the empirical methodology. We use a two-step estimation procedure

[1] A 'sunk cost' is an unrecoverable expenditure, in this case costs involved in entering a new market. Once they have been incurred, they cannot be recouped.
[2] A spillover is a type of externality, whereby the operations or decisions of one firm can have an effect on another, which was not taken into account when the decision was being made.

suggested by Orme (1997) to control for the influence of initial conditions. This correction for initial conditions has not previously been applied to the question of export participation. In addition, this paper tests for the existence of spillover effects in exporting, in particular if the levels of export activity in a sector increase the probability of a firm participating in the export market. It also looks at how these spillovers may differ depending on whether their source is export activity of Irish domestic firms or of multinationals exporting from a base in Ireland. Research on other countries has found mixed results when testing the presence and extent of influence of aggregate exporting on individual firm decisions.

The chapter proceeds as follows: section 4.2 reviews the recent literature on sunk costs and spillovers in firm entry to the export market. Section 4.3 outlines the theoretical model and section 4.4 details the empirical model to be tested, as well as discussing some relevant econometric issues. Section 4.5 describes the data and section 4.6 presents the empirical results. Section 4.7 concludes.

4.2 Literature Review

4.2.1 Sunk Costs

Firm level export decisions and performance are relatively recent and growing areas of interest in the economic literature. Roberts and Tybout (1997) tested for

the existence of hysteresis in export activity for a sample of 650 Columbian firms throughout the 1980s and found a significant impact of sunk costs. The presence of sunk costs can be detected by testing if the previous export activity of the firm can be used to explain its current status, controlling for other firm-level characteristics that may influence export activity. In their paper, previous participation in exporting was found to increase the probability of current export activity by up to sixty percent.

The importance of the existence of sunk costs in the export market is that it results in transitory changes, perhaps in the exchange rate or in trade policy, having permanent effects on the export activity of firms. Examples of sunk costs in exporting are thought to be mainly those of information gathering on the new market, setting up new distribution networks, marketing and possibly repackaging of the product to appeal to new consumers etc. A further interesting finding of the Roberts and Tybout analysis is the speed at which the benefit of experience in the foreign market can evaporate if the firm ceases to export. Firms which had previously exported, but exited the export market two years previously, were found to have the same probability of re-entering the export market as a firm which had never exported before, implying that the full amount of sunk costs were incurred at re-entry.

In addition to the positive and significant influence of a history of exporting (indicating the presence of sunk costs), a number of other plant characteristics

were found to impact the probability of being an exporter. Factors such as plant size, age and ownership by a corporation were found to increase the probability of exporting. Location, particularly in terms of distance to a port, was also found to be significant. However, no impact was found either for wages or for a measure of relative export to domestic prices (although the inclusion of time dummies would have already controlled for much of the impact of price changes).

Broadly similar results were found for German firms, with export history increasing the probability of current inclusion in the export market by up to 50 percent, depending on the specification (Bernard and Wagner, 2001). In addition to the other firm characteristics looked at by Roberts and Tybout (1997), higher levels of productivity were also found to positively affect the probability of exporting. The direction of the relationship between exporting and productivity has been the subject of a number of inquiries, for example Bernard and Jensen (2001). Due to data constraints, this relationship is not explicitly examined in this paper.

Bernard and Jensen (2004b) take both sunk costs and spillovers into account in their analysis of the export decision of US firms. They find similar effects of plant characteristics, with larger, high-wage, more productive plants being more likely to export. They also find significant sunk costs exist in entering the export market, with exporting in the previous period increasing the probability of current

exporting by approximately 36%. However, neither geographic nor industry spillovers were detected.

Sutherland (2003) finds significant sunk costs in her analysis of Irish indigenous firms. Sutherland analyses indigenous manufacturing firms from 1991 to 1998. Significant differences are found between exporting and non-exporting firms. Exporting firms are larger, with higher turnover, pay higher average wages, are more capital intensive and have higher value added. Using linear probability and probit specifications, the effect of past export activity on current export status is tested. Positive and significant effects were found, with firms almost 70% more likely to export if they had been exporters in the previous period. Firm size and employee skill level were consistently associated with firm exporting. Wages were significant only in the linear probability model in levels specification, where it had a negative coefficient. This is in contrast to some other studies but consistent with the findings of this chapter. Firms with higher export intensity (i.e. with exports accounting for a greater share of sales) are more likely to remain exporters, although the size of the effect decreases as intensity increases. Sutherland also separates exporters into those exporting to the UK only and those who export to other markets. The sunk costs involved in entering the UK market were found to be significantly lower than for the wider export market. This proposition of different sunk costs according to market will be examined in more detail in Chapter Five.

4.2.2 Spillovers

Extending the idea that sunk costs play a role in firm export activity, Aitken, Hanson and Harrison (1997) look at whether these sunk costs can be affected by spillovers from other firms. For example, a firm in an export intensive sector may find its cost of entering the foreign market reduced by the export activity of other firms. Aitken *et al.* hypothesise that such spillovers would be even larger from multinational companies as these might operate as a "natural conduit for information about foreign markets, foreign consumers, and foreign technology" to domestic firms. Testing this empirically on a sample of Mexican firms from 1986-1990, the main result that emerges is that multinational firms do have a positive spillover effect on the probability of domestic firms exporting. However, no such spillover effect is found for aggregate exporting activity. Looking at plant characteristics, they find larger plants are more likely to export, but unlike Roberts and Tybout (1997) they find higher wages (as a proxy for skill levels perhaps) also increases the likelihood of being an exporter.

Applying the Aitken *et al.* (1997) methodology to UK firms, Greenaway, Sousa and Wakelin (2004) find positive spillover effects from multinational enterprises on both the decision of domestic UK firms to enter the export market, and on their export intensity. They identify three potential routes for these spillovers:

(i) Export information externalities (as mentioned above);

(ii) Competition effect working on the domestic market, creating an incentive to improve firm efficiency and hence making the transition to exporting and competing internationally easier;

(iii) Demonstration effect through spillovers of technology, R&D or management techniques.

The third effect is not directly related to exporting but, like the increased competition effect, it could improve the firm's chances of success if they did take the decision to enter the export market.

The link between spillovers, R&D and exporting is further explored by Barrios, Görg and Strobl (2003), looking both at the firm's own level of R&D and at spillovers from other firms in the same sector. Spillovers from the export activity of multinationals and aggregate sectoral export activity are also tested. Using Spanish data they analysed both the decision to export and export intensity. They find that the probability of being an exporter is increased if the firm engages in its own R&D activity, but that the effects of R&D spillovers are negligible. However, when some interaction terms are included it appears that R&D spillovers from multinationals do exist, but benefit only other foreign firms. Similarly for export spillovers, firms in more export-orientated sectors do have a higher probability of themselves being exporters, but the specific export activities of multinationals do not appear to impact the export status of domestic firms.

Sutherland (2003) examines spillovers from foreign-owned exporters on Irish firms' export activity and export intensity. The presence of foreign-owned companies in a sector, as measured by their share of the sector employment, has a positive and significant effect on the export activity and export intensity of Irish firms. The export share of foreign firms in a sector on the other hand has a negative effect on the exporting and export intensity of the Irish firms. The first of these results, the positive effect of foreign presence, is interpreted as evidence of competition spillovers, indirectly increasing the capability of Irish firms to enter and compete on the international market. For spillovers to occur, linkages must be established between the Irish and foreign companies in a sector. If the foreign firms "are using their Irish manufacturing base almost exclusively as a platform for exporting, linkages between [Irish and foreign firms] that help to transmit information about export markets may not occur" (Sutherland, 2003).

The literature on spillovers from multinationals generally focuses on productivity effects, and only in a few instances, as above, on the possible link to export activity of domestic firms. In Ireland, with its high levels of FDI and the common assumption that at least part of its attractiveness as a location is as a base for exporting to the EU, the productivity spillovers from multinationals have generated much interest (see for example Ruane and Uğur, 2002, Ruane and Görg, 1999, and Görg and Strobl, 2000). Ruane and Uğur (2002) find some evidence of productivity spillovers, but the result is sensitive to the definition of foreign presence. Positive effects of multinationals on domestic firm survival are

found in Irish manufacturing by Görg and Strobl (2000) but only in high technology sectors, with no evidence of any spillovers to indigenous low technology firms.

On the related issue of the export intensity of firms who have already made the initial decision to export, Roper and Love (2001) find that some of the firm characteristics identified as important in the export decision papers can also impact on export intensity. For firms in the Republic of Ireland and Northern Ireland, they find higher export intensity in larger, externally owned plants with highly skilled workforces. Roper and Love's results were based on survey data from the Irish Innovation Panel, which collected information on manufacturing firms with more than ten employees from 1996-1999. The unbalanced panel included almost 900 firms in the Republic and 560 in Northern Ireland. Of these firms, export propensity was 30% in the Republic and 18% in Northern Ireland. Export behaviour of large plants was similar in both areas, but smaller firms (i.e. those with less than fifty employees) exported 10% less in Northern Ireland compared to firms with similar characteristics in the Republic. The dependent variable was export propensity (share of exports in sales), which was regressed against a range of plant characteristics (plant employment, percentage of employees with a degree, three R&D measures, plant age and foreign ownership) and sector dummies. The highest export intensity was found amongst the large, foreign owned firms, particularly those with a high percentage of graduate employees. R&D activity was positively associated with export intensity,

although the type of R&D that had an effect different according to firm ownership and size. For smaller firms both formal and informal R&D have a positive effect, for foreign firms only formally organised R&D has a significant effect. For indigenous firms, in-house R&D activity was positively associated with export intensity, whereas for foreign firms R&D activity undertaken elsewhere in the group has a greater effect. Barrios *et al.* (2001) found similar effects in their analysis of Spanish firms' export intensity.

4.3 Theoretical Model

The theoretical basis of sunk cost models was developed by Dixit (1989) and Krugman (1989), and applied empirically to the decision to enter the export market by Roberts and Tybout (1997) and Bernard and Jensen (2004b). This section outlines the model used by Bernard and Wagner (2001) and Bernard and Jensen (2004b). They in turn follow the structure of Roberts and Tybout (1997) whereby the decision to export is made in a similar way to a rational firm's decision to begin producing a new product. The profit-maximising firm makes its export entry decision based on expected profits from exporting, now and in the future, taking into account the fixed costs of entering the new market. The foreign market is treated here as a single unit.

We maintain the assumption of Bernard and Wagner (2001) that exporting experience does not impact the cost function of the firm. The costs we want to analyse are any costs that may be involved in entering the export market, for example in marketing, setting up distribution networks etc. These costs are assumed to be sunk and are incurred in full if the firm has left the export market for any period of time. It is assumed that the profit-maximising level of exports, q^*_{it} can always be produced by the firm, once it is in the foreign market. Including entry costs of N results in firm profits given by

$$\tilde{\pi}_{it}\left(X_t, Z_{it}, Y_{i,t-1}\right) = p_t q^*_{it} - c_{it}\left(X_t, Z_{it}/q^*_{it}\right) - N\left(1 - Y_{i,t-1}\right) \qquad (1)$$

Where p_t is the price of the exported goods, and $c_{it}(.)$ is the variable cost of producing the goods for the export market. Exogenous factors affecting profitability are given by X_t (e.g. macroeconomic conditions), and firm specific factors by Z_{it}. Variables that may be included in this firm specific term could include size, skill composition of labour force, productivity, product characteristics and ownership structure. If the expected profits are positive, then the firm will become an exporter. The export status of the firm i in period t is denoted by Y_{it}, where

$$Y_{it} = 1 \text{ if } \pi_{it} \geq 0 \qquad (2)$$

$$Y_{it} = 0 \text{ if } \pi_{it} < 0 \qquad (3)$$

If the firm exported in the previous period, $Y_{i,t-1} = 1$, then the firm does not have to pay any sunk cost. The firm will export if its expected profits, this time net of the sunk cost, are greater than zero, $Y_{it} = 1$ if $\tilde{\pi}_{it} > 0$.

Extending to the multiple period model, the inclusion of sunk costs provides a mechanism for current export decisions to also impact on decisions to export in the future, and also generates an option value to waiting (as in Dixit, 1989). The firm decides on a sequence of export levels, $\{q_{is}^*\}_{s=t}^{\infty}$ to maximise discounted future profits,

$$\Pi_{it} = E_t\left(\sum_{s=t}^{\infty}\delta^{s-t}\left[\tilde{\pi}_{is}\cdot Y_{is}\right]\right) \tag{4}$$

Where the profits for each period are given by the single-period expression and the firm can always choose not to export. The value function is given by

$$V_{it}(\cdot) = \max_{q_{it}^*}\left(\tilde{\pi}_{it}\cdot\left[q_{it}^*>0\right]+\delta E_t\left[V_{i,t+1}(\cdot)\middle|q_{it}^*\right]\right) \tag{5}$$

A firm will choose to export in period t if

$$p_t q_{it}^* + \delta\left(E_t\left[V_{i,t+1}(\cdot)\middle|q_{it}^*>0\right]-E_t\left[V_{i,t+1}(\cdot)\middle|q_{it}^*=0\right]\right)$$

$$> c_{it} + N_{it}\left(1-Y_{i,t-1}\right) \tag{6}$$

4.4 Empirical Model[3]

4.4.1 Specification

From the multi-period model above, the firm will enter the export market if its expected current and future profits from doing so are greater than the costs involved,

$$Y_{it} = 1 \text{ if } \tilde{\pi}_{it} > c_{it} + N(1 - Y_{i,t-1}) \quad (7)$$

$$Y_{it} = 0 \qquad \text{otherwise} \quad (8)$$

Where

$$\tilde{\pi} \equiv p_t q_{it}^* + \delta\left(E_t\left[V_{i,t+1}(\cdot)\middle| q_{it}^* > 0\right] - E_t\left[V_{i,t+1}(\cdot)\middle| q_{it}^* = 0\right]\right) \quad (9)$$

Rather than attempt to parameterise the cost function, we follow Bernard and Wagner (2001) in focusing on identifying the factors that increase the probability that a firm will be an exporter. This is estimated using a binary choice non-structural approach given by

$$Y_{it} = 1 \text{ if } \beta Z_{it} - N(1-Y_{i,t-1}) + \varepsilon_{it} > 0 \quad (10)$$

$$Y_{it} = 0 \qquad \text{otherwise} \quad (11)$$

With the vector Z_{it} denoting plant characteristics, while the residual term ε_{it} captures any other effects (such as terms of trade shocks, which would have formed part of X above). The plant characteristics that will be included in the vector Z_{it} follow those that have been found to have an impact in previous studies. They include measures of plant success, namely size (numbers employed) and productivity (output per worker), as the literature has consistently found that

[3] This section draws mainly on Bernard and Wagner (2001)

better firms are more likely to be exporters. Wages will also be included as a proxy for the skill level of the workforce, which would be expected to have a positive effect on exporting probability. A dummy for foreign ownership will be included as it is frequently assumed that the presence of foreign firms in Ireland relates to a desire to use it as an export base for the EU market. Foreign ownership should therefore have a strong positive effect on export status.

Following Aitken et al. (1997), spillover effects are included in the model by allowing the distribution costs in the foreign market for a firm to be a function of the total exporting activity in the sector to which the firm belongs, and also a function of the MNE export activity in the sector. This enables testing of different spillover effects from exporters in general and more specifically from multinationals' exports. Total export activity in the sector is denoted as Γ_{EX}, and multinational export activity as Γ_{MNE}.

4.4.2 Econometric Issues 1: Lagged Endogenous Variable

Bernard and Jensen (2004b), and Bernard and Wagner (2001) discuss the main potential problem in this estimation as being the identification of the parameter on the lagged endogenous variable. As it is possible that there are permanent and serially correlated unobserved characteristics of the firm that could be influencing its decision to export, the error term ε_{it} will be made up of two components, one of which is a permanent firm specific effect, κ_i and another transitory effect to pick up exogenous shocks, η_{it}. Given the (0, 1) nature of the dependent variable,

the estimation methods that can be used for this model include probit with random effects, and linear probability models with fixed or random effects. Roberts and Tybout (1997) use a random effects probit specification, while Bernard and Wagner (2001) and Bernard and Jensen (2004b) use both a linear probability model and probit with random effects, a methodology which will be followed here.

The linear probability framework is given initially by

$$Y_{it} = \beta Z_{i,t-1} + \theta Y_{i,t-1} + \varepsilon_{it} \tag{12}$$

and including plant effects is

$$Y_{it} = \beta Z_{i,t-1} + \theta Y_{i,t-1} + \kappa_i + \eta_{it} \tag{13}$$

Both of the linear probability specifications will be estimated in levels, using one-period lags of all plant characteristics to avoid simultaneity problems.

The random effects probit is given by

$$Y_{it} = 1 \quad if \quad \beta Z_{it-1} - \theta Y_{i,t-1} + \kappa_i + \eta_{it} > 0 \tag{14}$$

$$Y_{it} = 0 \qquad \text{otherwise} \tag{15}$$

If there are sunk costs in entering the export market, the coefficient on the previous period's export activity should have a significant and positive effect on current exporting activity. To test how quickly this effect diminishes, export status of the two previous periods will also be included.

4.4.3 Econometric issues 2: Initial Conditions Problem

There is an additional issue to be addressed in the estimation of this type of model. The 'initial conditions' problem arises when the start of the sample period is not the same as the start of the process that generates firm export decisions. The sample period begins in 1983, but many of the firms covered may have been in operation and/or exporting before this period. Whether or not a firm exports in 1983 may therefore be the result of earlier experiences or due to other observable or unobservable characteristics. The initial conditions problem is dealt with by following Heckman (1981) and specifying a reduced form equation for the initial observation:

$$Y_{i1}^{*} = \lambda' X_i + u_i \qquad (16)$$

where $var(u_i) = \alpha^2_u$, with $corr(\kappa_i, u_i) = \rho$ and X_i is a vector of exogenous instruments which includes variables relevant in period 1 and other pre-sample information[4]. To account for a non-zero ρ, a linear relationship is assumed between error components:

$$u_i = \varphi\kappa_i + \eta_{i1} \qquad (17)$$

With κ_i and η_{i1} orthogonal to one another, $\varphi = \rho\sigma_u/\sigma_\kappa$ and $var(ui1) = \sigma^2_u(1-\rho^2)$. We assume that the initial observation y_{i1} is uncorrelated with u_{it} and that u_{i1} is uncorrelated with z_{it}. The 'initial conditions' equation now becomes:

$$Y_{i1}^{*} = \lambda' X_i + \varphi\kappa_i + \eta_{i1} \qquad i = 1,\ldots N \text{ and } t=1 \qquad (18)$$

Together with equation (13) this now represents a complete model for the export decision process. It is possible to estimate this system of equations by

[4] Some versions also include the vector of means to pick up possible correlation between time-varying regressors and unobservable heterogeneity.

programming the maximum likelihood estimation, as is done by Roberts and Tybout (1997). However, a more practical two-step estimation procedure has been suggested by Orme (1997). This procedure has been implemented by Arulampalam et al. (2002) to test state dependence in unemployment and by Henley (2002) for self-employment, but has not previously been applied to the export decision. This two-step procedure involves first estimating the initial conditions probit equation (for the first year of the sample period) and then using the generalised residuals from this as a correction to the random effects probit model for the rest of the sample. The form of the random effects model under this procedure is shown by transforming equation (17), which becomes:

$$\kappa_i = \delta u_i + e_i \tag{19}$$

Where $\delta=\rho\sigma_\kappa/\sigma_e$ and $var(e_i)= \sigma_\kappa^2(1-\rho^2)$. Substitution for κ_i in the random effects probit equation gives:

$$Y_{it} = \beta Z_{i,t-1} + \theta Y_{i,t-1} + \delta u_i + e_i + \eta_{it} \qquad i = 1,\ldots N \text{ and } t = 2,\ldots T_i \tag{20}$$

Orme's method involves first estimating the reduced equation for the initial time period (equation 18). The probit error from this estimation is then used to replace u_i in a random effects probit estimation of (20). The importance of the initial conditions correction can be estimated from a standard t-test on the significance of δ.

It is important to note that when using this system including the 'initial conditions' correction, we must have all plants entering the panel at the same start time. Exit of firms from the panel is allowed but no further entry. Figure 4.3

shows that for our data this results in lower entry and exit to the export market when no new firms are entering the sample.

4.5 Data: Forfás Irish Economy Expenditures Survey

The data is taken from the annual Forfás Irish Economy Expenditures Survey covering Irish firms over the period 1983 to 1999, which is sent to all firms of over 30 employees. The survey contains information on sales, exports, employment, expenditures and ownership, amongst other things. The available data is an unbalanced panel with approximately half of the sample being exporters. Excluding those firms for which some relevant variables were missing, the final sample comprises just over 12,000 observations. For the initial conditions correction model, firms have to have a common entry date to the sample and this reduces the number of observations to just over 4500.

Table 4.1 presents some summary statistics for three years of the sample (1983, 1990 and 1998), comparing characteristics of exporting and non-exporting firms. Exporters are generally larger, both in terms of sales and employment; have much higher value added per employee and pay higher wages (except in 1983). These differences remain fairly constant throughout the sample period. Table 4.2 shows the level of persistence in firm export activity. The number of firms entering or exiting the export market is low over the entire seventeen-year period. This is not

unusual: Bernard and Wagner (2001) find similar percentages of entry and exit in their German study. Firms exporting in any period *t* are overwhelming likely to have exported in the previous period. This implies that exporting firms are significantly different from non-exporters in some way that allows them to compete internationally, or that there are sunk costs to entering the export market, generating hysteresis in firm export status.

4.6 Empirical Results

4.6.1 Sunk Costs Results

Table 4.4 presents empirical results to explain the export status of the firm, without including any firm effects or initial conditions control, and therefore can be interpreted as giving an upper bound to the measurement of sunk costs (Bernard and Jensen, 2001). All firm characteristics are lagged one period. The first column presents the results of a linear probability model, which shows a highly significant effect of past exporting experience on current export status. Export status lagged two periods is also significant but with a much smaller coefficient. The benefit to previous experience remains but diminishes over time. Sunk costs for re-entrants would therefore appear to be lower but the value of prior experience wears off the longer they have been out of the export market. However, very few firms would fall into this category of exiting and re-entering the export market so this variable should be interpreted with some caution. Sunk

costs will not be the sole determinant of such firm decisions and there may be strategic reasons for leaving the export market. This is particularly the case when there may be increased opportunities in the domestic market, which the high levels of economic growth have provided firms in Ireland. Foreign ownership and being a high-technology firm are also significant predictors of a firm being an exporter. The technology dummy is 0 for a high technology firm and 1 for a low productivity firm[5]. Its negative coefficient means low technology firms are less likely to be exporters.

Columns two and three of Table 4.4 give probit results for the estimation without firm effects; column two gives the probit coefficients and column three the changes in probability for the same model estimation. Again the influence of past exporting is high and significant. Ownership and technology have the same effects, but value-added per employee and wage per employee are also significant in the probit specification. Higher value-added per employee, indicating higher productivity in the firm, increases the probability of exporting. Wage costs have a negative impact. This is in contrast to most of the other literature where they have been used as a proxy for skill mix and typically are found to have a positive impact on being an exporter. Given that productivity is already included in the value-added per employee variable, it is perhaps reasonable to view the wage per employee as simply a cost variable, which would account for its negative coefficient.

[5] The sectoral technology dummy is based on the Davies and Lyons (1996) classification. I would like to thank Dr Ciara Whelan of University College Dublin for providing the command files for the technology classification and converting of industry codes.

Columns four and five are also probit results of coefficients and probabilities respectively, including the additional variable of employment squared. Although this variable is not in itself significant, when it is included the coefficient for employment becomes positive and significant. This would indicate the possibility of some degree of non-linearity in the relationship between size and exporting, and that larger firms are more likely to export. Other literature on sunk costs has interpreted similar results as indicating the presence of economies of scale (see Bernard and Jensen, 2001 for example).

The positive result for the impact of export history on current export activity in the results of Table 4.4 could simply be picking up some unobserved firm effects that increase the probability of exporting, such as management practices or superior technology, and thus are likely to overstate the measurement of sunk costs. Table 4.5 therefore estimates the probability of being an exporter, controlling for the unobserved firm heterogeneity, using fixed effects estimation for the linear probability model (column 1) and a random effects probit (column 2). These results confirm that past exporting is a significant determinant of the firm currently exporting, although it is worth noting that the coefficient for the linear probability model is much lower when fixed effects are used.

The exercise was repeated for Irish owned firms only, to test if these firms encountered higher sunk costs than average, as foreign owned firms would

possibly have an advantage in terms of experience of foreign markets, distribution etc. as a result of their ownership. Results are presented in Tables 4.6 and 4.7 and are in essence very similar to those found for the whole sample, in both sign and magnitude. Again the persistence in exporting activity, when controlling for other factors, would appear to support the hypothesis that some sunk costs are incurred in becoming an exporter.

Tables 4.8 and 4.9 repeat the empirics of Tables 4.4 and 4.5 using a sub-sample of the data, firms which existed in 1983. This is for comparison purposes when the initial conditions control is introduced, as it requires a common start date. Introducing the initial conditions correction, Table 4.10 presents the results for export status in 1983. The residual from these regressions are then used to adjust for initial conditions, the results of which are shown in Table 4.11. The initial conditions variable is significant, but the magnitudes and significance of the other variables are relatively unchanged.

4.6.2 Spillovers Results

Results without plant effects are presented in Table 4.12, using probit specifications with export status as the dependent variable, given a value of 1 if the firm has positive exports and 0 otherwise. Firm characteristics are found to be important determinants of whether or not the firm is an exporter. Employment is positive and significant, showing that larger firms are more likely to export. As in the sunk costs estimations, employment size can be interpreted as an indicator of

economies of scale for the firm. Higher value-added per employee is also associated with a decision to be an exporter. Again, wages per employee are found to have a negative coefficient. Foreign ownership is positively related to export market involvement, as is presence in a high technology sector.

Two measurements are used for spillovers. First, the exports from Irish and Foreign firms in the firm's sector are used to test for spillovers from exporting and if these spillovers are different from foreign owned firms. The second measure is sector size, measured by employment, for Irish and Foreign owned firms. This is to test if there are direct spillovers to export activity from foreign presence in a sector, irrespective of the level of actual exports from the foreign firms. Sector exports, regardless of whether they originate from Irish or Foreign owned firms, have a positive and significant effect on the firm's probability of being an exporter, with the positive spillover being larger from export activity of Irish owned firms in the sector. Using the sector employment measure, we find that foreign presence in a sector has a positive impact on firm export activity but a negative coefficient was found on employment in Irish-owned firms. This could be interpreted as meaning that firms in sectors with high levels of employment accounted for by Irish firms are more likely to focus on serving the domestic market. Taken together, these results could be read as indicating that decisions to export are subject to positive spillovers from foreign presence in a sector, and from the export activity of these foreign firms but spillovers from Irish firms are from exporting activity solely.

A random effects probit specification to take into account unobserved firm heterogeneity, the results of which are presented in Table 4.13. Again employment is a positive and significant indicator of the likelihood that a firm is an exporter; this time however wage per employee is positive and significant and the spillover effects are not all found to be significant. Foreign presence in terms of employment is still associated with increasing the probability of any firm becoming an exporter, but the foreign exports measure is not significant and Irish firm export activity in a sector is found to impact negatively. The finding for Irish firms' exports in this specification is inconsistent with the other results. A potential explanation for a negative coefficient could be the existence of a crowding out effect, whereby incumbent domestic exporters are fully exploiting a particular export niche. In such a situation, non-exporting firms will not find entry into the export market attractive.

Looking specifically at the export status of Irish owned firms, the results for firm characteristics remain very similar to those for the whole sample in sign and significance. Results without firm effects are presented in Table 4.14, and with firm effects in Table 4.15. Both types of estimation show positive and significant spillovers from exporting activity of both Irish and foreign owned firms on the decision to export. Positive spillovers can also be discerned from the employment measure of foreign presence in a sector. Tables 4.16 and 4.17 include both sunk costs and spillovers, using random effects probit and the initial conditions

corrections respectively. Spillovers are present as before in Table 4.16, but when the initial conditions residual is introduced in Table 4.17 this effect disappears.

4.6.3 Sector Tradability

The interpretation of the variables used to proxy sunk costs and spillovers (i.e. lagged exporting, multinational and domestic exports and employment) have so far followed those of the literature in this area, particularly Roberts and Tybout (1997) and Aitken et al. (1997). However, it is possible that these proxies are in fact picking up information on the 'tradability' of sectors. A highly tradable sector would have low trading costs, both fixed and variable, and it may not be possible to separate this empirically from low sunk costs of market entry. The same is true of our proxy for spillovers; sectors with high levels of exports and high probability of entry to exporting could be those with easily tradable products, without any necessity for the existence of informational or competitive spillovers. These explanations are not necessarily mutually exclusive – the existence and level of sunk costs would be a factor in determining how tradable a sector is – however it would widen our interpretation of the exporting experience variable to include a wider range of influences on the exporting decision.

An attempt is made in the final empirical specification to separate this issue of sector tradability from the influence of the firm's past exporting record. To do this a new variable is introduced; an index of sectors designed to capture the ease

with which they can be traded internationally. This is based on Swan and Zeitsch (1992), although the sector coverage of their study was much wider. The index values used in this paper are presented in Table 4.18. The index is constructed as a ratio of trade to production, using data from Japan and the US. The index ranges from zero (non-tradable goods) such as retail trade and government to 62 (the most tradable sector) for water transport. The most tradable sector to which firms in our sample belong is precision instruments with a tradability index of 46; the least tradable is printing with a value of 4. The lowest tradability sectors are mainly services, which are not represented in the firm survey.

The index of tradability is included in Table 4.19 and is found to have a positive and significant effect on the probability of exporting. Spillovers effects, from sector exports or size, are not present in this specification. However, past export status remains a significant determinant of current exporting. The coefficient on export status in the previous period has fallen slightly however; in this specification it is 2.71 compared to 2.89 in Table 4.17 (which uses the same specification apart from the inclusion of the tradability variable). This indicates that some information on sector tradability could have been picked up by the lagged export status variable in the earlier specifications.

4.7 Conclusions

The importance of exporting for the health of the economy necessitates an understanding of what factors determine the export decisions of firms. In particular, the issue of whether entry to the export market is characterised by sunk costs would have significant implications for understanding entry and exit patterns to exporting and for the success of government policies designed to encourage firms to export. Likewise, if the existence of spillovers from currently exporting firms could reduce the sunk costs of entry to the export market, additional positive externalities could accrue to export promotion strategies.

Sunk costs are important in market entry as they can result in transitory changes, perhaps in the exchange rate or in trade policy, having permanent effects on the export activity of firms. Sunk costs can be detected as the presence of persistence in firm exporting. This can be implemented empirically by testing if the previous export activity of the firm can be used to explain its current export status, controlling for other firm-level characteristics. Given the 0, 1 nature of the dependent variable (export/not export), the estimation methods used for this model include probit with random effects, and linear probability models with fixed or random effects.

In order to address the issue that pre-sample decisions may have effected firms' exporting in the period covered by the current data, a procedure to control for

initial conditions is also used. This two-step estimation developed by Orme (1997) has been applied to questions of state dependence in the labour market, but has not previously been used to estimate persistence in export activity. The data uses annual firm level data to examine the issues of sunk costs and spillovers in the export decision. The data is from the Forfás Irish Economy Expenditures Survey, a yearly firm-level survey. The time period covered is 1983 to 1999.

This chapter demonstrates that there is a high level of persistence in firms' export status, even when controlling for firm characteristics and unobserved heterogeneity. Past exporting experience influences current export status, and this result is robust in all specifications.

Other factors that increase the probability of a firms' participation in the export market include foreign ownership and being in a high technology sector. Value-added is another significant variable, indicating that higher productivity firms and exporting are positively linked. However, the direction of causation between productivity and exporting activity is not clear. Firm size, measured by employment, showed that larger firms are more likely to be exporters. The inclusion of initial conditions in the export decision specification was significant, demonstrating the importance of this control variable to pick up unobservable firm characteristics that influence the export decision.

Having established persistence in firm exporting, the chapter then examines if there are spillover effects from being in the same sector as other exporting firms. Given the policy focus in Ireland on exporting and FDI as factors underpinning successful economic performance, it is interesting to question the effect an export orientated sector or foreign presence in a sector can have on the export decision of other firms operating in the same sector of the economy. If spillovers increasing the probability of exporting activity exist, this could be an important consideration for any public policy geared towards encouragement of exporting activity. Spillovers could increase the probability of being an exporter by reducing the sunk cost of entering the export market. This reduction in sunk cost could come about for example through access to transport networks or information on the foreign markets.

Sector exports were found to have a positive and significant effect on the probability of the firm being an exporter. If the exports are by Irish owned firms, the spillover effect is stronger. This could indicate that there are stronger linkages or more information sharing between Irish owned firms than exists between multinationals and domestic firms. Alternatively, it could be a function of the operations of organisations such as Enterprise Ireland, which promotes the development of Irish industry with a focus on participation of Irish firms in the world market. However, when sunk costs and spillovers were tested together and initial conditions were controlled for, the effect of spillovers was no longer significant.

The final section of the chapter examines the robustness of the sunk costs and spillovers specification to the inclusion of a variable measuring the tradability of the sector. Using an index developed by Swan and Zeitsch (1992), being in a sector with a higher degree of tradability is found to positively effect the probability of a firm being an exporter. Lagged export status remains a significant variable, albeit with a rather smaller coefficient. Once again, no evidence of spillover effects is found.

The importance of persistence in the firms' export activity is a strong effect found in all variations of the empirical analysis. Some tentative evidence is initially found on the existence of spillovers, but it is not robust when sunk costs and initial conditions are also included in the specification. Throughout this chapter, the export market as been treated as a single unit, which is the approach of all the literature on sunk costs and export spillovers. The next chapter relaxes this assumption, recognising that the export market is made up of many individual countries. The export decisions of individual firms on whether to serve one or many foreign markets are examined in Chapter Five.

Figure 4.1: Growth in Employment, Sales and Exports, Firms in Forfas Expenditure Survey 1983-1999

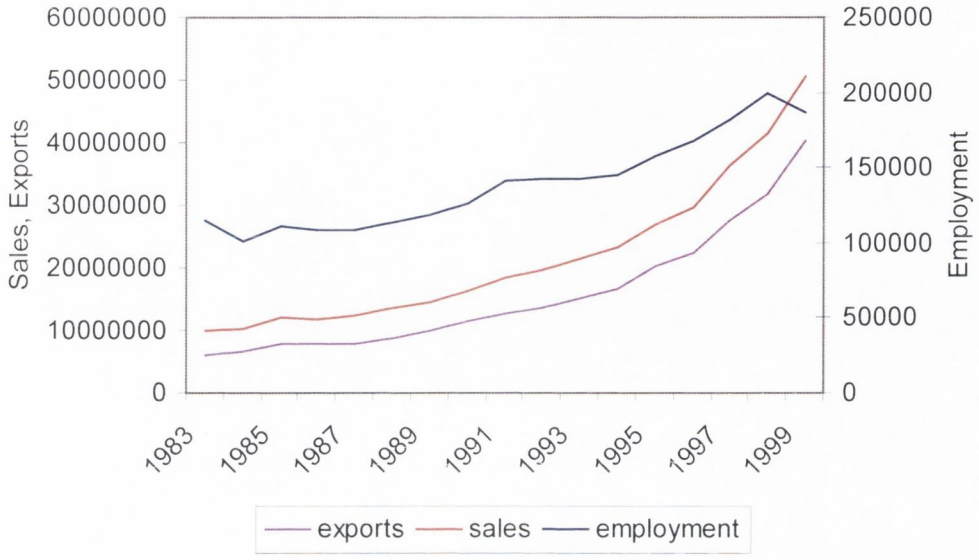


Figure 4.2: Entrants and Exitors to Exporting, 1983-1999

Figure 4.3: Entrants and Exitors to Exporting, Continuing Firms Only

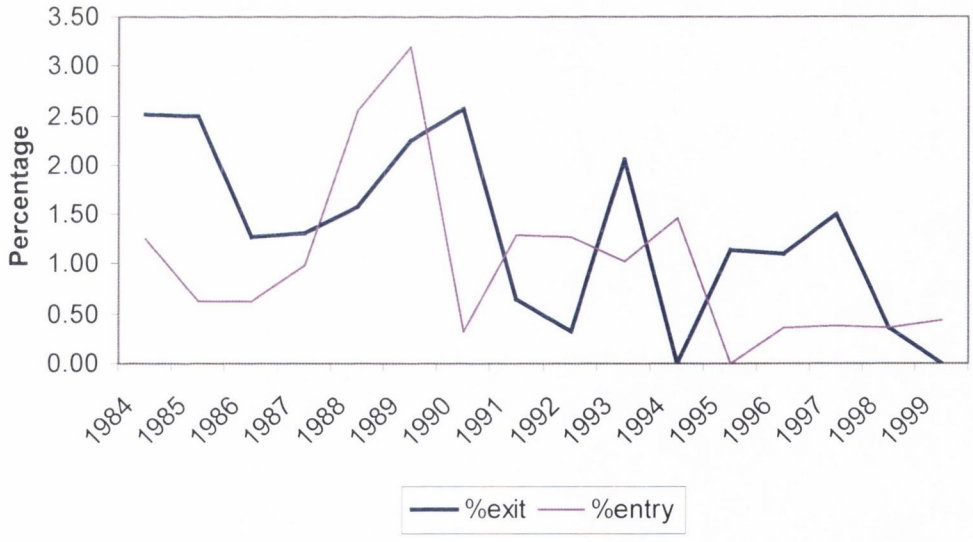


Table 4.1: Mean Values of Firm Characteristics for Exporters and Non-Exporters, 1983, 1990 and 1998

	1983		1990		1998	
	Exporters	Non-Exporters	Exporters	Non-Exporters	Exporters	Non-Exporters
Employment	170	106	144	89	141	55
Employment Growth*	0.03	-0.06	0.05	0.04	0.05	0.02
Sales	15189	7380	19153	9486	30055	7382
Wage per Employee	11.9	12.5	15.7	13.9	20.4	18.2
V.A. per Employee	8.69	1.71	22.4	3.06	41.6	30.03
Exports	10188		14360		24197	

*1983/84, 1989/90, 1997/98
All variables except employment and employment growth are in thousands of 1985 ECU

Table 4.2: Exporting Status Changes

	Total Exporters	Exitors	Entrants	Stayers
1984	471	5	10	456
1985	544	4	12	528
1986	573	2	7	564
1987	601	7	8	586
1988	662	11	12	639
1989	697	18	14	665
1990	773	5	23	745
1991	847	8	18	821
1992	1154	12	28	1114
1993	1118	21	24	1073
1994	1021	10	20	991
1995	1058	6	14	1038
1996	1188	12	23	1153
1997	1204	10	12	1182
1998	1371	7	10	1354
1999	1215	7	16	1192

Table 4.3: Export Propensity and Foreign Presence, 1983-1999

	All firms		Irish-Owned Firms		Foreign-Owned Firms	
	Export Propensity*	No. Exporters	Export Propensity	No. Exporters	Export Propensity	No. Exporters
1983	59.72	584	40.97	297	77.17	287
1984	65.54	558	44.03	272	79.77	286
1985	65.59	616	40.56	306	81.47	310
1986	64.81	620	42.36	316	80.97	304
1987	63.97	646	39.26	342	80.98	304
1988	65.80	678	40.98	355	81.99	323
1989	69.23	731	41.02	369	85.63	362
1990	69.63	800	37.94	412	87.29	388
1991	68.31	1081	38.05	601	85.22	480
1992	68.24	1103	40.27	625	83.63	478
1993	70.44	1073	42.47	611	84.41	462
1994	71.96	1034	43.39	571	85.36	463
1995	75.96	1136	47.07	638	87.26	498
1996	75.76	1189	43.10	659	87.72	530
1997	75.86	1202	41.68	668	87.79	534
1998	76.63	1316	42.54	749	87.61	567
1999	79.85	1066	41.36	574	89.13	492

*Export Propensity measures the percentage of firms that are exporters

Table 4.4: Decision to Export – Full Sample
Estimating the probability of being an exporter, no plant effects

	LP-OLS	Probit (I)		Probit (II)	
		Coefficients	Marginal Effect	Coefficients	Marginal Effect
Export status in t-1	0.757***	2.792***	0.679***	2.792***	0.6788***
	(0.0084)	(0.0904)	(0.0285)	(0.0904)	(0.0285)
Export status in t-2	0.116***	0.8319***	0.0917***	0.8303***	0.0814***
	(0.00822)	(0.0911)	(0.0162)	(0.0913)	(0.016)
Employment (t-1)	0.0000079	0.00025	0.000015	0.00043*	0.000027*
	(0.0000063)	(0.00017)	(0.000011)	(0.00026)	(0.000016)
Employment^2 (t-1)				-0.00000011	-0.000000007
				(0.0000001)	(0.000000006)
VA per employee (t-1)	0.0000069	0.00316**	0.00019**	0.00312**	0.000192**
	(0.000015)	(0.0014)	(0.00008)	(0.00139)	(0.000081)
Wage per employee (t-1)	-0.00022	-0.01326***	-0.00081***	-0.0137***	-0.00084***
	(0.00026)	(0.0044)	(0.00027)	(0.0044)	(0.000269)
Ownership	0.0024	0.2368***	0.0143***	0.2289***	0.01379***
	(0.0038)	(0.773)	(0.00456)	(0.0778)	(0.00458)
Technology dummy	-0.0305	-0.21697***	-0.0129***	-00.2188***	-0.0131***
	(0.04397)	(0.0709)	(0.00413)	(0.0711)	(0.00413)
Year dummies	Yes	Yes	Yes	Yes	Yes
Industry dummies	Yes	No	No	No	No
N	10835	10835	10835	10835	10835

Standard Errors in parentheses

*** Significant at 1% level, ** at 5% level and * at 10% level

Dependent Variable: Export status (1=exporter, 0=non-exporter)

LP-OLS is the linear probability OLS specification

Probit results (I) and (II) report coefficients and their equivalent marginal effects

Table 4.5: Decision to Export – Full Sample
Estimating the probability of being an exporter, with plant effects

	LP - FE	RE Probit
Export status in t-1	0.4697***	2.7619***
	(0.00925)	(0.0838)
Export status in t-2	0.00966	0.9275***
	(0.0086)	(0.0843)
Employment (t-1)	0.000027	0.000516**
	(0.000024)	(0.000227)
Employment^2 (t-1)	-0.000000007	-0.00000015*
	(0.0000000073)	(0.000000086)
VA per employee (t-1)	0.00002	0.000144
	(0.000027)	(0.000219)
Wage per employee (t-1)	0.00086*	-0.00339
	(0.00048)	(0.00377)
Year dummies	Yes	Yes
N	12168	12168

Standard Errors in parentheses
*** Significant at 1% level, ** at 5% level and * at 10% level
Dependent Variable: Export status (1=exporter, 0=non-exporter)
Regressions include plant specific effects
LP-FE indicates linear probability specification with fixed effects
RE Probit is a random effects probit specification

Table 4.6: Decision to Export - Irish Owned Firms
Estimating the probability of being an exporter, no plant effects

	LP-OLS	Probit		Probit	
		Coefficients	Probability	Coefficients	Probability
Export status in t-1	0.7536***	2.735***	0.73475***	2.734***	0.7344***
	(0.0112)	(0.099)	(0.0256)	(0.099)	(0.0256)
Export status in t-2	0.119***	0.8401***	0.1546***	0.8388***	0.1542***
	(0.01094)	(0.09903)	(0.0242)	(0.09906)	(0.0242)
Employment (t-1)	0.000041*	0.00027	0.000025	0.000526*	0.000068*
	(0.000023)	(0.000214)	(0.0000276)	(0.000314)	(0.000041)
Employment^2 (t-1)	-0.00000001			-0.00000014	-0.000000018
	(0.000000008)			(0.00000011)	(0.000000014)
VA per employee (t-1)	0.00031*	0.00378	0.000487	0.003778	0.000487
	(0.00016)	(0.00248)	(0.00032)	(0.00248)	(0.0003199)
Wage per employee (t-1)	-0.000176	-0.0106*	-0.00137*	-0.0116**	-0.001499**
	(0.00049)	(0.00574)	(0.00074)	(0.0058)	(0.000748)
Technology dummy	-0.0674	-0.2728***	-0.0317***	-0.2763***	-0.032***
	(0.0802)	(0.0892)	(0.009)	(0.089)	(0.00923)
Year dummies	Yes	Yes	Yes	Yes	Yes
Industry dummies	Yes	No	No	No	No
N	6006	6006	6006	6006	6006

Standard Errors in parentheses

*** Significant at 1% level, ** at 5% level and * at 10% level

As for Table 4.4, restricting sample to Irish-owned firms only

Table 4.7: Decision to Export - Irish Owned Firms
Estimating the probability of being an exporter, with plant effects

	LP - FE	RE Probit
Export status in t-1	0.4521***	2.644***
	(0.0124)	(0.09091)
Export status in t-2	0.0203*	0.9096***
	(0.0115)	(0.09091)
Employment (t-1)	0.000052	0.000347
	(0.000048)	(0.00029)
Employment^2 (t-1)	0.000000011	-0.000000096
	(0.000000012)	(0.00000011)
VA per employee (t-1)	0.00015	0.00169
	(0.00021)	(0.00197)
Wage per employee (t-1)	0.002569***	-0.00773
	(0.00089)	(0.00515)
Year dummies	Yes	Yes
N	6805	6805

Standard Errors in parentheses
*** Significant at 1% level, ** at 5% level and * at 10% level
As for Table 4.5, restricting sample to Irish-owned firms only

Table 4.8: Decision to Export - Continuing Firms Only
Estimating the probability of being an exporter, no plant effects

	LP-OLS	Probit	
		Coefficients	Probability
Export status in t-1	0.78219***	2.889***	0.688***
	(0.0128)	(0.157)	(0.0495)
Export status in t-2	0.1068***	0.715***	0.0604***
	(0.0126)	(0.16)	(0.0218)
Employment (t-1)	0.0000138*	0.000634**	0.00003**
	(0.0000007)	(0.00028)	(0.000013)
VA per employee (t-1)	0.000065	0.00297	0.00014
	(0.00006)	(0.0021)	(0.00009)
Wage per employee (t-1)	-0.000638**	-0.0166**	-0.00078**
	(0.00316)	(0.0069)	(0.00033)
Ownership	0.00588	0.275**	0.0134**
	(0.00466)	(0.1233)	(0.0061)
Technology dummy	-0.00233	-0.1304	-0.0061
	(0.0049)	(0.1328)	(0.006)
Year dummies	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes
N	4554	4554	4554

Standard Errors in parentheses

*** Significant at 1% level, ** at 5% level and * at 10% level

As for Table 4.4, excluding firms that were not in the sample in 1983

Table 4.9: Decision to Export, Continuing Firms Only
Estimating the probability of being an exporter, with plant effects

	LP - FE	RE Probit
Export status in t-1	0.558***	2.819***
	(0.0139)	(0.1454)
Export status in t-2	0.0066	0.8557***
	(0.013)	(0.1478)
Employment (t-1)	0.00087**	0.00099**
	(0.000037)	(0.000426)
Employment^2 (t-1)	-0.000000003**	-0.00000003
	(0.0000000016)	(0.000000025)
VA per employee (t-1)	0.00013	0.00259
	(0.00009)	(0.00167)
Wage per employee (t-1)	0.0013*	-0.00708
	(0.00069)	(0.0064)
Year dummies	Yes	Yes
N	4878	4878

Standard Errors in parentheses
*** Significant at 1% level, ** at 5% level and * at 10% level
As for Table 4.5, excluding firms that were not in the sample in 1983

Table 4.10: Initial Conditions Equation
Export Status in 1983

	(I)	(II)	(III)
Firm Age	-0.00729** (0.0037)	-0.0103*** (0.00389)	-0.00869** (0.0041)
Ownership	0.8912*** (0.1426)	0.8498*** (0.1476)	0.7697*** (0.158)
Technology Dummy	-0.5869*** (0.1634)	-0.6179*** (0.1657)	-0.098 (0.1857)
Sales		0.0000174** (0.0000007)	0.000034*** (0.000012)
Employment		0.003** (-0.00118)	0.0026** (0.0013)
Wages		-0.00019*** (0.000059)	-0.0002*** (0.00007)
Sector Exports			0.000016*** (0.00000024)
Sector Sales			-0.0000094*** (0.0000015)
Sector Employment			0.000084 (0.000091)
Location Controls	Yes	Yes	Yes
Sector Controls	Yes	Yes	Yes
N	647	647	647

Standard Errors in parentheses
*** Significant at 1% level, ** at 5% level and * at 10% level
Dependent Variable: Export status (1=exporter, 0=non-exporter)
Residuals from this estimation of export status in 1983 are used as controls for initial conditions in the two-step probit specification (Table 4.10)

Table 4.11: Decision to Export
Including probit residual from Initial Conditions estimation

	(I)	(II)	(III)
Export Status t-1	2.897***	2.904***	2.886***
	(0.157)	(0.1572)	(0.158)
Export Status t-2	0.7052***	0.7147***	0.6724***
	(0.1608)	(0.161)	(0.1627)
Employment (t-1)	0.00088*	0.000854*	0.00085*
	(0.00047)	(0.000477)	(0.00048)
Employment Squared (t-1)	-0.00000026	-0.000000278	-0.00000028
	(0.000000299)	(0.00000031)	(0.00000032)
Wage per Employee (t-1)	-0.01227**	-0.0106*	-0.0088
	(0.00649)	(0.00634)	(0.006)
VA per Employee (t-1)	0.00324	0.00328	0.00325
	(0.00204)	(0.00205)	(0.002)
Probit Residual (I)	1.031***		
	(0.376)		
Probit Residual (II)		0.7173**	
		(0.318)	
Probit Residual (III)			0.8325***
			(0.2396)
N	4529	4529	4529

Standard Errors in parentheses
*** Significant at 1% level, ** at 5% level and * at 10% level

Table 4.12: Spillovers in Deciding to Export
Estimating the probability of being an exporter, no plant effects

	Probit[1]	Probit[2]	Probit[1]	Probit[2]
Employment	0.001***	0.00021***	0.0011***	0.00022***
	(0.00011)		(0.000111)	
VA per employee	0.0021***	0.0004***	0.00217***	0.00043***
	(0.00052)		(0.000525)	
Wage per employee	-0.0077***	-0.00152***	-0.006**	-0.00118**
	(0.0019)		(0.00198)	
Ownership	0.7222***	0.1335***	0.6734***	0.12377***
	(0.0346)		(0.035)	
Technology dummy	-0.4398***	-0.0829***	-0.3466***	-0.643***
	(0.329)		(0.03538)	
Sector Exports (Irish)	0.00000024***	0.000000047***		
	(0.000000059)			
Sector Exports (Foreign)	0.000000083***	0.000000016***		
	(0.000000021)			
Sector Size (Irish)			-0.0000189**	-0.0000037**
			(0.0000067)	
Sector Size (Foreign)			0.0000576***	0.0000113***
			(0.00000895)	
Year dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
N	15841	15841	15839	15839

Standard Errors in parentheses

*** Significant at 1% level, ** at 5% level and * at 10% level

[1] Maximum likelihood probit coefficients

[2] Reports change in probability for a tiny change in each independent variable or discrete change for a dummy variable

Dependent Variable: Export status (1=exporter, 0=non-exporter)

Table 4.13: Spillovers in Deciding to Export
Estimating the probability of being an exporter, with plant effects

	RE Probit	RE Probit
Employment	0.0021***	0.0021***
	(0.00018)	(0.00018)
VA per employee	0.000233	0.00018
	(0.0035)	(0.000179)
Wage per employee	0.0227***	0.0248***
	(0.0035)	(0.00324)
Sector Exports (Irish)	-0.00000036**	
	(0.00000016)	
Sector Exports (Foreign)	0.000000044	
	(0.000000031)	
Sector Size (Irish)		0.000026
		(0.0)
Sector Size (Foreign)		0.000042**
		(0.000015)
Year dummies	Yes	Yes
N	18175	18173

Standard Errors in parentheses
*** Significant at 1% level, ** at 5% level and * at 10% level

Dependent Variable: Export status (1=exporter, 0=non-exporter)
Random effects probit includes plant-specific effects

Table 4.14: Spillovers in Deciding to Export - Irish Owned Firms
Estimating the probability of being an exporter, no plant effects

	Probit[1]	Probit[2]	Probit[1]	Probit[2]
Employment	0.000875*** (0.00013)	0.0026***	0.001*** (0.000132)	0.0003***
VA per employee	0.0033** (0.0011)	0.000989**	0.00287*** (0.00105)	0.00114***
Wage per employee	0.0069** (0.0026)	0.0021**	0.00954*** (0.00264)	0.0028***
Technology dummy	-0.407*** (0.0399)	-0.1099***	-0.3048*** (0.0433)	-0.084***
Sector Exports (Irish)	0.00000019** (0.0000000062)	0.000000056**		
Sector Exports (Foreign)	0.0000000145*** (0.000000036)	0.000000043***		
Sector Size (Irish)			-0.0000296*** (0.0000073)	-0.0000087***
Sector Size (Foreign)			0.000069*** (0.0000123)	0.0000204***
Year dummies Industry dummies	Yes Yes	Yes Yes	Yes Yes	Yes Yes
N	9311	9311	9309	9309

Standard Errors in parentheses
*** Significant at 1% level, ** at 5% level and * at 10% level

[1] Maximum likelihood probit coefficients
[2] Reports change in probability for a tiny change in each independent variable or discrete change for a dummy variable

Table 4.15: Spillovers in Deciding to Export - Irish Owned Firms
Estimating the probability of being an exporter, with plant effects

	RE Probit	RE Probit
Employment	0.00102***	0.0022***
	(0.00022)	(0.00024)
VA per employee	0.00326	0.0039*
	(0.00216)	(0.00217)
Wage per employee	0.00303	0.00523
	(0.00437)	(0.0041)
Sector Exports (Irish)	0.000002***	
	(0.00000039)	
Sector Exports (Foreign)	0.00000025***	
	(0.000000059)	
Sector Size (Irish)		0.0000096
		(0.000019)
Sector Size (Foreign)		0.000136***
		(0.000024)
Year dummies	Yes	Yes
N	10713	10711

Standard Errors in parentheses
*** Significant at 1% level, ** at 5% level and * at 10% level

Table 4.16: Sunk Costs and Spillovers

Estimating the probability of being an exporter, with plant effects (all firms)

	RE Probit	RE Probit
Export Status t-1	2.737***	2.7288***
	(0.0829)	(0.083)
Export Status t-2	0.9105***	0.898***
	(0.0837)	(0.0838)
Sector Exports (Irish)	-0.000000083	
	(0.000000126)	
Sector Exports (Foreign)	0.0000000665**	
	(0.0000000259)	
Sector Size (Irish)		-0.0000305***
		(0.0000117)
Sector Size (Foreign)		0.0000423***
		(0.0000113)
Employment (t-1)	0.000347**	0.000344**
	(0.00016)	(0.000165)
Wage per Employee (t-1)	-0.00196	-0.00236
	(0.0033)	(0.00334)
VA per Employee (t-1)	0.000078	0.000104
	(0.0002)	(0.00022)
Year	Yes	Yes
N	12168	12166

Standard Errors in parentheses

*** Significant at 1% level, ** at 5% level and * at 10% level

Table 4.17: Decision to Export – Sunk Costs and Spillovers
Including probit residual from Initial Conditions estimation (Continuing firms only)

	(I)	(II)
Export Status t-1	2.89*** (0.157)	2.89*** (0.1574)
Export Status t-2	0.696*** (0.161)	0.693*** (0.162)
Sector Exports (Irish)	-0.000000064 (0.00000017)	
Sector Exports (Foreign)	0.000000176 (0.000000155)	
Sector Size (Irish)		-0.0000116 (0.00002)
Sector Size (Foreign)		0.00005 (0.000039)
Employment (t-1)	0.00067** (0.00028)	0.00065** (0.0029)
Wage per Employee (t-1)	-0.00847 (0.00539)	-0.0075 (0.0055)
VA per Employee (t-1)	0.0011 (0.002)	0.00114 (0.0021)
Probit Residual (I)	0.8445** (0.396)	0.71318** (0.421)
Year	Yes	Yes
N	4529	4528

Standard Errors in parentheses
*** Significant at 1% level, ** at 5% level and * at 10% level

Table 4.18: Sector Tradability Index

Sector Description	Nace-Clio Code	Tradability
Precision instruments	371	46
Telecommunications equipment	344	39
Jewellery	491	33
Office machinery	330	26
Optical instruments	373	25
Pharmaceutical products	257	24
Electric motors	342	24
Electrical equipment for industry	343	21
Synthetic fibres	260	20
Woven materials	432	19
Secondary processing metal	313	18
Machinery & mechanical equipment	328	16
Medico-surgical equipment	372	15
Pens & other products	495	14
Electric household appliances	346	12
Household linen	455	12
Footwear	451	10
Soaps, perfumes etc	258	9
Clothing	453	8
Rubber products	481	8
Plastic products	483	8
Spare parts - motor vehicles	353	7
Machinery for building & mining	325	6
Concrete, cement	243	5
Printing	473	4

Based on Swan and Zeitsch (1992)

Table 4.19: Decision to Export – Sunk Costs and Spillovers

Including Tradability index and probit residual from Initial Conditions estimation (Continuing firms only)

	(I)	(II)
Export Status t-1	2.71***	2.71***
	(0.136)	(0.136)
Export Status t-2	0.826***	0.823***
	(0.14)	(0.14)
Sector Exports (Irish)	0.0000004	
	(0.0000012)	
Sector Exports (Foreign)	0.00000002	
	(0.00000004)	
Sector Size (Irish)		-0.00001
		(0.00003)
Sector Size (Foreign)		0.00002
		(0.00002)
Tradability Index	0.014**	0.011*
	(0.006)	(0.006)
Employment (t-1)	0.0005	0.0005
	(0.0004)	(0.0004)
Wage per Employee (t-1)	-0.009*	-0.009*
	(0.005)	(0.005)
VA per Employee (t-1)	0.0019	0.002
	(0.001)	(0.001)
Probit Residual (I)	1.34***	1.27***
	(0.377)	(0.392)
Year	Yes	Yes
N	5769	5769

Standard Errors in parentheses

*** Significant at 1% level, ** at 5% level and * at 10% level

Chapter 5

Examining the Geographic Market Coverage of Irish Firms' Exports

5.1 Introduction

The aim of this chapter is to extend the analysis of the geographic dimension of trade by examining the trading patterns of individual Irish firms. Ireland is known as a highly specialised economy, the bulk of exports coming from a relatively narrow range of products, as examined in Chapter 2. However, changes in geographic specialisation have not received as much attention, and there has been no prior study of this aspect of trade at the firm level. This gap in the literature is primarily due to an absence of firm level data containing detailed information of export destinations. Utilising a new firm survey carried out by Forfás, the determinants of export participation and market coverage of Irish firms are explored in this chapter.

The previous chapter addressed the issue of the existence of sunk costs in entering the export market. Significant evidence of sunk costs was found, based on the observed persistence of export activity and the explanatory power of previous

exporting experience on current export status. These findings are in line with a number of studies on firm decisions to export; for example Roberts and Tybout (1997), Bernard and Jensen (2004b) and Sutherland (2003). The shortcoming of this research is that the export market is treated as a single entity. With multiple export markets, one must ask if experience of exporting to one market reduces the cost of entering further export markets. *A priori,* it would appear sensible to suggest that sunk costs of entering a new market would be reduced if the firm already had exporting experience, particularly if it was already exporting to a similar or neighbouring country.

Changes in market orientation have been observed at the aggregate trade level. For example, for much of its history, Ireland's trade relied heavily on the UK as a destination market (see for example Gallagher and McAleese, 1994). Table 5.1 shows the decline in the pre-eminence of this market, although it remains one of Ireland's largest trading partners.

This chapter presents an analysis of the geographic dimension of trade. It does so by examining the trading patterns of individual Irish firms. Aggregate data does not tell us if a sector is geographically diversified because there are many exporting firms each of which specialises in a separate destination, or if the firms themselves are selling their exports in many markets. This analysis is made possible by access to a new survey dataset of Irish firms compiled by Forfás,

which includes detailed information on firm characteristics and on the destinations of their exports.

The paper is organised as follows. Section 5.2 reviews some literature on destination of trade. Section 5.3 introduces the data sources. Section 5.4 looks at firm-level export destination specialisation or diversification and its determinants. Section 5.5 concludes and indicates further work to be done in this area.

5.2 Literature Review

Evenett and Venables (2001) present a decomposition of the growth of exports of twenty-four developing countries comparing export products and destination markets in 1970-74 and 1993-97. They find that across all countries, it is extremely unusual for a country to drop the exportation of any product line and that exports to existing trading partners account for approximately half of all export growth. The extension of an existing product line to a new geographic market accounts for around one-third of export growth, with the contribution being made by the introduction of new products averaging ten percent of growth. The 'geographic spread of trade' of a product to a new market is more likely if the exporting country already exports to a country close-by the new market, something Evenett and Venables refer to as "distance to the supply frontier", which they use to enhance the usual gravity model distance variable.

Evenett and Venables attribute the importance of this supply frontier distance to "the effect of information acquisition by exporting firms about potential new foreign markets". Once a firm has made the initial decision to export and has learnt about the costs and opportunities of trading in its destination market, it may find that this knowledge also applies to other similar or neighbouring markets, encouraging the firm to expand the geographic coverage of its exports.

The importance of the geographic dimension of trade has also been raised in a shift-share analysis of Irish exports for the 1970s and 1980s. O'Donnell (1998) found the market destination effect in her analysis on export growth varied over time, depending to a large extent on whether the UK, Ireland's largest export market, was growing faster or slower than the world average.

Although this paper focuses on the geographic spread of exports from firms who are already exporting, some aspects of the decision to export literature are relevant. Although this literature is dealt with in detail in Chapter Four; some of the salient points will be reviewed here. The initial decision of the firm to enter the export market has been the topic of a number of papers e.g. Bernard and Jensen (2004b) on exporting activity in the US, and Roper and Love (2001) on export intensity of Irish firms. The decision to begin exporting will be taken, as would any decision by a rational profit-maximising firm i.e. if the benefits from the activity exceed the costs. The factors influencing entry into new export

destinations are likely to be similar to those affecting the initial decision to become an exporter. These can be classified as characteristics reflecting the factor endowments of a firm and those related to its level of technology and the quality of its products (Roper and Love, 2001).

The question of whether sunk entry costs exist in becoming an exporter seems to be answered positively by Bernard and Jensen (2004b), who found that exporting in the previous period substantially increases the probability of being an exporter in the next period, although some firms do transfer in or out of the export market. For the current purposes, it seems natural to assume that such sunk costs exist in the decision to enter each new market but that they may be reduced if the firm has experience of already supplying a similar market. Relating exporting activity to firm characteristics finds that exporters tend to be larger, pay higher wages and have higher productivity (Bernard and Jensen, 2004b).

The impact of geographic dispersion of exports at the firm level has received little investigation to date, due largely to the scarcity of the necessary data. At this time, only two papers have been able to address issues related to the geographic coverage of a firm's exports. Eaton, Kortum and Kamarz (2004), using French data for 1986, find great heterogeneity in firms' export participation. Most firms sell only in the domestic market, and for the exporters they find that the modal firm exports to a single market, and only a small fraction of firms exports to a

large number of markets. This pattern holds across all sixteen industries in the data.

Damijan, Glažar, Prašnikar and Polanec (2004) assess the impact of productivity on export and outward-FDI decisions made by Slovenian firms over a nine-year period. As in other studies, significant sunk costs are found for firms entering the export market, but these prove less of an obstacle for higher productivity firms. The number of markets exported to is greater for firms that are more productive. Changes in market coverage occur slowly, the typical increase in destination markets is one per year. High productivity is also a key determinant of a firm's decision to invest (outward-FDI) in other countries.

The only existing analysis on Irish firm-level decisions to export, by Sutherland (2003) found significant sunk costs exist in entering the export market. She also had data available on whether firms exported to the UK, EU or elsewhere. This allowed her to test differences in the levels of sunk costs for entry to the UK market compared to other exports. Entry costs for Irish firms to the UK market were found to be significantly lower than the average sunk cost of exporting (i.e. the coefficient on lagged export status was lower for exporting to the UK compared to exporting in general).

The growth of Ireland's exports has been heavily influenced by the presence of many foreign-owned firms, raising some questions as to the performance and

competitiveness of indigenous companies. This chapter does not address the issue of any differential in performance associated with ownership. The data on destination of exports is available only for Irish-owned firms. Apart from the data constraint, the very existence of a perceived performance differential can justify an analysis specifically looking at the Irish-owned group of firms.

A topic of related interest, the impact of corporate location diversification (in terms of plant ownership in different countries) on firm value found being internationally active had a positive effect (Bodnar *et al.* 1997). Although the type of international activity they analysed (FDI) is different from the subject of this paper (exporting), their finding of a positive effect on firm value might give an *a priori* expectation of a similar positive effect of geographic export spread on firm performance. Geographical diversification in terms of ownership of plants in different countries has also been examined by Barry and Pavelin (2003). Using a sample of the largest firms in the EU, they find a significant increase in the proportion with operations in more than one country between 1987 and 1993. High R&D and advertising intensive firms are the most likely to be multinational in their operations.

The model used is based on the empirical decision to export model presented in the previous chapter, where a firm treats the decision to export as analogous to producing a new product. Exporting will take place if the revenues received

exceed the costs involved, including any sunk cost of market entry. Firm export status Y_{it} equals one if the firm is an exporter.

$$Y_{it} = 1 \qquad if \quad \beta Z_{it} - N(1 - Y_{i,t-1}) + \varepsilon_{it} > 0$$
$$Y_{it} = 0 \qquad otherwise$$

Where Z is a vector of plant characteristics. The addition to this standard model in the case of multiple export markets was suggested by Sutherland (2003) and it allows the sunk costs element to differ across markets:

$$N_{itd}(1 - Y_{itd-1})$$

Where d is the destination market. Unfortunately the short time span of the current data, described in the next section, does not allow us to explicitly test this sunk-cost hypothesis by analysing the time persistence of exporting. We can however test the explanatory power of various firm characteristics on the number of markets a firm exports to, given its export status.

5.3 Data – Enterprise Ireland Firm Survey

The firm-level data comes from a survey of Irish-owned manufacturing firms carried out by Enterprise Ireland in 2000 and made available by Forfás. This is the first survey to include detailed information on the destinations of firm exports[1]. The sample size consists of 1087, firms of whom 776 are exporters.

[1] A similar survey covering foreign-owned firms was undertaken by the IDA, but unfortunately does not include the relevant question on detailed export destination.

The survey includes information on various firm characteristics such as employment, inputs, wage costs, R&D spending, as well as export sales and the breakdown of countries to which the firm exports.

This survey of Irish indigenous manufacturing covers firms of over 25 employees. It is the only data of its kind that questions firms on the exact destination of their exports. The survey covers 1999, 2000 and 2001 for firm characteristics and for 2000 and 2001 includes the destination of exports question. The information on firm characteristics available for 1999 allows us to lag these explanatory variables without losing any of the export data we are particularly interested in. The variables included are: employment, domestic sales, exports, goods distributed but not manufactured by the firm, internet sales, total sales, wage costs, cost of materials, percentage of raw materials sourced in Ireland, percentage of raw materials sourced elsewhere in the EU, materials purchased via the Internet, services, percentage of services from Irish providers, percentage of services from the EU, and other expenditure. The data has been deflated to 1985 ECU.

Additional data on the number of sectors a firm operates in was obtained from a directory of Irish firms available via the Internet. The website www.Irishmanufacturing.com survey gives information on the products manufactured by each firm. These were then matched to the Forfás data. This product coverage variable is available for approximately 400 of the firms in the sample.

Figure 5.1 shows that the relationship between export intensity and number of markets covered is non-linear. Although firms with low export intensity tend to export to few markets, high export intensity is observed for a wide range of market coverage outcomes. Figure 5.2 enlarges the lower left-hand section of Figure 5.1 (area closest to the origin); this covers export intensity less than 45% and market coverage below ten. The lowest levels of market cover are associated with all levels of export intensity; for higher market coverage, observations become fewer and more dispersed in relation to export intensity.

The distribution of firms according to the number of markets they serve is graphed in Figure 5.3. As was found by Eaton, Kortum and Kamarz (2004), a large number of firms serve only the domestic market (market coverage = 1), and many exporting firms export to a single foreign market. In the French data this single destination was usually Belgium, for Irish firms it is the UK. The number of markets covered declines quite steeply, with only a small number of firms exporting to many markets. This pattern applies broadly across sectors, as shown in Figure 5.4.

The percentage of firms exporting to any individual market appears to decline in line with the distance of the market from Ireland, as would be expected from standard gravity model predictions of trade. Table 5.2 shows that over three-quarters of Irish exporting firms sell to England, 60 percent export to Northern

Ireland and almost a third export to France and/or Germany. In contrast, less than five percent of exporters sell to markets such as Brazil or Malaysia. The exception to this geographic distance rule is the US, with slightly more than 30 percent of Irish exporters selling to this market.

Geographic distance also plays a role in the dependence of firms on an individual market. Firms that export to only one market usually export to closer destinations. These are typically part of the UK or EU, although some firms also send all their exports to the US, as shown in Table 5.3. This could indicate that firms do not extend exporting activity to more distant markets without some initial export experience, although this is difficult to test without a longer time dimension to the data.

Chapter Four examined the entry and exit of firms to and from exporting, and found extremely high levels of persistence in firm export status. Only a small percentage of firms switched between production purely for the domestic market and exporting in any given year. The current dataset of Irish owned firms in 2000 and 2001 shows the same pattern, with only two firms withdrawing from the export market and no entrants.

However, Table 5.4 shows that this observed persistence in export status hides a much more dynamic picture when it comes to the market coverage of current exporters. Quite a large number of exporters increase or decrease their market

coverage over these two years. Approximately 16 percent of exporters increased their number of export destinations, while slightly fewer, 15.5 percent, decreased market coverage. Of these, most increased or decreased market coverage by one market. This was also found to be the case by Damijan *et al.* (2004), with firms gradually changing export patterns over time by one or two markets per year. Only a tiny number of firms changed their market coverage by more than five destinations.

Average export intensity increased for the sample, from just under 29 percent in 1999 to over 30 percent in 2001, as shown in Table 5.5. The average changes in export intensity at the firm level are small. Firms that increased export intensity had an average change of just over half a percent in 2000; those reducing export intensity did so with an average of –0.16 percent. Table 5.6 shows the distribution of exporters by how much they changed their export intensity. As with changes in market coverage, changes in export intensity appear primarily gradual, with few firms dramatically increasing or decreasing intensity in a single period.

We follow Sutherland (2003) and Ruane and Sutherland (2004) in testing the impact of exporting on a range of firm characteristics to examine the presence of an export premium[2]. Table 5.7 contains the results of regressing export status (a

[2] I.e. the existence of a positive relationship between exporting and other firm characteristics such as size or productivity

dummy variable equal to 1 if the firm is an exporter, and 0 if a non-exporter) on firm employment, sales, sales per employee, average wage, value added and value added per employee. All are OLS regressions of logged characteristics, and contain year and sector controls. For all firm characteristics, a positive and significant relationship is associated with being an exporter. Exporters are therefore typically larger, more productive and pay higher wages; these results are consistent with those found elsewhere in the decision to export literature.

Table 5.8 extends this exercise by substituting market count as the dependent variable, thereby testing if there is any relationship between firm characteristics and selling to a greater number of markets. The count of markets includes Ireland, so firms selling only in the domestic market have a count measure of one. Again all the results are positive and significant. However, the magnitudes of the coefficients are slightly smaller. Table 5.9 presents results examining the proposition put forward by Sutherland (2003) that firms exporting solely to the UK have a lower export premium. This is found to be the case for most firm characteristics, with the exception of average wage and value added per employee.

5.4 Results

The firm's export specialisation is first measured by a count of the markets to which it exports, and the percentage of a firm's exports that go to its largest market. A weakness of these measures is that they do not tell us if the firm has one main market and a number of smaller markets or if it exports equally to all its identified destinations. To adjust for this a weighted measure of geographic market concentration is used, equivalent to a Herfindahl (HH) index of industrial concentration. In this instance, it measures the squared shares of each destination market in the exports of a given firm. Therefore, a HH of 1 would indicate that the firm exports to only one country, in other words that it is completely specialised geographically. HH measures close to zero indicate a great deal of diversification by the firm, with no destination being dominant.

We use a Heckman selection model to empirically test the determinants of export diversification, given that a firm is already an exporter. Selection into exporting is estimated first, followed by the extent of the firms exports, which are measured in a number of ways in the different specifications. The first specification tests firm market coverage, and the results are presented in Table 5.10. The selection into exporting column is the first stage of the regression and tests the determinants of the firm's export status. We find that larger, older firms that spend more on R&D and on average wages are those most likely to export. Domestic sales,

which are included only in the selection equation[1], have a negative effect. Given the selection into exporting, we find that larger firms export to more markets. Age however has a different effect in the market coverage equation with younger firms exporting to more markets. It is likely that this effect is due to many older traditional firms being reliant on the UK as an export market. High technology firms are also more likely to export to a greater number of markets, although technology level did not effect the selection into exporting. R&D intensity is positively associated with greater market coverage, as well as with the exporting decision.

An alternative measure of export specialisation or diversification is the Herfindahl index. The results in Table 5.11 are similar for the export selection equation. The Herfindahl results show larger firms are more diversified in their exporting, while older and low technology firms are more specialised. R&D expenditure has no effect on the market diversification in this specification, although it was still significant and positive for entry to the export market. Greater dependence on a single export market is associated with smaller, low technology firms, as demonstrated in Table 5.12. Table 5.13 specifically tests exports to the UK, the most common export market. The only significant variable is the dummy for low technology firms, which is strongly associated with higher exports to the UK. The specification using export intensity is in Table 5.14. Larger firms are more

[1] It is necessary to have at least one different variable in the selection equation for econometric identification purposes.

export intense, as are younger and more high technology firms. R&D also has a positive effect on the export intensity.

Table 5.15 again uses market coverage as the dependent variable. This time a new variable is included: the firm's product coverage, which was available for a subset of the firms. Figure 5.5 shows the distribution of product counts for the firms. Most firms produce in between one and six sectors, followed by a sharp drop, with only a small number of firms producing a greater range. The product coverage variable is significant in the selection into exporting, with more specialised firms more likely to be exporters. Once selection is controlled for however, there is no relationship between product and market coverage. This supports the findings of Lefebvre and Lefebvre (2000) who find specialisation positively related to exporting. The same was true if product coverage was included in the specifications for the other measures of export activity.

Thus far, we have looked at the geographic dispersion of firms' exports and associated them with firm-specific characteristics without considering the impact of characteristics of the destination markets. Table 5.16 presents some preliminary estimates of three destination characteristics (geographic, market size and income), which economic theory would suggest are important in export decisions.

The first column of Table 5.16 regresses firm market coverage on dummy variables for the regions to which the firm exports. As in a gravity model, these regional variables can be thought of as proxies for trading costs, with closer markets assumed to be more accessible. Some tentative support for this may be found in so far as the coefficients on market coverage are higher for distant regions, indicating that only firms with high levels geographic diversification export to regions such as the Middle East or to Asia.

The lower coefficients on the UK and EU-15 would mean firms exporting to markets in these regions might not have as wide a level of market coverage. In other words, in general firms exporting to a small number of markets will tend to export to geographically close markets, whereas only firms with a wide portfolio of export markets will export to more distant regions. This relationship between market coverage and distance has exceptions however, most notably the low coefficient on America, although this is easily explained by the strong economic and cultural ties existing between Ireland and the US, which make it an attractive market for Irish firms. The coefficient on 'Other Europe' does not fit in with this explanation of distance proxying costs of trading; however this may be due to the relatively recent opening up of these economies and it would be interesting to test this with data from after the EU accession of many of the countries in this bloc.

Market size would be expected to be a major factor in a firm's decision to export to any individual country. To estimate this, the countries are divided into six

groups by size of population, and the firm's overall market coverage is regressed against the number of markets it exports to in each size category.

Something of an inverted-U shape relationship is evident with low coefficients for coverage of small and large countries but higher overall market diversification associated with exporting to medium sized markets (i.e. those with populations between 50 and 100 million). This middle category includes several of the large EU countries (England, Italy, France and Germany), which Irish firms are most likely to send exports. A negative coefficient is found on the group with the largest population size (over 1000 million). This group comprises China and India; to which less than 3% of the sample firms export (see Table 5.2). Although we would expect larger markets to attract more exporting firms, this pattern holds only to up to a point.

Market size may be an important consideration, but a wealthy medium-sized market many prove a much more desirable destination for a firm's exports than one where a large population is combined with low income. The pattern in the third column of Table 5.16 presents the results of firm coverage of markets in different income bands (measured as GDP per capita). Greater market coverage is associated with coverage of higher income markets; higher income can be translated into greater demand and this makes a market more attractive to an exporter. These results indicate that market characteristics, as well as firm characteristics, play an important role in the diversification of exports across

geographic markets. Investigating this further could prove to be an interesting avenue for further research.

5.5 Conclusions

This paper looked at the geographic dimension of trade for Ireland using a unique firm level dataset. This contained detailed export destination information at the firm level for Irish owned firms. While Chapter Four found evidence of sunk costs associated with entry into exporting, it assumed the export market was a single market. In reality, the export market comprises many different countries, all of which may be thought of as separate markets. A firm makes a new export decision to enter each of these markets.

With multiple export markets the issue of sunk costs becomes one of whether experience of exporting to one market reduces the cost of entering further export markets. It is possible that the sunk costs of entering a new market are a function of the number of markets already being exported to by the firm. Having built up exporting experience in a number of markets could make expanding into an additional market less costly, particularly if the firm was already exporting to a similar or neighbouring country.

As the data only spanned two years, it was not possible to test this sunk-cost hypothesis by analysing the time persistence of exporting. Instead, this chapter examined the effect of various firm characteristics on the geographic specialisation or diversification of individual firms. We find that a large number of firms serve only the domestic market and many exporting firms export to a single foreign market. The persistence in export status examined in Chapter Four is present in this data, with almost no entry or exit to exporting. However, a large number of exporters are found to change their market coverage over these two years. Approximately 16 percent of exporters increased their number of export destinations, while slightly fewer, 15.5 percent, decreased market coverage. Of these, most increased or decreased market coverage by one market.

A Heckman selection model was used to control for the export status of the firm. The selection estimation for being an exporter found that larger, older firms that spend more on R&D and on average wages, are those most likely to export. The measures of market coverage used are the count of export destinations and a Herfindahl index to measure market specialisation. One of the main findings is that larger firms are more likely to export, and once in the export market they have greater levels of market coverage. The existence of a dominant market for exports has a negative relationship with firm size. The age of the firm has a different effect in the market coverage equation compared to the export status equation. While older firms were more likely to export, younger firms export to more markets. It is likely that this effect is due to many older traditional firms

being reliant on the UK as an export market. High technology firms are also more likely to export to a greater number of markets, although technology level did not effect the selection into exporting. R&D expenditure was significantly and positively associated with selection into exporting in all specifications. However, its effect on market coverage is not as clear; it was significant in two cases – increasing the count of markets and export intensity – but not the Herfindahl concentration measure or percentage exported to a single market.

Looking at some market characteristics, firm export diversification is associated with market size and income. Distance also plays a role, with more diversified firms more likely to be exporting to regions outside of the UK and EU. Further examination of these characteristics and interactions between them would be a useful extension of this thesis.

Table 5.1: Destination of Aggregate Manufactured Exports (Percent)

	UK	Europe: ex UK	USA	Other
1960	75	6	8	11
1970	62	11	13	14
1980	43	32	5	20
1990	34	41	8	17
1999	22	43	15	20
2003	18	42	22	18

Source: CSO (2004)

Table 5.2: Percentage of Exporters Exporting to each Destination

	2000	2001		2000	2001
Northern Ireland	60.5	60.7	Chile	1.9	1.8
England	75.6	75.9	Argentina	1.9	2.1
Scotland	23.5	24.2	South Africa	7.2	6.6
Germany	33.4	33.4	Algeria	0.9	1.0
France	31.5	31.3	Egypt	3.1	3.0
Netherlands	26.1	26.0	Morocco	1.3	1.2
Belgium	21.0	21.1	Nigeria	2.2	2.2
Italy	19.2	19.1	Kuwait	2.1	1.8
Denmark	17.9	17.1	Saudi Arabia	4.5	4.3
Greece	7.2	6.6	Jordan	1.8	1.7
Spain	18.5	19.1	Tunisia	0.3	0.4
Portugal	10.5	10.5	UAE	6.3	6.0
Austria	8.5	8.0	Israel	6.8	5.6
Finland	9.2	9.2	Lebanon	2.2	2.2
Sweden	16.3	16.3	China	2.7	3.0
Norway	11.2	10.3	S. Korea	3.2	3.5
Switzerland	10.7	9.7	Hong Kong	5.2	4.7
Russia	5.3	4.7	Philippines	2.8	3.1
Hungary	4.0	3.8	Japan	9.9	9.3
Czech Rep.	5.0	4.5	Malaysia	3.7	4.0
Slovakia	2.2	1.8	Singapore	4.1	3.8
Turkey	5.0	5.0	Taiwan	3.2	3.4
Poland	7.0	7.4	Thailand	2.8	2.6
Slovenia	1.9	1.9	Pakistan	1.5	1.6
USA	30.2	30.4	Australia	7.6	7.2
Canada	9.9	9.4	India	2.6	2.7
Mexico	2.5	3.2	New Zealand	4.9	5.3
Brazil	3.1	3.4			

Explanatory note: This table presents the frequency with which destinations appear in the firm export data e.g. 60.5% of exporters sent some of their exports to Northern Ireland in 2000; 4.9% of exporters had New Zealand as one of their destinations

Table 5.3: Maximum Percentage of Exports from any Firm in Sample to each Destination

	2000	2001		2000	2001
Northern Ireland	100.0	100.0	Chile	26.2	26.6
England	100.0	100.0	Argentina	9.7	3.9
Scotland	100.0	100.0	South Africa	13.0	84.4
Germany	100.0	100.0	Algeria	16.9	35.5
France	99.7	100.0	Egypt	22.8	24.4
Netherlands	100.0	100.0	Morocco	1.7	2.6
Belgium	78.9	100.0	Nigeria	38.7	60.8
Italy	65.8	67.7	Kuwait	5.3	4.7
Denmark	97.6	43.9	Saudi Arabia	40.0	33.8
Greece	50.0	46.7	Jordan	3.9	3.1
Spain	100.0	100.0	Tunisia	0.2	0.2
Portugal	100.0	100.0	UAE	18.4	11.6
Austria	50.0	50.0	Israel	69.5	57.4
Finland	100.0	100.0	Lebanon	4.3	1.3
Sweden	93.3	92.5	China	57.0	50.0
Norway	100.0	88.9	S. Korea	53.3	53.3
Switzerland	51.4	89.4	Hong Kong	81.8	83.3
Russia	32.5	37.6	Philippines	80.0	66.7
Hungary	14.3	8.7	Japan	92.4	92.6
Czech Rep.	17.1	4.7	Malaysia	40.5	47.6
Slovakia	3.5	4.7	Singapore	30.0	30.0
Turkey	14.0	15.2	Taiwan	17.5	10.0
Poland	31.2	31.2	Thailand	11.2	9.6
Slovenia	6.0	7.7	Pakistan	18.3	17.9
USA	100.0	100.0	Australia	34.1	18.2
Canada	50.0	41.7	India	15.0	16.5
Mexico	8.0	10.0	New Zealand	9.9	8.6
Brazil	36.3	40.4			

Explanatory note: This table gives the percentage of exports to each destination from the firm with the highest export share to that country. This indicates that there are exporters in the sample exporting exclusively to one market (e.g. 100% of some firms' export sales are to England), and also shows the markets on which no individual exporter is reliant (e.g. Slovakia accounts for at most 3.5% of any firms' exports)

Table 5.4: Number of Firms Changing Market Coverage

Exporters and Non-Exporters in the Sample				
	2000	*2001*		
Exporters	775	773		
Non-exporters	312	314		
Firms in sample	1087	1087		
Firms Changing Number of Export Markets				
Increased markets		124	(16% of exporters)	
Decreased markets		120	(15.5% of exporters)	
Number of Firms by Change in Export Markets				
Export Market Change	*No. of Firms*		*Export Market Change*	*No. of Firms*
Increase by 1	74		Decrease by 1	54
Increase by 2	31		Decrease by 2	30
Increase by 3	7		Decrease by 3	14
Increase by 4	6		Decrease by 4	5
Increase by 5	1		Decrease by 5	8
Increase by 6	1		Decrease by 6	3
Increase by 7	2		Decrease by 7	2
Increase by 8	0		Decrease by 8	2
Increase by 9	1		Decrease by 9	0
Increase by 10	0		Decrease by 10	2
Increase by 11	1		Decrease by 11	0

Table 5.5: Changes in Export Intensity

	1999	*2000*	*2001*
Mean intensity	28.78	29.23	30.14
No. firms increasing intensity		403	453
No. firms decreasing intensity		329	262
Average change in intensity		0.226	0.174
Average change *For firms increasing intensity*		0.566	0.349
Average change *For firms decreasing intensity*		-0.160	-0.089

Table 5.6: Magnitudes of Export Intensity Changes

	Number of firms:		*Percentage of exporters*	
	99-00	*00-01*	*99-00*	*00-01*
Increase>1%	349	374	0.45	0.48
Decrease>1%	279	175	0.36	0.23
Increase>5 %	274	286	0.35	0.37
Decrease>5 %	198	117	0.26	0.15
Increase>10 %	208	218	0.27	0.28
Decrease>10 %	153	70	0.20	0.09
Increase>20 %	149	135	0.19	0.17
Decrease>20 %	92	34	0.12	0.04
Increase>50%	79	62	0.10	0.08
Decrease>50%	27	5	0.03	0.01
Increase>100%	36	25	0.05	0.03
Decrease>100%	0	0	0.00	0.00

Table 5.7: Export Premium Test

	Ln (Employment)	Ln(Sales)	Ln(Sales/ Employee)	Ln(Average Wage)	Ln(VA)	Ln(VA/ Employee
Export Premium	0.5166*** (0.051)	0.7439*** (0.0679)	0.2203*** (0.038)	0.098*** (0.025)	0.7529*** (0.0693)	0.2302*** (0.0396)
Year, Sector controls	Yes	Yes	Yes	Yes	Yes	Yes
No. Observations	2168	2166	2163	2162	2147	2144
R-sqrd	0.05	0.058	0.017	0.014	0.058	0.018
F-Test	37.93***	44.09***	12.61**	10.18***	44.18***	13.38***

Standard Error in parentheses
*** Significant at 1%, ** significant at 5%, * significant at 10%

Table 5.8: Market Coverage Test

	Ln (Employment)	Ln(Sales)	Ln(Sales/ Employee)	Ln(Average Wage)	Ln(VA)	Ln(VA/ Employee
Ln(Market Count)	0.3601***	0.5189***	0.1566***	0.0701***	0.4919***	0.1399***
	(0.0227)	(0.0302)	(0.017)	(0.0116)	(0.0286)	(0.0156)
Year, Sector controls	Yes	Yes	Yes	Yes	Yes	Yes
No. Observations	2168	2166	2163	2162	2076	2074
R-sqrd	0.108	0.125	0.038	0.024	0.128	0.038
F-test	87.34***	102.9***	28.67***	17.43***	101.6***	27.27***

Standard Error in parentheses
*** Significant at 1%, ** significant at 5%, * significant at 10%

Table 5.9: Export Premium and UK Dependence Test

	Ln (Employment)	Ln(Sales)	Ln(Sales/ Employee)	Ln(Average Wage)	Ln(VA)	Ln(VA/ Employee
Export Premium	0.627***	0.876***	0.2413***	0.1132***	0.8819***	0.2476***
	(0.054)	(0.0723)	(0.041)	(0.0269)	(0.0737)	(0.0424)
UK-only exporter	-0.316***	-0.377***	-0.0599	-0.043	-0.369***	-0.0498
	(0.0548)	(0.073)	(0.0411)	(0.027)	(0.0748)	(0.0429)
Year, Sector controls	Yes	Yes	Yes	Yes	Yes	Yes
No. Observations	2168	2166	2163	2162	2147	2144
R-sqrd	0.064	0.069	0.018	0.015	0.069	0.02
F-test	37.16***	40.10***	9.99***	8.27***	39.59***	10.38***

Standard Error in parentheses
*** Significant at 1%, ** significant at 5%, * significant at 10%

Table 5.10: Heckman Selection Model for Market Coverage

	Ln(Market Coverage)	Selection into Exporting
Employment	0.17557***	0.5305***
	(0.0307)	(0.07339)
Age	-0.0746*	0.2039***
	(0.0412)	(0.0675)
R&D	0.0353**	0.051*
	(0.018)	(0.0297)
Training	-0.0385**	-0.0177
	(0.0193)	(0.0333)
Average Wage	0.0168	0.328***
	(0.0582)	(0.118)
Low Technology Dummy	-0.3238***	-0.012
	(0.071)	(0.131)
Domestic Sales		-0.344***
		(0.0492)
Year Control	Yes	Yes
Industry Control	Yes	Yes
No. Observations	842 (c=134, u=708)	
P	-0.6838 (0.0639)	
Λ	-0.566 (0.0623)	
LR test of indep. eqns. (ρ=0)	$\chi2$ (1) = 29.88	Prob> $\chi2$ = 0.000
Wald Test	$\chi2$ (8) = 61.26	Prob> $\chi2$ = 0.000

Standard Errors in parentheses.
***Significant at 1%, ** significant at 5%, * significant at 10%
Note: firm characteristics are in logarithms and are lagged one year

Table 5.11: Heckman Selection Model for Market Concentration

	Export Market Herfindahl	Selection into Exporting
Employment	-0.029**	0.4816***
	(0.0119)	(0.0853)
Age	0.0265*	0.2049***
	(0.0154)	(0.0696)
R&D	-0.008	0.0503*
	(0.0068)	(0.0302)
Training	0.0035	-0.0164
	(0.0072)	(0.0338)
Average Wage	-0.00536	0.2631**
	(0.0214)	(0.1188)
Low Technology Dummy	0.095***	-0.0394
	(0.026)	(0.1316)
Domestic Sales		-0.2938***
		(0.0532)
Year Control	Yes	Yes
Industry Control	Yes	Yes
No. Observations	841 (c=134, u=707)	
P	0.6663 (0.131)	
Λ	0.2028 (0.047)	
LR test of indep. eqns.	$\chi2$ (1) = 12.95	Prob> $\chi2$ = 0.000
Wald Test	$\chi2$ (8) = 27.07	Prob> $\chi2$ = 0.0007

Standard Errors in parentheses.
***Significant at 1%, ** significant at 5%, * significant at 10%
Note: firm characteristics are in logarithms and are lagged one year

Table 5.12: Heckman Selection Model for Dependence on Largest Market

	Percentage Exported to Main Market	Selection into Exporting
Employment	-2.557** (0.9977)	0.5065*** (0.07998)
Age	2.011 (1.323)	0.2132*** (0.0703)
R&D	-0.9411 (0.581)	0.0632** (0.031)
Training	0.3882 (0.6159)	-0.0295 (0.0343)
Average Wage	-0.8733 (1.84)	0.2465** (0.1211)
Low Technology Dummy	7.315*** (2.26)	-0.07778 (0.1325)
Domestic Sales		-0.2863*** (0.0551)
Year Control	Yes	Yes
Industry Control	Yes	Yes
No. Observations	841 (c=134, u=707)	
P	0.4134 (0.122)	
Λ	10.702 (3.366)	
LR test of indep. eqns.	$\chi2$ (1) = 6.56	Prob> $\chi2$ = 0.010
Wald Test	$\chi2$ (8) = 28.07	Prob> $\chi2$ = 0.000

Standard Errors in parentheses.
***Significant at 1%, ** significant at 5%, * significant at 10%
Note: firm characteristics are in logarithms and are lagged one year

Table 5.13: Heckman Selection Model for Exports to UK

	Percentage Exported to UK	Selection into Exporting
Employment	0.403 (1.46)	0.524*** (0.08)
Age	3.08 (1.94)	0.221*** (0.07)
R&D	-0.822 (0.85)	0.066** (0.03)
Training	0.567 (0.01)	-0.035 (0.03)
Average Wage	-0.645 (2.72)	0.216* (0.12)
Low Technology Dummy	8.02** (3.34)	-0.058 (0.13)
Domestic Sales		-0.306*** (0.06)
Year Control	Yes	Yes
Industry Control	Yes	Yes
No. Observations	841 (c = 134, u = 707)	
P	0.437 (0.108)	
Λ	16.71 (4.42)	
LR test of indep. eqns.	$\chi2$ (1) = 9.15	Prob> $\chi2$ = 0.003
Wald Test	$\chi2$ (8) = 15.42	Prob> $\chi2$ = 0.052

Standard Errors in parentheses.
***Significant at 1%, ** significant at 5%, * significant at 10%
Note: firm characteristics are in logarithms and are lagged one year

Table 5.14: Heckman Selection Model for Export Intensity

	Export Intensity	Selection into Exporting
Employment	2.264* (1.237)	0.6122*** (0.0646)
Age	-6.924*** (1.671)	0.182*** (0.0668)
R&D	2.2514*** (0.7296)	0.0072 (0.027)
Training	-2.439*** (0.7872)	0.01228 (0.0301)
Average Wage	1.1838 (2.386)	0.3766*** (0.1022)
Low Technology Dummy	-13.616*** (2.901)	0.1199 (0.1227)
Domestic Sales		-0.4824*** (0.0431)
Year Control	Yes	Yes
Industry Control	Yes	Yes
No. Observations	841 (c=134, u=707)	
P	-0.902 (0.0238)	
Λ	-31.089 (1.472)	
LR test of indep. eqns.	$\chi2$ (1) = 128.24	Prob> $\chi2$ = 0.0000
Wald Test	$\chi2$ (8) = 60.34	Prob> $\chi2$ = 0.0000

Standard Errors in parentheses.
***Significant at 1%, ** significant at 5%, * significant at 10%
Note: firm characteristics are in logarithms and are lagged one year

Table 5.15: Heckman Selection Model for Product and Market Coverage

	Ln(Market Coverage)	Selection into Exporting
Product Coverage	-0.012 (0.013)	-0.101*** (0.029)
Employment	0.119*** (0.043)	0.635*** (0.156)
Age	-0.068 (0.062)	0.380*** (0.143)
R&D	0.031 (0.023)	0.034 (0.047)
Training	-0.022 (0.025)	0.028 (0.052)
Average Wage	0.111 (0.082)	0.331 (0.224)
Low Technology Dummy	-0.325*** (0.091)	-0.356 (0.281)
Domestic Sales		-0.531*** (0.128)
Year Control	Yes	Yes
Industry Control	Yes	Yes
No. Observations	418 (c=31, u=387)	
P	-0.774 (0.092)	
Λ	-0.636 (0.089)	
LR test of indep. eqns. (ρ=0)	$\chi2$ (1) = 17.92 Prob> $\chi2$ = 0.000	
Wald Test	$\chi2$ (9) = 30.83 Prob> $\chi2$ = 0.000	

Standard Errors in parentheses.
***Significant at 1%, ** significant at 5%, * significant at 10%
Note: firm characteristics are in logarithms and are lagged one year

Table 5.16: Market Coverage and Market Characteristics

	(I)	(II)	(III)
	Region	Population	GDP/Capita
UK	1.69***		
	(0.16)		
EU-15	2.22***		
	(0.18)		
Other Europe	4.72***		
	(0.24)		
America	1.46***		
	(0.20)		
Mid-East	4.71***		
	(0.27)		
Asia	3.90***		
	(0.24)		
Pop >1000million		-1.77***	
		(0.52)	
1000m>Pop>100m		1.19***	
		(0.16)	
100m>Pop>50m		2.35***	
		(0.09)	
50m>Pop>20m		1.68***	
		(0.16)	
10m<Pop<20m		1.26***	
		(0.12)	
$25000+			1.82***
			(0.11)
$20000 - $25000			1.45***
			(0.05)
$10000 - $20000			1.18***
			(0.15)
$5000 - $10000			0.82***
			(0.15)
N	2174	2174	2174
R-Sqd	0.73	0.66	0.67
F-Statistic	978.7***	826.1***	1116.7***

Standard Errors in parentheses

***Significant at 1%, ** significant at 5%, * significant at 10%

Region base category: Other Markets

Population base category: Population < 10million

GDP per capita base category: < $5000

Figure 5.1: Export Intensity and Country Coverage

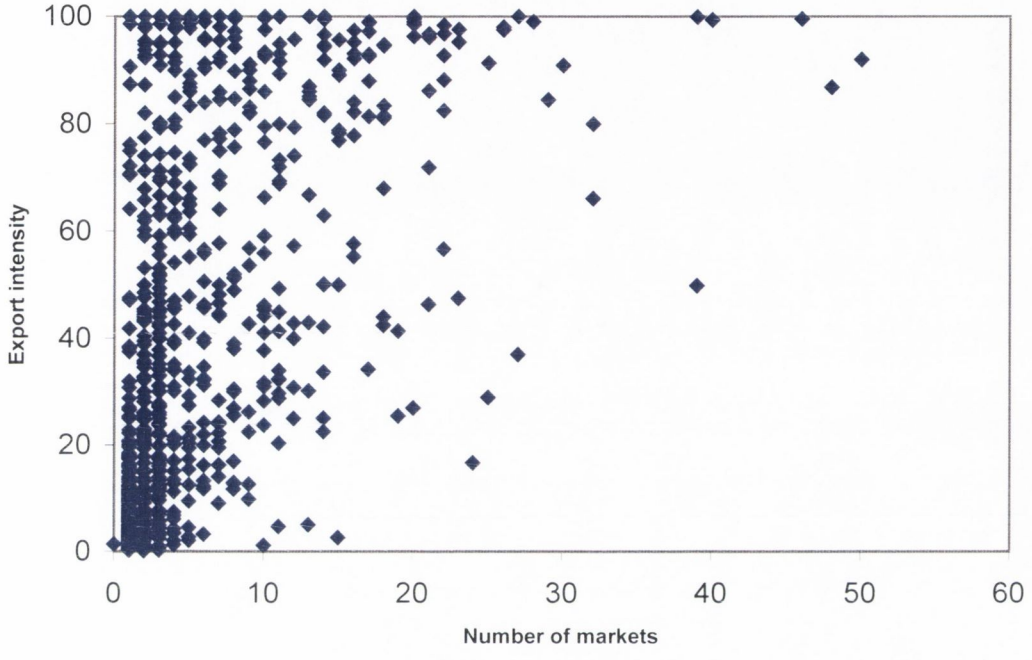


Figure 5.2: Export Intensity and Country Coverage
Enlargement of small values of Figure 5.1

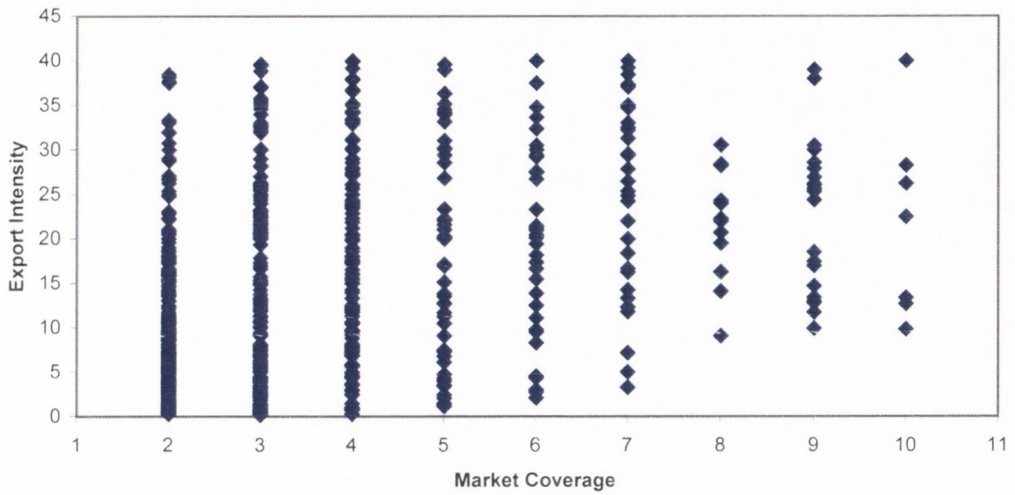


Figure 5.3: Distribution of Firms by Market Coverage (Count)

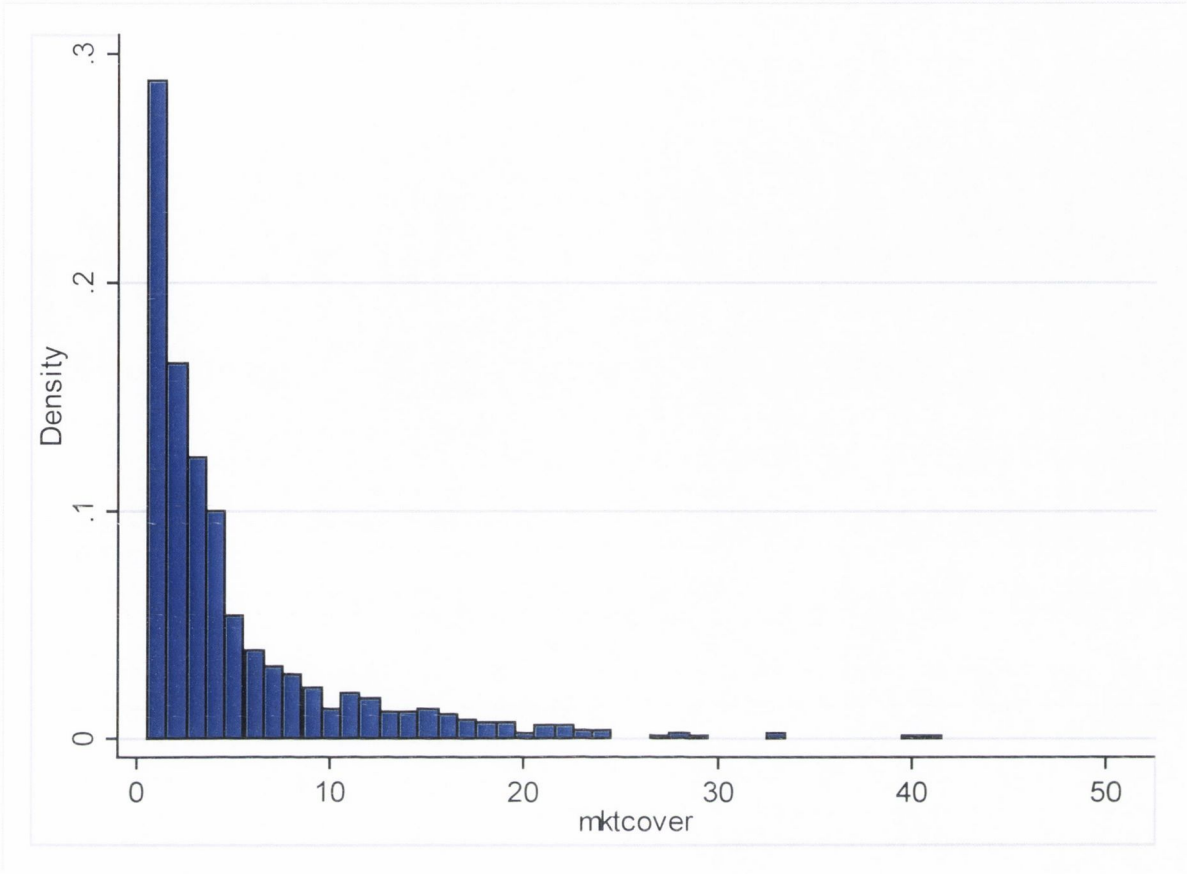


Figure 5.4: Distribution of Firms by Market Coverage, by Nace-Clio Sector

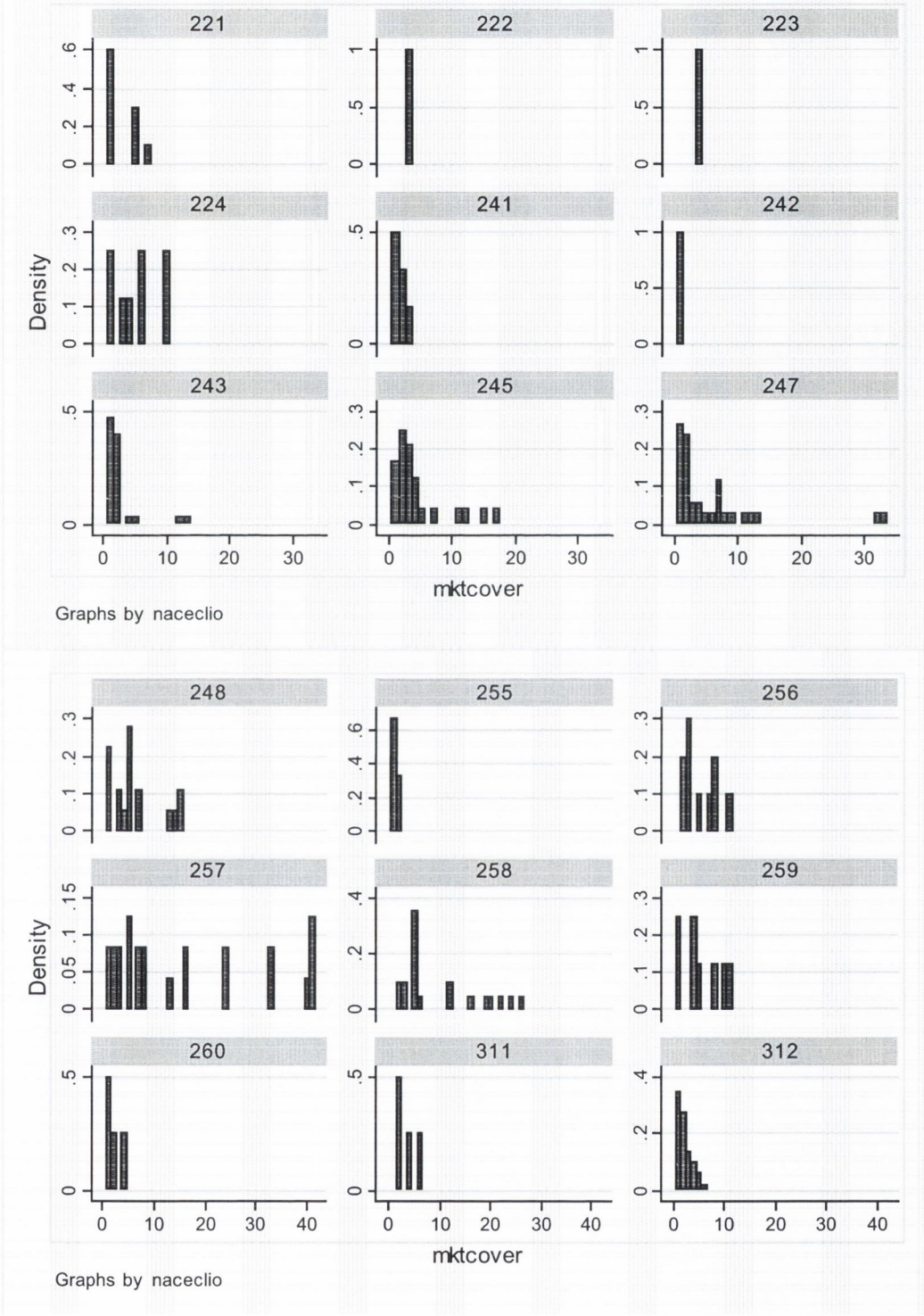
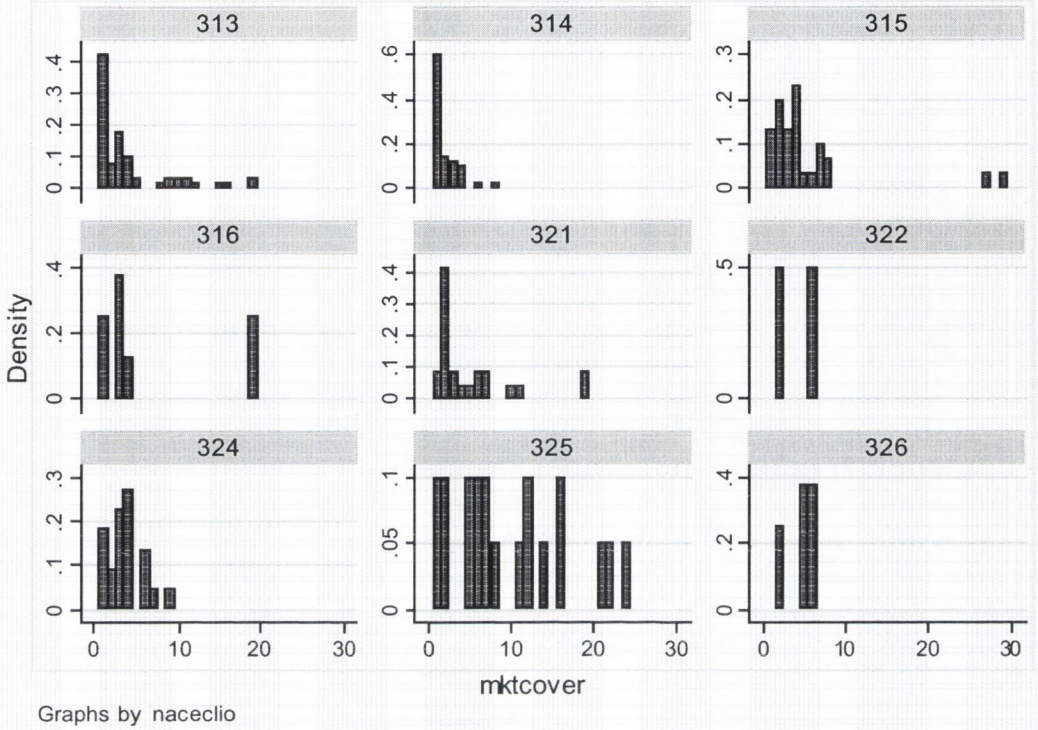


Figure 5.4: Distribution of Firms by Market Coverage, by Nace-Clio Sector



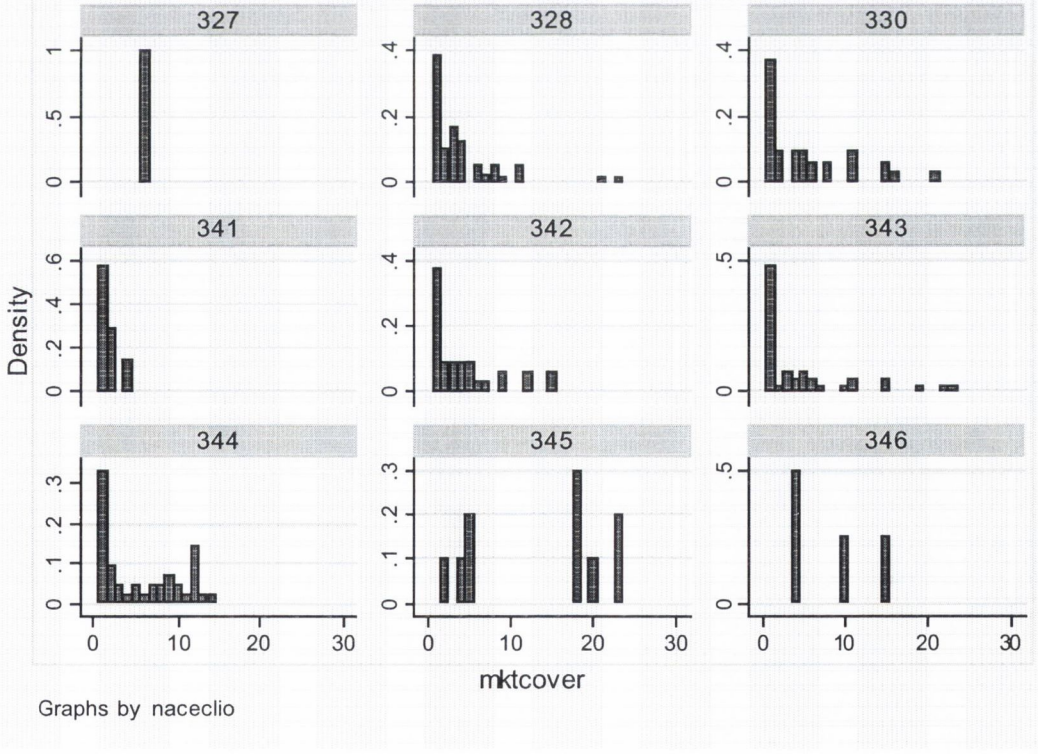


Figure 5.4: Distribution of Firms by Market Coverage, by Nace-Clio Sector

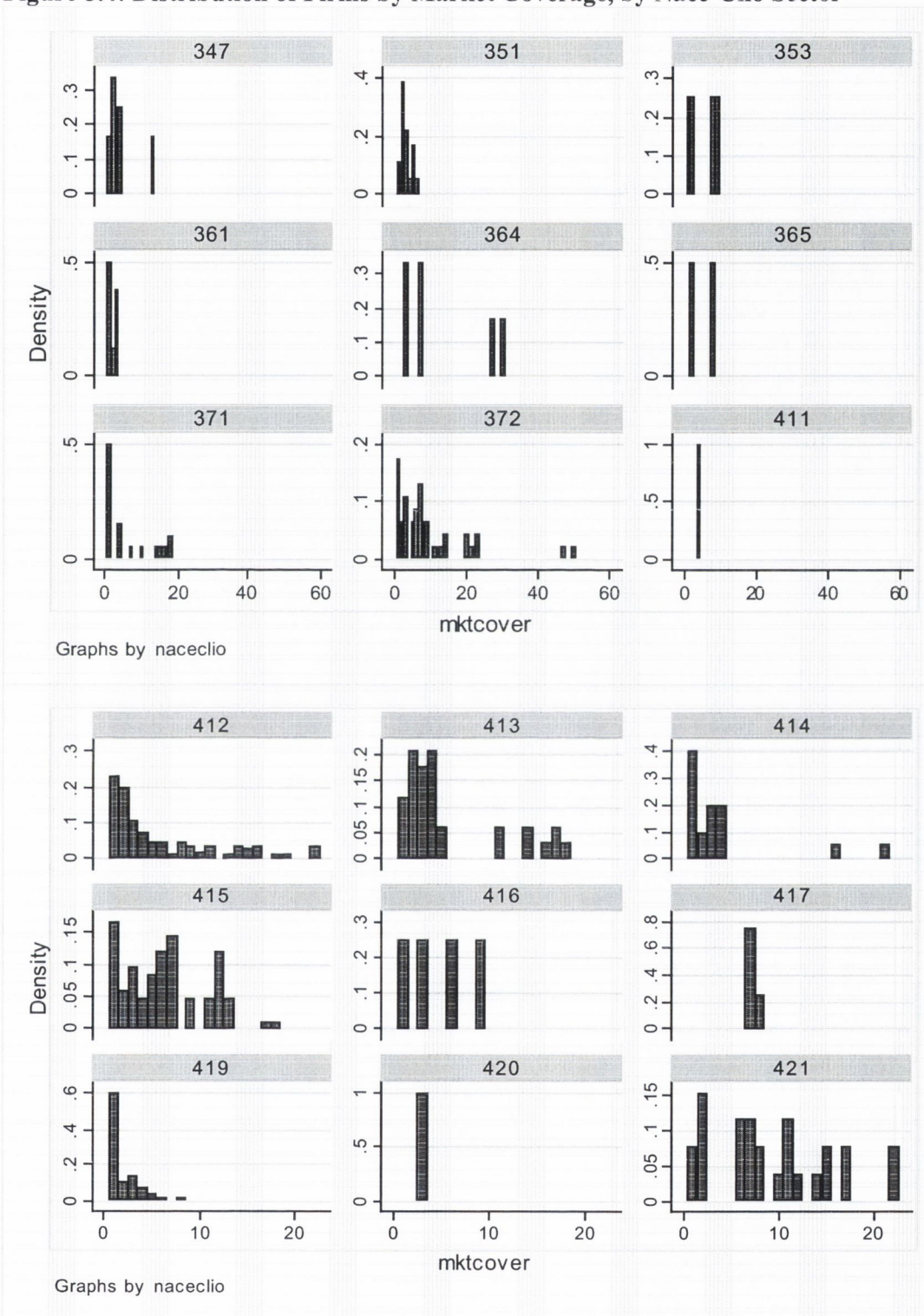


Figure 5.4: Distribution of Firms by Market Coverage, by Nace-Clio Sector

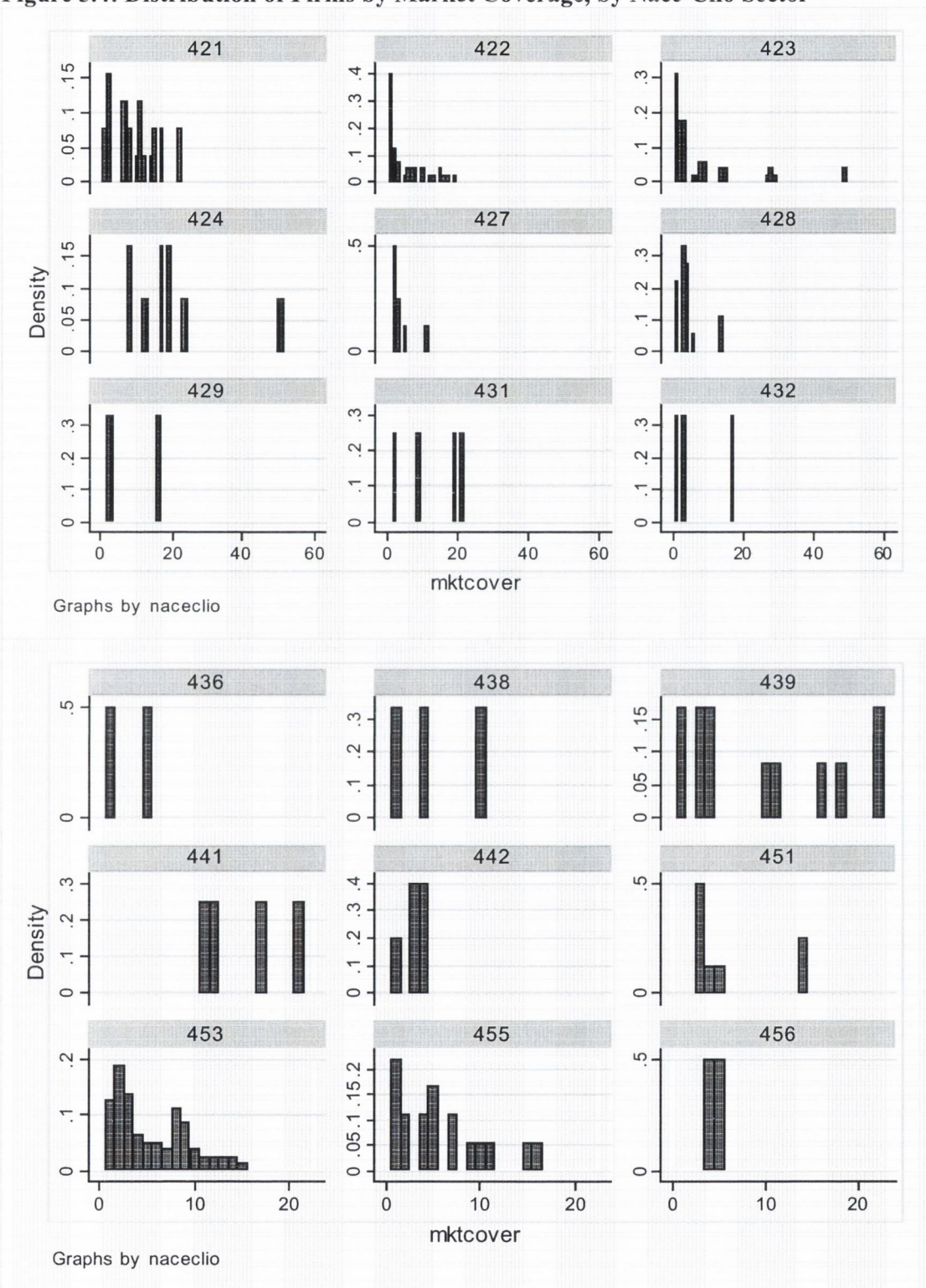


Figure 5.4: Distribution of Firms by Market Coverage, by Nace-Clio Sector

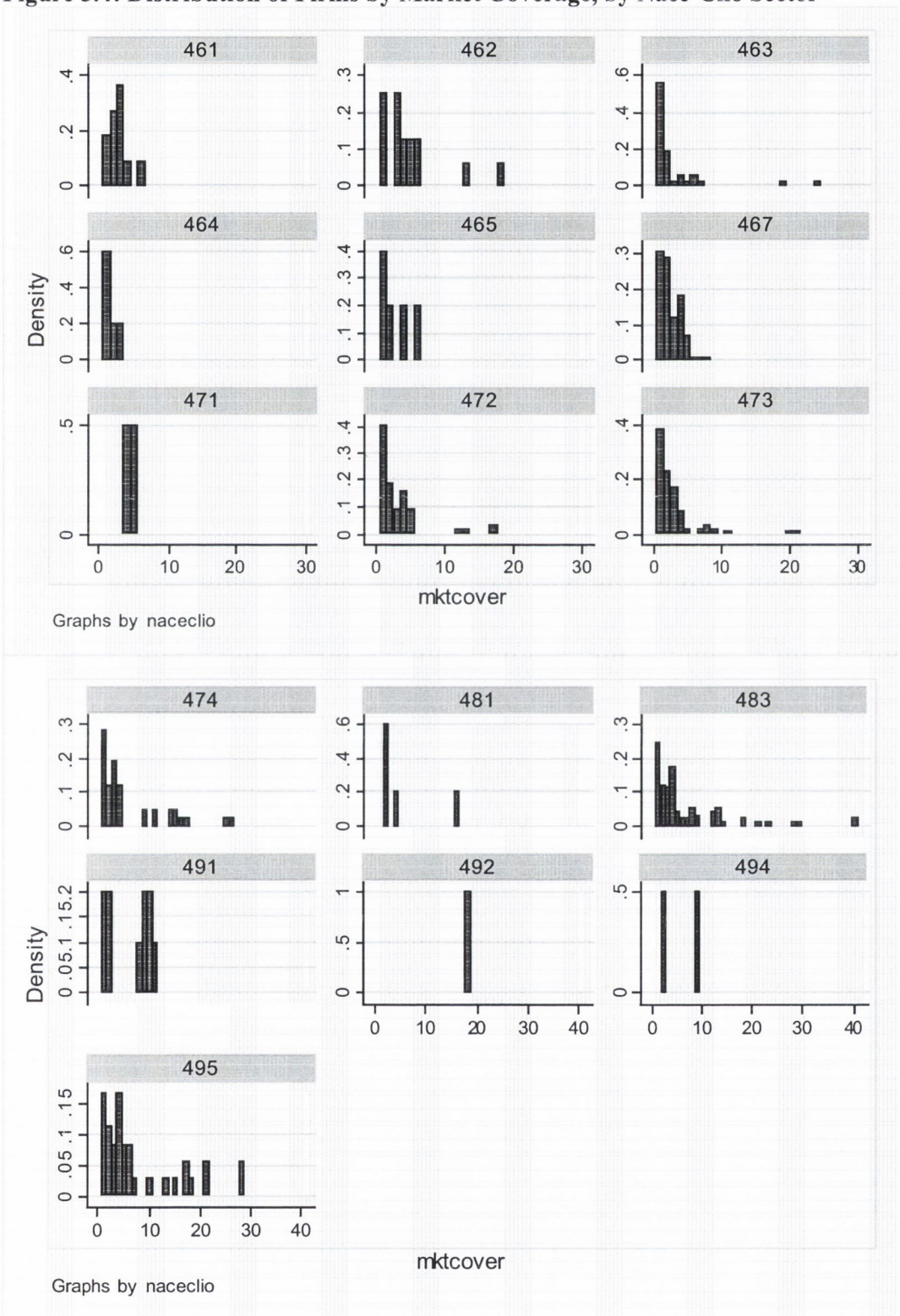
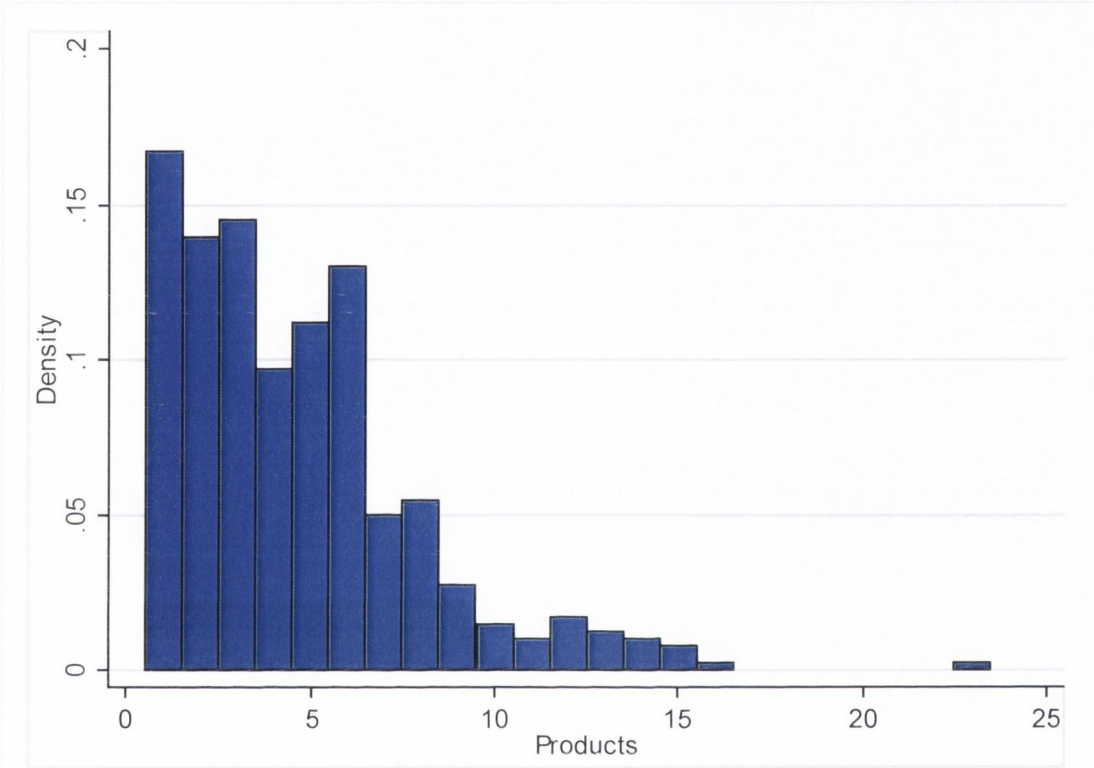


Figure 5.5: Distribution of Firms by Number of Products



Chapter 6

Conclusions

This thesis examined Irish export performance over the past twenty-five years. This period was one of profound change in the economy, and export growth played a central role in the transformation to a Tiger economy. A number of different aspects of export activity are analysed at sector and firm level, and these are linked by two common threads that make up the central thesis of this research.

The first thread relates to the level of inertia in the export structure, with change occurring very gradually over a long time period and strongly dependent on the initial conditions. At the sector level, this is evident in the gradual displacement of traditional, low technology sectors with the higher technology Computers, Chemicals and Electronics sectors. This did not occur as a result of a sudden structural break. On the contrary, higher than average growth rates are observed in these sectors right back to the 1976-81 period.

This persistence in exporting, observed at the sector level, is further examined at the firm level. Evidence of sunk costs is found in the firm's decision to enter the export market, with past export experience one of the main determinants of the firm's current export activity.

The second central thread is the role of specialisation, including analysis of the level of specialisation in geographic markets. The main hypothesis here is that sector exports expand by increasing their market coverage, even when the sector remains specialised in terms of its product range. There is a gradual process of geographic diversification, consistent with the building up of a portfolio of markets. At the firm level, we find evidence of the importance of market coverage. In fact, the most successful exporters in our data are those most diversified in their geographic coverage.

This thesis has extended the existing literature on Ireland's export experience in a number of ways. The important contribution to export performance of increasing the market coverage of exports has been examined, providing confirmation of the Evenett and Venables (2000) research on the geographic spread of trade. The increased sector specialisation of Irish exports was documented in Chapter Three, where it was contrasted to the differing evolution of specialisation in employment. Employment specialisation across sectors was found to follow the U-shape predicted by Imbs and Wacziarg (2003). Export specialisation, on the other hand, has increased steadily over time.

In the two microeconomic chapters, we found significant evidence of persistence in the export activity of individual firms. A two-step econometric procedure was

used to control for initial conditions and unobserved firm characteristics. The geographic coverage of individual firm exports was examined for the first time.

There are a number of limitations in the preceding analysis, all of which give rise to the possibility of extending the research presented here. The first issue relates to the aggregate export data and the extent to which it may be affected by transfer pricing. The large multinational presence in Ireland, coupled with relatively low corporation profit taxes, gives rise to the possibility that companies may overstate their production and profits in Ireland to take advantage of the lower tax rates. This may also lead to overestimation of the exports from these companies. It should also be noted that the export data used in this thesis reports only trade in goods. Exports of services are thus excluded, although we are aware that these are of growing importance to the economy.

The firm level data available from Forfás has a number of attributes, in particular the relatively long time span of the Irish Economy Expenditures Survey used in Chapter Four. However, it should be emphasised that this is a survey and therefore is at risk of bias from the non-respondents and from the exclusion of firms with less than twenty employees. In terms of the variables included in the survey, the lack of data for example on capital and investment has limited the analysis to some extent.

The very interesting link between exporting and productivity is difficult to address without this additional information. The extension of the survey to include data on export destinations was unfortunately available only for Irish owned firms. An obvious extension of Chapter Five would be a comparison with the geographic orientation of foreign owned firms. Further research on firm destinations would also benefit from a longer time span of data when further survey results become available.

A note on the issue of transfer pricing and intra-firm trade is required as this is a concern frequently raised when discussing trade flows. Intra-firm trade refers to transactions between affiliates of multinationals located in different countries. It can be used to facilitate distribution and to allow the company to exploit cost advantages of locating different stages of production in different countries. However, the pricing structure of intra-firm transactions is frequently unclear and questions arise over the company's ability to allocate costs across countries to take advantage of local tax codes. It is particularly pertinent to the Irish case given the large share of production and trade accounted for by multinational corporations and the incentive to report profits in Ireland generated by the low corporate tax rates.

Evidence from the United States and Japan indicates that intra-firm transactions account for a sizable proportion, almost one-third of trade in both countries (OECD, 2002; Rangan, 2001; Bonturi and Fukasaku, 1993). Unfortunately, these

are the only two countries for which these official data are available and this data are not without shortcomings. Transfer pricing may involve under-charging and/or over-charging affiliates for transactions; even with data on intra-firm flows, this practice is unlikely to be identified (Bonturi and Fukasaku, 1993). For the US, the percentage of intra-firm trade in the total has remained almost unchanged over the thirty years examined by Rangan (2001).

Sectors with the highest degree of intra-firm trade in US exports are transport equipment, plastics, chemicals, computers and electronic and electrical equipment. In these sectors, intra-firm trade accounts for between 35 and 41 percent of US exports (OECD, 2002). With the exception of transport equipment, the sectors with the most intra-firm trade are those identified in this thesis as Ireland's main areas of specialisation. This is an issue with considerable scope for future research. The identification of potential transfer pricing has also been estimated for Ireland by Conroy, Honohan and Maîre (1998), focusing on its implications for recent estimates of economic growth. They identify four sectors as having excess returns on capital and low labour share (chemicals, software computers and cola concentrates), which may be indicative of the existence of entrepôt activity that repackages or distributes a product without significantly altering it.

In terms of policy towards exporters, the finding that past export experience lowers the current cost of exporting, so that otherwise identical incumbent and

potential exporters react differently to changes in export market conditions could have important implications. It implies that if policymakers are interested in encouraging exporting, it might be as useful to adopt policies aimed at reducing entry costs as to use policies that increase current export profitability.

Policies targeted at reducing sunk costs may be more successful, as they would be more likely to increase the base of exporting firms. In any event, policies that try to make exporting more profitable, through fiscal incentives or direct subsidisation, would almost certainly contravene EU or WTO trade rules. Sunk costs, on the other hand, could be reduced to some extent by strategies such as those suggested by the recent O'Driscoll Report (Enterprise Strategy Group, 2004). This suggests the foundation of a "dedicated structure", to be known as 'Export Ireland', to "develop a more focused approach to export market intelligence and promotional activities."

The O'Driscoll Report expresses some concern about the export performance of indigenous companies, particularly when compared to the export intensity of multinationals based in Ireland. They suggest the promotion of export sales from domestic firms could be done through increasing access to information on international markets; this would reduce one potential cost in becoming an exporter, namely the research required prior to entry into exporting.

Priorities for policymakers required to maintain comparative advantage and encourage firm development are cost competitiveness, infrastructure, innovation and management capability. Facilitating access to export markets and encouraging R&D are identified as key strategies for the enterprise development agencies. The emphasis on specialisation, particularly in high technology, continues; "as a small country, Ireland has limited resources and must therefore be selective and specific around the areas in which it chooses to focus and invest" (Enterprise Strategy Group, 2004).

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