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Empirical Essays in International Macroeconomics

by

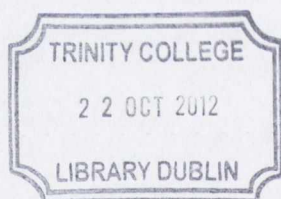
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A thesis submitted for the degree of
Doctor of Philosophy

Supervised by
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2011



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Declaration

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Summary

This thesis is composed of three essays. The first paper examines private credit growth in Europe between 1999 and 2007. The results highlight the importance of external liabilities in facilitating the credit boom. Although private sector credit growth is correlated with the current account balance, some countries had rapid credit growth without large current account imbalances. We show that this because debt flows have a different relation to private credit growth than equity flows. In addition, bank debt flows are more closely correlated with private credit growth than other debt flows. Finally, we find limited evidence that bank regulation and competition were important determinants of private credit growth during the period.

The second paper applies Hummels and Klenow (2005) method and tests their predictions on a longitudinal export data set for Ireland over the period 1984 to 2000. International trade data is used to decompose Irish exports into extensive and intensive margins, with price and quantity components. The results of regressions using data for Irish trade versus 18 European countries indicate that the response of overall export share to an increase in Ireland's relative income and relative income per worker were primarily correlated with increases in the relative quantities of exports. We contrast these results with the predictions of theoretical trade models.

The third paper seeks to identify the relation between a country's trade share and its income level. We ask whether this relation changed between 1995 and 2005 and whether there has been an observable shift towards increased trade variety for high income countries. In order to address these questions, we employ the trade decomposition method that consists of dividing the overall trade share of a given country into the extensive and intensive margins. The latter is further decomposed into price and quantity components. A country's relative income has a smaller effect on trade share vis-a-vis the EU 15 than was previously the case, primarily because relatively low-income countries now also export large quantities of goods.

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Chapter 1

Introduction

This thesis addresses two important issues in international macroeconomics, (i) the relation between private credit growth and international capital flows in Europe and (ii) the relation between a country's exports and its income level. In doing so, we address two major aspects of globalisation. The first issue relates to international financial integration while the second examines issues related to the increase in international trade.

In Chapter 2 we examine private credit growth in Europe over the period 1999 to 2007. This is an issue of critical importance as prior growth in private credit growth has been highlighted as one of the factors determining the severity of the recessions experienced by countries during the current crisis. Without a clearer understanding of what drove the crisis it will be impossible for future policy makers to avoid repetition of the excess credit growth of the past decade, with all the adverse economic and social consequences that this entails.

One contribution of Chapter 2 is to show that private credit growth is more closely correlated with international debt flows than equity flows. Although this is a intuitive conclusion, it is not clear that this has been recognised by policy makers where discussions have tended to focus on the need to monitor aggregate current account balances.

In Chapter 2, we also examine whether financial integration and bank regulation were important determinants of credit growth. Although the findings are not conclusive in the context of the panel regressions used here, this does not imply that that improved financial and banking regulation is unimportant or that financial regulators can be absolved of responsibility. It should also be emphasised that, although the current crises has highlighted the potential pitfalls of international capital flows, international financial integration can have positive consequences for both debtors and creditors if funds are invested wisely and productively.

Chapter 3 examines the extent to which the rapid growth in the export share of Ireland in the 1990s is consistent with the emergent "new new trade" literature. The paper innovates by applying an existing trade decomposition method to a individual country, a small open economy, in a time series context rather than the more familiar cross sectional analysis. The results suggest that Irish export quantities were most closely correlated with the increase in Ireland's relative income.

Although the variety of Irish exports did increase, much of this variety increase occurred prior to Ireland experiencing income growth. The observed pattern is consistent with Ireland's role as host for export platform FDI in Europe. The new trade literature was constructed with large, relatively closed economies in mind. In that context, it is plausible to think of domestic companies producing for the local market and then the most successful of those companies expanding and exporting. However, outsourcing and FDI flows remain an important characteristic of the current wave of globalisation and the Irish pattern of export development, although extreme, is unlikely to be unique.

Chapter 4 examines the relation between a country's trade share and its income level and we examine whether the relation between these variables has changed in recent years. The period 1995 to 2005 saw a considerable increase in trade flows both within Western Europe and with trade partners in Central and Eastern Europe, China and South East Asia. As a consequence, there has been an increasing public awareness of and interest in the process of globalisation much of which has focused on the fear of the effect of increased exposure to competition from developing countries on living standards in the developed world.

Chapter 4 innovates by applying an existing trade decomposition method to a more reliable, more detailed data over multiple years and by incorporating time-varying coefficients. Our results indicate that a country's relative income has a smaller effect on trade share vis-a-vis the EU-15 than was previously the case, primarily because relatively low-income countries now also export large quantities of goods. Wealthier countries continue to export a wider variety of goods at relatively higher prices. We relate these findings to the existing "new new trade" literature and suggest that it may be the case that the elasticity of substitution may vary systematically across countries. Thus, variety is the key remaining trade characteristic of relatively high income countries.

This thesis thus examines several facets of globalisation, namely trade and financial integration. Chapter 2 examines the relation between private credit growth and different types of international capital flows. Chapter 3 examines the evolution of Irish trade on the extensive and intensive margin. Chapter 4 examines the evolution of international trade on the extensive and intensive margins. Chapter 5 concludes.

Chapter 2

Capital Flows and Credit Growth.

2.1 Introduction

In the period prior to the recent global financial crisis, many European countries experienced rapid growth in private sector credit. At the same time, there were large increases in international capital flows associated with greater current account dispersion and an expansion of bank balance sheets.

This paper seeks to explain the credit boom episode experienced by many countries in Europe in the years preceding the current financial crisis. We examine private credit growth in Europe over the period 1999 to 2007. Prior growth in private credit is one of the key factors determining the severity of the current crisis across countries (Lane and Milesi-Ferretti; 2010b; Aisen and Franken; 10). It is essential that future policy makers have a clear understanding of what has occurred so that the mistakes of the past are not repeated. The crucial question is what caused credit growth.

One possible explanation focuses on financial integration in Europe as the source of increased credit supply. Financial integration does not necessarily lead to external imbalances between countries. Similarly, it is possible for a country to experience credit growth without any capital inflows (Jorda et al.; 2010). In Europe, however, financial integration allowed countries to accumulate larger net foreign asset positions which were reflected in increased current account dispersion (Caballero; 2006; Lane and Milesi-Ferretti; 2010b). Countries that were expected to grow more rapidly received capital inflows, accumulated financial liabilities and ran current deficits (Pels; 2010). Countries with slower growth prospects experience capital outflows, accumulated financial assets and ran current account surpluses.

It has also been suggested that inappropriate monetary policy or the introduction of the euro contributed to excess borrowing (Barnes; 2010). Alternatively, it is possible that countries experienced rapid credit growth due to financial reform, inadequate bank regulation or excessive competition between banks (Giannone et al.; 2010).

In order to address these questions, we analyse panel data for the period 1999 to 2007. We examine the results of regressions with the ratio of private credit to gross domestic product (GDP) as the dependent variable. A variety of variables and specifications are

employed to investigate the impact of different types of capital flows and the effect of financial reform, bank regulations and market structure.

The countries examined are the EU 27 and Iceland, Norway and Switzerland (henceforth the E30). The E30 are of particular interest for a number of reasons. European countries are highly financially integrated. This process has accelerated since the introduction of the euro in 1999. An unusually high proportion of capital flows between these countries is accounted for by bank flows (Milesi-Ferretti and Tille; 2010). Furthermore, the E30 provide an interesting case because, despite the implementation of financial reforms, there is still considerable variation in bank regulation as there has only been limited harmonisation of these policies in Europe. Finally, Europe is of particular interest because it has been, and continues to be, particularly severely affected by the current crisis.

The results of the analysis show the importance of external sources of funding in facilitating private sector credit growth. Although private sector credit growth is found to be correlated with the current account balance, some countries had rapid credit growth without large current account imbalances. We show that this was primarily because net debt flows have a different relation to private sector credit than equity flows. Furthermore, a large proportion of debt flows were attributable to banks. Private credit growth is shown to be more closely correlated with bank debt flows than other flows. Finally, we find limited evidence that bank regulations and bank competition played a role in determining credit growth.

The remainder of this paper is divided into the following sections. Section 2.2 provides some background information and a brief review of related literature. Section 2.3 explains the regression specification and section 2.4 outlines the data sources. Section 2.5 presents descriptive statistics and section 2.6 provides analysis. Finally, section 2.7 highlights the main findings and delivers some concluding remarks.

2.2 Background and Related Literature

2.2.1 Private Credit and Financial Development Literature

Although recent events have highlighted the pitfalls of excess credit growth and financial innovation, domestic financial development has been recognised as a driver of economic growth for a long time. As early as 1911, Joseph Schumpeter argued that financial intermediaries were essential to promoting technological innovation and economic development (King and Levine; 1993). He argued that these institutions help the economy by evaluating projects, managing risk, monitoring managers and facilitating transactions as well as by mobilising saving.

Access to credit has a number of positive implications. Some investment projects may require large capital inputs particularly in the presence of economies of scale. Financial intermediaries can facilitate such large projects by agglomerating savings thereby encouraging economic efficiency (Levine; 1996).

Credit availability is also desirable in that it decouples consumption from output. At a

micro level, the permanent income hypothesis suggests that consumers make consumption choices based on their long-term income expectations rather than only on the basis of their current income (Friedman; 1957). If a consumer believes that his future income will be higher than his current income, he will borrow in order to smooth his consumption. Thus, access to credit can improve an individual's welfare.

These concepts also relate to the national and international context. Increased international financial integration may influence private credit for a number of reasons. Financial integration could increase the availability of funds, allowing greater aggregate consumption smoothing, thereby improving individuals' welfare.

International financial integration facilitates greater investment efficiency and allows investors to diversify risk. Furthermore, it allows for the decoupling of domestic saving and investment decisions. In autarky, even if a country's aggregate income is expected to rise, its current consumption will be limited to current output. An open economy may borrow now and run a current account deficit (Engel and Rogers; 2006), paying back the borrowed funds in the future and smoothing consumption over time. Thus, in open economies the current account balance often reflects aggregate national borrowing decisions by both public and private agents. International consumption risk sharing should be a major motivation for international capital flows, although the phenomenon has been difficult to prove empirically (Corcoran; 2008).

Obstfeld and Rogoff (1996) suggest that mobile capital should flow from capital-abundant countries to countries with a higher rate of return. Capital-abundant countries benefit from higher returns, countries where capital is scarce should benefit from increased investment.

Although not the case in the rest of the world, capital flows in Europe did follow the "down-hill" pattern predicted by economic theory (Bakker and Gulde; 2010). If countries and individuals borrow more to finance productive investment, they can expect to increase their incomes in the future (Giavazzi and Spaventa; 2010). In the European context, such flows were consistent with income convergence.

In much of the literature, measures of private sector credit to GDP are used as indicators of domestic financial development, such as in Lane and Milesi-Ferretti (2008). The authors state that domestic financial development can drive financial globalisation as the creation of domestic financial products facilitates foreign demand for domestic liabilities. In this paper private sector credit is the dependent variable. This is motivated by the fact that private credit, along with high debt levels and housing booms, has been found to be a key financial development indicator of countries adversely affected by the crisis, along with pre-crisis housing booms (Lane and Milesi-Ferretti; 2010b).

2.2.2 Private Credit Supply and Demand and Asset Prices

This paper highlights the role of international factors in increasing the supply of capital available for funding private credit. Earlier literature on the subject of private credit tends to focus more on domestic cyclical and demand determinants. Private credit is jointly determined by the credit supply and credit demand. Demand determinants of

credit include expected future income, investment, demographics, interest rates and house prices (Hofmann; 2001; de Bandt et al.; 2006). A reasonably typical example of the earlier empirical literature, Bernanke and Blinder (1988) pay particular attention to the role of interest rates and central banks in the credit cycle.

Schularick and Taylor (2008) outline the literature on the relation between the real economy, money supply and credit. The “money view” posited that the central bank should target aggregate bank liabilities but that the actual functions of banks and their role in credit creation are of no great importance. Writers such as Mogdigliani and Miller (1958) suggested that finance was merely a “veil” and, thus, that financial structure did not affect real economic decisions.

This view was contested by later papers such as Bernanke and Blinder (1988) who emphasise the fact that monetary policy’s affect on the real economy can be amplified by its effect on private credit, referred to as the “financial accelerator”. Bernanke and Lown (1991) explain how the financial accelerator may have operated in a paper focussing on the potential causes of an apparent decline in credit in the U.S. in the early 1990s. Demand for construction, producer investment and consumer durables declines during a recession. They define a bank credit crunch as a significant leftward shift in the supply curve for bank loans, holding constant both the safe real interest rate and the quality of potential borrowers. The authors also emphasise balance sheet effects, whereby falling asset values and reduced cash flows lead to reduced creditworthiness and, thus, reduced credit supply. In this way financial accelerator effects could amplify the business cycle.

The supply side was influenced by the availability of loanable funds, securitisation of bank assets, the zeal of bank examiners and, most importantly, the possible shortage of bank equity capital. The authors also test for evidence of procyclical regulation. This would occur if regulators were to shift from an overly lax regime to being actuarially fair. They reject this hypothesis in favour of a “Capital Crunch”.

Schularick and Taylor (2008) emphasise that aggregate credit is no longer closely related to monetary aggregates. The author suggests that financial innovation and regulatory ease facilitated a rapid growth in credit without a corresponding change in monetary aggregates. This credit growth had large effects on the real economy.

Financial accelerator type effects are tested empirically in numerous papers. For example, Hofmann (2001) discuss the determinants of private credit in industrialised countries with a focus on the role of property prices. Long run relationships are found to exist between real GDP and real property prices. Traditionally these would have been interpreted as long-run credit demand relationships. They find evidence of a significant two way dynamic relationship between bank credit and property prices. This is consistent with the observation that credit cycles tend to coincide with fluctuations in economic activity and property prices.

Hofmann (2001) also state that the coincidence of cycles in credit and economic activity may reflect adjustments of credit demand to changes in economic activity. Favourable economic conditions and prospects stimulate consumption and investment demand, thus

increasing the demand for credit. However, Hofmann (2001) emphasise that the transmission of the effect of increased property prices into credit is primarily a balance sheet effect. The increase in house prices leads to improved credit worthiness and so households can borrow more. According to de Bandt et al. (2006) over 80 percent of credit extended to households is in the form of housing loans.

This is consistent with Kelly (2010) who finds that rising house prices in pre-crisis Ireland were driven almost exclusively by increases in the size of mortgages that banks were willing to give. So, even if reliable and comparable house price data were available, it would be very difficult to disentangle the causality of private credit and house prices. The more tractable question then is one of supply: how were banks financing these larger mortgages?

2.2.3 Private Sector Credit and External Flows

In order to understand the relation between international financial flows and the supply of private credit, it is necessary to understand how banks fund credit growth. To this end, Table 2.1 shows the components of banks balance sheets and is based on a table from ECB (2010).

According to the ECB (2009), commercial banks fund their balance sheets in layers, starting with a capital base comprising equity, subordinated debt and hybrids of the two, plus medium and long-term senior debt. The next layer consists of customer deposits. The final layer comprises of other short term liabilities.

The assets side of the balance sheet consists primarily of loans which may be to the private sector, to other banks (referred to as monetary financial institutions (MFI's)) and to the government. Banks may have other assets in the form of shares and other equity, other securities and central bank reserves. In general, these assets and liabilities may have domestic or foreign counterparties.

Introductory literature on banking concentrates on the effect of bank multipliers on money supply operating through deposit growth (Schularick and Taylor; 2008). However, in the run up to the recent financial crisis bank deposits grew less rapidly than private credit in many of the sample countries. In the E30 the average bank deposit to GDP ratio was 57 percent in 1999, increasing to 89 percent by 2007. In 1999 the average private credit to GDP ratio was 67 percent, increasing to 107 percent in 2007.

Beck et al. (2009) find that countries with less mature financial markets tend to be more reliant on deposits for their funding. As we shall see below, indicators suggest that Europe has a sophisticated financial system that allowed banks access non-deposit sources of funding. This took place against the background of rapid international financial integration.

Lane and Milesi-Ferretti (2010b) report that the value of external assets and liabilities (scaled by GDP) surged by a factor of three for industrialised countries between 1995 and 2007. This global phenomenon was particularly pronounced in Europe as the continent moved deliberately toward greater regional trade and financial integration.

The period was also characterised by increasing current account dispersion. The relation between the current account imbalances and the severity of the impact of the crisis has received considerable attention (Giavazzi and Spaventa; 2010; European Commission; 2010). Figure 2.6 illustrates that there is indeed some correlation between the two variables. Other commentators, such as Lane and Milesi-Ferretti (2010b), also highlight the correlation between the impact of the crisis and the extent of pre-crisis private credit growth.

It is possible to approximately identify how private credit relates to the current account by examining the various accounting identities relating to the concepts. The most familiar definition of the current account can be written as follows:

$$\text{Current Account} = \text{Trade Balance} + \text{Transfers} + \text{Net Investment Income} \quad (2.1)$$

However, the current account can also be written as:

$$\text{Current Account} = \text{Financial Account} + \text{Capital Account} - \text{Errors and Omissions} \quad (2.2)$$

Errors and Omissions are a balancing item. The *Capital Account* is equal to net capital transfers and payments for non-produced assets. Capital transfers may refer to some types of foreign aid, transfer of ownership of non-financial assets, assets of migrants and debt forgiveness.

The component of the current account that relates to private credit is the financial account. This can be stated as follows:

$$\text{Financial Account} = \text{Flow}_{\text{Assets}} - \text{Flow}_{\text{Liabilities}} + \text{Flow of Derivatives} \quad (2.3)$$

Countries that accumulated liabilities faster than assets would have a positive balance on their financial account. In the absence of offsetting deficits on the capital account, the financial account surplus would also lead to a current account deficit.

Financial assets and liabilities may be in the form of foreign direct investment (FDI), portfolio equity, portfolio debt, other debt and reserves. These are the categories available in Lane and Milesi-Ferretti (2007a). The corresponding breakdown provided in the IMF balance of payments statistics (BOP) divide assets and liabilities into FDI, portfolio equity and debt, financial derivatives and other investment (IMF; 2010).

Which categories of capital are likely to be associated with credit growth? As we have already noted when discussing bank balance sheets, FDI and portfolio equity flows into a country could be used to fund credit growth.

The ECB (2009) show that the equity share of bank funding did not increase noticeably in the years leading up to the financial crisis. Furthermore, Milesi-Ferretti and Tille (2010) show that, although the absolute values of FDI and equity capital flows increased, their

share of total flows declined in developed economies and in the euro area.

Milesi-Ferretti and Tille (2010) show that bank capital flows increased more rapidly than other types of capital flows. Banks' share of total developed country outflows went from 21 to 33 percent between the periods 2000-2003 and 2004-2007. Banks' share of inflows increased from 24 to 32 percent. In the euro area, banks' share of total capital outflows also rose rapidly from 22 to 32 percent. Banks' share of inflows increased from 22 to 33 percent.

In order to finance credit growth that was more rapid than deposit growth, banks could raise funds by borrowing short term on international inter-bank and money markets or by issuing bonds. The tight correlation between bank deposits and private credit began to break down as banks increasingly resorted to wholesale cross border funding (BIS; 2009; Hoggarth et al.; 2010). Similarly, much of the increase in domestic credit has been shown to have been facilitated by a large increase in cross border inter-bank lending, the opening of international subsidiaries and the emergence of financial derivatives (Cetorelli and Goldberg; 2010, 2008; Altunbas et al.; 2007).

According to ECB (2009), between December 2003 and December 2007 the total balance sheets of euro area monetary financial institutions (MFI) increased by 53 percent. In particular, banks increasingly resorted to short term funding. European banks' money market funding increased from 11.8 percent in 2003 to 16 percent in 2007. Interbank markets grew by 16 percent in 2007. There was also an rapid increase in securitisation.

Thus, we anticipate that banks were primarily using international debt flows to finance credit growth. This assertion is supported by graphical and regression analysis presented below. That the credit bubble was dependent on cross border bank debt flows is also supported by the finding of Raddatz (2010) who finds that banks that relied more heavily on wholesale funding were more severely affected by the shock of the financial crisis.

2.2.4 Private Sector Credit and Europe

The launch of the euro in 1999 was an important factor contributing to financial integration in Europe. The euro removed exchange rate risk applying to international transactions within the euro area and allowed countries and companies in the euro area to raise finance in domestic currency (Lane and Milesi-Ferretti; 2008).

Barnes (2010) examines euro area imbalances. Although the euro area as a whole had a balanced external position in the period following the new currency's introduction, there were considerable imbalances within the euro area. The external deficits of countries such as Ireland, Spain and Greece were mirrored by surpluses in Germany, the Netherlands and Austria. The author cites rampant private demand driven by low real interest rates and strong credit growth as the primary sources of the Irish and Spanish current account deficits.

Bakker and Gulde (2010) provide analysis of the credit boom in the EU new member states. They find that the credit cycle was driven to a large extent by factors external to the region. Although some countries, Slovakia and the Czech Republic in particular,

avoided excess credit growth, they attribute only limited credit for this result to prudential policies. Rather, they highlight the dampening effect of exchange rate appreciation in both countries. The appreciation of the exchange rate helped keep inflation low which kept real interest rates high. Barnes (2010) emphasises the effect of the decline of the real interest rate in many of the peripheral euro area economies following the introduction of the euro.

Similarly, EBRD (2010) and Jevcak et al. (2010) suggest that external push factors were important contributors to rapid credit growth in the new EU member states. Capital inflows and foreign bank presence have been a source of growth in the transition region since the 1990s and have made a significant contribution to regional income convergence.

Pels (2010) finds that current account deficits in the E30 in the period prior to the crisis were less well explained by income convergence than by perceived growth prospects. Thus, countries with higher expected future income could justify borrowing large sums for the purposes of productive investment and consumption smoothing.

On the other hand, Giavazzi and Spaventa (2010) state that, if a country borrows mostly to finance the production of non-traded goods, it will violate its inter-temporal budget constraint. Some countries, like Spain and Ireland, used external borrowing to finance investment in the non-traded goods sector such as real estate which have proved not to be productive.

Why were foreign investors unaware of the sustainability problems? The answer, according to Giavazzi and Spaventa (2010), is that, to a large extent, there were no foreign investors investing specifically in assets earmarked for the financing of the construction activity. Instead, foreign financial institutions would lend to domestic financial institutions who would then lend to finance property purchases or development. In particular there was considerable growth in bank bond issuance where markets did not differentiate greatly between the various euro area member countries.

Excess use of external finance increases the vulnerability of countries to economic crisis. According to Milesi-Ferretti and Tille (2010), the increase in cross border bank lending made up a particularly high proportion of the growth of European cross-border flows, although this is partially because of the presence of large financial centres like the UK and Switzerland. Cross-border bank flows exhibited the largest decline in the immediate aftermath of the crisis.

2.2.5 Private Sector Credit and Regulation

It has been suggested that some of the responsibility for excess lending and the consequent bad debts lies with bank regulators and insufficiently strict regulations. Furthermore, improvements in bank regulation are widely regarded as being an important requirement in order to prevent a repeat of the current crisis.

There exists some literature to support this interpretation of events. Beck et al. (2009) find that low net interest margins, rising profitability and declining stability characterise the banking sectors of high income countries in the period prior to the crisis. Giannone et al. (2010) find that policies that favour liberalisation in credit markets and reduced

regulatory quality facilitated greater leverage and risk taking, thereby reducing countries' resilience to the recent recession.

Lanau (2009) investigates the relationship between domestic financial regulation and the incentive of non-banks to borrow from banks abroad. The results indicate that non-banks from countries in the upper quartile of a financial deregulation index borrow 20 percent more than non-banks in a country with minimum regulation. The regulation data they employ are taken from Abiad et al. (2008) and the sample period ends in 2005.

Djankov et al. (2007) investigate the cross-country determinants of private credit. They employ data on legal creditor rights and private and public registries. Credit rises after improvements in creditor rights and in information sharing.

Tressel and Detragiache (2008) find that financial reforms led to financial deepening but only in countries with developed political institutions. In particular, they find that their aggregate bank reform index has a significant correlation with the growth of private credit. Their sample extends from 1978-2005 and covers 91 countries.

2.2.6 Summary of Literature

As we have seen credit growth can have many positive consequences. Yet the recent credit boom episode has been a key cause of the current financial crisis. The narrative that emerges from our examination of the literature presented above can be summarised as follows:

Financial reform and integration, an ongoing process since at least the 1980s, has resulted in increased capital mobility and caused an exogenous increase in international capital flows (Lane and Milesi-Ferretti; 2008). Although this was a global phenomenon it was particularly pronounced in Europe where there has been a marked increase in current account dispersion (Barnes; 2010). Deregulation of financial markets was associated with increased leverage and increased financial flows. From 1999 to 2007, a large proportion of this increase took the form of cross-border banking flows (Milesi-Ferretti and Tille; 2010). Banks used debt rather than equity capital to increase lending (ECB; 2009).

Countries with insufficiently sophisticated financial institutions or countries with low growth prospects (due to political uncertainty, declining stocks of natural resources, demographic trends) exported capital. Investors sought attractive investment destinations with good growth prospects, political stability and financial systems sufficiently sophisticated to absorb substantial inflows (Pels; 2010; Schmitz; 2009; Caballero; 2010). As the number of countries satisfying these criterion was limited, excess inflows to attractive destinations or countries with inadequate bank regulation led to dynamic credit and domestic asset bubbles (Giannone et al.; 2010).

2.3 Regression Specification

A panel regression is run on data using non-overlapping three year period averages for the years 1999-2001, 2002-2004 and 2005-2007. This is common in the literature, as it

eliminates short-term cyclical factors. This allows us to focus on the medium-term factors that relate to private credit (Chinn and Prasad; 2003). The use of period averages are generally used for the control variables also but may represent individual years as dictated by the limited availability of some variables. For instance, regulatory variables from Barth et al. (2001, 2006, 2008) represent the values for the individual year in which each survey was released. Lagged control variables represent the level of each variable three year prior to the current period, $t - 3$.

Using data for the E30 gives a maximum number of observations of 90, 87 if we exclude Luxembourg. The panel is not balanced as some observations are not available, but there does not appear to be a sample selection problem. Thus, given the limited size of the dataset, we employ a relatively parsimonious fixed effects panel regression specification. The regression is run using least squares with the growth in private credit as the dependent variable:

$$F_{it} = \alpha_i + \beta_1 X_{it} + \beta_2 Z_{it} + \epsilon \quad (2.4)$$

The dependent variable F_i is the change in the ratio of private credit to GDP where t refers to the period average over the three years. X_i is a vector of control variables. Z_i is a vector containing one or multiple capital flows, bank regulation or market structure variables. α_i are the country fixed effects and ϵ is the error term. This chapter employs a fixed effects regression methodology. When considering whether to use fixed or random effects the latter has considerable advantages in that dummy variable approach is costly in terms of degrees of freedom. Furthermore, from a purely statistical perspective and depending on the specification, the use of the random effects specification was sometimes supported by the results of the Hausman test. It is difficult, however, to justify the assertion that the unobserved cross-country heterogeneity is random as is required by random effects. According to Greene (2002): "There is little justification for treating individual effects as uncorrelated with the other regressors, as is assumed in the random effects model. The random effects treatment, therefore, may suffer from the inconsistency due to this correlation between the included variables and the random effect." In the case of the country level data used in the analysis, there may be time invariant, unobserved characteristics relating to culture or that can be controlled for by implementing the fixed effects approach Verbeek (2004). If these factors are correlated with the explanatory variables then failure to include the country fixed effects would result in biased and inconsistent estimates. Therefore it is logical to use the fixed effects, within, estimator where the interpretation of the beta (value of coefficient) coefficients is, for example, for a given country as x varies across time by one unit, y increases or decreases by beta units. Furthermore, the usual assumption in OLS regressions is that errors are independently and identically distributed but in a panel regression it is often assumed that there are "clustered errors". This means that observations within group (in this case country) are correlated in some unknown way resulting in correlation between the error term within group, but that the errors of different groups are not correlated Nichols and Schaeffer (2007). In the presence of clustered errors OLS

estimates are still unbiased but the standard errors may be wrong. In other words, the use or otherwise of cluster robust standard errors has no effect on the point estimates but does alter the standard errors.

The regressions are run using the stata commands `xtreg` and `xtivreg2` (Schaeffer; 2005) which is the panel wrapper for `ivreg2` (Baum et al.; 2002). Using the "robust" command in Stata 11 with these commands adjusts the standard errors for country clusters in the standard errors by adjusting the covariance matrix of the error term by an intra-cluster covariance matrix for each group (Wooldridge; 2002).

As there is potential for endogeneity in the relation between credit growth and GDP growth and credit growth and the capital flows variables we use an instrumental variables approach using either a two stage least squares (2SLS) or generalised method of moments (GMM) estimator. If an explanatory variable is endogenous to the dependent variable then the expected value of the error term times the explanatory variable is no longer equal to zero. This violates the necessary conditions, known as moment conditions, for the OLS estimator to be unbiased and consistent. In order to generate unbiased and consistent estimates we need to find an instrument for the endogenous explanatory variable. An instrumental variable must be uncorrelated with the error term but correlated with the endogenous explanatory variable. The instrumental variable can therefore provide an additional moment condition because the expected value of the errors times the instrumental variable is zero by definition. This is a simplified explanation of what happens if the number of instruments exactly equals the number of endogenous variables.

If the number of instruments exceeds the number of regressors then there would be more equations than unknowns. Rather than dropping instruments and losing efficiency the GMM approach chooses the estimator such that the sample moments are as close as possible to zero by assigning different weights to each of the sample moments. According to Verbeek (2004) the general argument for the GMM estimator is based on the "moment condition" that the sample average converges to the population means as the sample size increases. Briefly, the true parameter values of the moment conditions of the population are zero so an estimator that minimises the sample moments as close to zero as possible will converge to the true value and will thus be consistent. This intuition is also outlined in more detail for the specific stata command used here in Baum et al. (2007). There are a number of algorithms available for solving this minimisation problem as outlined in Wooldridge (2002).

The details of the instruments are outlined below. The GMM estimator performs better than the 2SLS estimator in the presence of heteroskedasticity but its use has been questioned where it is applied on small samples (Verbeek; 2004).¹

¹All variables are in logs except dummies, demographic, financial reform and bank regulation and competition variables.

2.4 Data Sources and Stylised Facts

The Beck et al. (2009) financial development and structure database provides data on private credit to GDP. We use data on private credit from deposit taking banks rather than a similar measure on private credit of deposit taking banks and other financial institutions where available. Employing the alternative measure does not greatly alter the results of the analysis presented below as the data are extremely similar.²

Data on debt and equity flows and bank debt flows come from the IMF balance of payments statistics. Additional data on countries international investment positions come from Lane and Milesi-Ferretti (2010b) and the IMF international financial statistics. Trade data are taken from the IMF direction of trade (DOTS) statistics.

Data on GDP, inflation and population come from Eurostat. Interest rate data and supplementary inflation and current account data are taken from the IMF World Economic Outlook. The real effective exchange rate data are taken from the BIS.

As the availability of the data is limited, the panel dataset used here is unbalanced but there is little evidence to suggest that this results in any bias. That is, sample selection is not a serious issue. The number of observations available is not correlated with countries being among the Central and Eastern European (CEE) accession states. The regressions reported here exclude observations for Luxembourg, while we include Iceland, Ireland and Malta. These small countries are often considered offshore financial centres (Lane and Milesi-Ferretti; 2008) and the observations for these countries are generally very large and are often outliers. In the majority of instances, including or excluding the available observations for these countries does not undermine the proposed interpretation of the results.

Abiad et al. (2008) provide a more comprehensive data set on financial reforms for the period 1973-2005. We use indicators from this database on financial reform and an aggregate indicator for the quality of bank supervision. We also utilise indicators from the Beck et al. (2009) database on the net interest margin of banks and the number of listed companies per capita.

Barth et al. (2008, 2006, 2001) provide bank regulation data. In this paper the data from the three surveys are used to generate indicators across a number of subheadings using the summations suggested by the original papers. The private monitoring and capital stringency subheadings were of particular interest. Although we tried to follow their indices as closely as possible, the number of question included within each indicator differs from those outlined in Barth et al. (2006), as we were forced to drop some questions in order to maximise the number of observations. The basis for eliminating questions is largely quantitative, even though some of the ignored questions can be considered to be of as great importance as those included. This step is an unavoidable consequence of the limited

²Data are missing in the case of Norway and Iceland in 2007 and Austria, Belgium and France in 1999. We insert equivalent national central bank data or, where this is unavailable, the latest available adjacent year for these missing observations. If we extrapolate these missing values instead, it does not greatly alter the results as each year is only one third of each period average.

coverage of the data.

2.4.1 Instrumental Variables

The income growth and net financial flows variables are considered to be potentially endogenous. This issue is addressed using an instrumental variables approach.

The instrumental variables used are trade partner GDP growth, lagged values of income growth, the lagged change in the real effective exchange rate and the lagged change in the net equity and debt international investment position (IIP) and the lagged equity and debt international financial integration (IFI) ratio as well as the lagged change in the net and gross international equity and debt positions.³ We considered additional instruments such as trade openness and terms of trade adjustments, but these were not utilised as they did not improve the specification.

Trade partner economic growth is calculated using data on growth from the IMF World Economic Outlook (WEO) dataset weighted using export data from the IMF Direction of Trade statistics (DOTS). The latter data are also used to calculate trade openness which is exports plus imports as a ratio to GDP. The IIP and IFI ratios were calculated using the External Wealth of Nations data developed by Lane and Milesi-Ferretti (2007a).

The lagged change in the real effective exchange rate (REER) is taken from the Bank of International Settlements (BIS). Countries that had experienced a real effective exchange rate appreciation in preceding 3 year period exhibited larger net debt inflows in the 2005 to 2007 period.

2.5 Stylised Facts

Private Sector Credit

Private sector credit in the E30 under examination grew very rapidly between 1999 and 2007. At the end of the period, the countries with the highest private credit were the economies of Western Europe such as Ireland, the Netherlands, the UK, Spain, Portugal and Denmark. The CEE states had the lowest level of private credit at the beginning in 1999. The growth rate of private credit in these countries measured relative to previous values was very rapid but the dependent variable examined here refers to the growth of the ratio of private credit to GDP ratio. Both GDP growth and inflation were also faster in these countries. This puts the CEE countries further down the table in terms of the growth rate of the variable of interest.

The countries with the largest change in the private credit to GDP ratio in the years 2005 to 2007 were Ireland, Spain, Denmark, the Netherlands, the UK, Estonia, Latvia and Lithuania (see Figure 2.1). Germany is striking in that its private credit to GDP ratio actually declined over the period. If one looks at the growth rate of private credit rather

³The IIP is assets minus liabilities over GDP. The IFI ratio is assets plus liabilities over GDP.

than its ratio to GDP, the Baltic states appear to have a much more rapid growth rate of private credit as they had a far lower stock of debt at the beginning of the period.

Current Account and Financial Flows

Data on the current account come from the IMF World Economic Outlook (WEO) database. As outlined above, we expect larger increases in private credit to be correlated with current account deficits if that credit expansion is being financed using imported capital. Over the three years to the end to 2007, Bulgaria, Latvia, Lithuania and Greece had the largest current account deficits.

Data on financial flows come from a number of sources. Data for the composition of countries external position are taken from Lane and Milesi-Ferretti (2007a) and the IMF IFS data base. The data decompose the international investment position into portfolio equity, portfolio debt, foreign direct investment and “other”. The debt data presented in Figure 2.6 as the sum of portfolio debt and the other category.

Data on the composition of external flows are taken from the IMF BOP statistics. The data show equity and debt flows and also provide a breakdown into sectors. We are interested in the bank sector and bank debt in particular. The bank debt variable is calculated as the sum of portfolio debt plus other investments, except the “other” subcategory of the “other” component for which very few observations are available. The majority of the “other” component of investments is generally accounted for by loans and currency and deposits.

The non-bank debt variable is total flows minus bank debt flows as a ratio to GDP. The data on disaggregated capital flows is missing for many countries so the sample is considerably smaller when these variables are included. Of the countries for which such data are available, Iceland and Latvia had the largest bank debt inflows while Germany and Malta had the largest bank debt outflows. All the current account and capital flows variables are 3 year period averages.

Finance and Banking Regulation and Market Structure Indicators

In order to examine whether financial liberalisation indicators can help explain the growth of private credit, we include a financial reform variable is taken from Abiad et al. (2008). The variable is only available up until 2005 so it is lagged. That is the period average growth in private credit between 2005 and 2007 is regressed on the value of the indicator in 2005.

It is possible that a country that liberalised a long time ago would already have a high level of private credit and, thus, lower private credit growth. In order to address this we also examine the first difference of this indicator as an indicator of the process of financial liberalisation.

It should be noted, however, that many of the countries under examination were at the upper limit of the financial reform index. This limits both time series and cross-sectional variation for countries that had already liberalised their financial systems.

We also include the first difference of bank supervision component of the financial reform index taken from Abiad et al. (2008). This relates to capital adequacy ratios and the independence and legal power of the supervisory agency. Once again, there is an issue arising from a lack of variation in this variable both within and between many countries.

Barth et al. (2001, 2006, 2008) provide a large number of regulatory variables. They include a measure capital regulatory stringency based on two separate concepts. Overall capital stringency measures the extent of regulatory requirements regarding the amount of capital banks must hold. According to the Barth et al. (2008) data, in 2007 the minimum capital to asset ratio requirement is in line with the 1988 Basel guidelines in all of the EU27+3 group of countries. The capital requirement (excluding variation for initial years) was 8 percent in all countries except Bulgaria, Romania and Cyprus. The majority of the variation in the overall capital stringency variable comes from regulations regarding deductions to the book value of assets. Belgium, Ireland and Lithuania are among the most lenient countries in this regard.

The private monitoring index includes questions relating to the quality and reliability of bank corporate accounts publications and the extent to which off balance sheet transactions are publicly available information. In 2007, the mean value of the private monitoring index was 7.5, slightly lower than in 2003 at 7.9. In 2001 the value was 5.7.

As discussed previously, Beck et al. (2009) provide data on a variety of bank related variables. We are particularly interested in investigating whether competition between banks resulted in faster private credit growth. One indicator of this is the net interest margin, which equals the accounting value of a bank's net interest revenue as a share of its total earning assets. Beck et al. (2009) state that higher levels of net interest margin indicate a lower level of bank efficiency. We interpret this indicator as reflecting the level of bank market competition. Ireland, Belgium, Luxembourg and Spain had the lowest net interest margins in 2007.

The Barth et al. (2001, 2006, 2008) market structure indicator includes three variables. These are variables measuring the market share of foreign and the market share of government owned banks and a market concentration indicator. The concentration indicator from Beck et al. (2009) offers superior coverage so this is preferred. Germany is an outlier in that the government owned share of bank market remains large in 2007.

2.5.1 Other Control Variables

Lagged Private Credit

We include a lagged level of private credit variable. It is anticipated that, *ceteris paribus*, a country that already has large stock of private credit will have slower credit growth. A debtor that is already highly leveraged is more likely to be considered risky.

Countries that had higher lagged private credit to GDP ratios in 2004 had higher GDP and experienced slower average growth in GDP in the subsequent three years.

To try and capture more of the complex relation between GDP and private credit

we also include a private credit*GDP interaction term (in addition to the lagged GDP variable). A country or individual with a higher income can afford to borrow more than a poorer country. For this reason, lagged GDP and private credit are positively correlated. Wealthy countries that already have a large stock of private credit are expected to have slower private credit growth.⁴

Lagged GDP and 3 year growth in GDP

Germany, France and the UK are the largest economies examined. Luxembourg, Norway, Iceland, Ireland and Switzerland are the countries with the highest GDP per head of population. The countries with the fastest GDP growth over the period 2005 to 2007 were Romania, the Baltics and Slovakia. The countries with the slowest growth were Germany, Italy and Switzerland. Countries with a larger change in the ratio of real private credit to GDP tended to have higher nominal GDP growth. When we examine simple correlations and scatter plots, the relationship between the change in the private credit to GDP ratio and the level of GDP or GDP per head of population is not that clear.

Euro

Countries within the euro area had higher than average private credit to GDP ratios, higher GDP per head of population, higher GDP and slower GDP growth. Euro area member countries had a higher change in the ratio of private credit to GDP. Increased financial integration resulting in increased market liquidity and the removal of exchange rate risk in the euro area may have increased the supply of funds and reduced borrowing costs. Greece and Slovenia are the countries that joined the euro over the course of the time period under examination.

Change in real interest rate

One might anticipate that, in countries with flexible exchange rates and, thus, independent monetary policies, a reduction in the ex-post real interest rate would have a more rapid growth rate in private credit.⁵ This is not initially observable from the data and it may have been the case that central banks worried that excess credit growth raised interest rates. Furthermore, according to Lane and Milesi-Ferretti (2002), if the supply of international

⁴In order to examine financial accelerator type explanations it would be necessary to include a measure of asset prices. The most appropriate asset price to use would be one measuring house prices. A reliable cross country data set on housing prices is not available (the BIS series is the closest thing to such an indicator). Moreover, it is questionable whether including such a variable would be appropriate as papers such as Hofmann (2001) and Kelly (2010) suggest that the change in house prices and the change in private credit are cointegrated. Therefore, it is not an objective of this paper to test the relation between asset prices and private credit.

⁵The inflation rate used to adjust the nominal interest rate is the observed ex post inflation rate rather than the ex ante expected inflation rate. Saving and investment decisions are generally considered to be based on expected inflation. In the majority of the countries under examination, the years under examination are part of what is referred to as "the great moderation" as central banks successfully reduced inflation expectations and actual inflation. It should be acknowledged, however, that inflation in the Baltics and particularly in Romania and Bulgaria remained relatively volatile.

funds is upward sloping, a debtor country should experience higher interest rates than creditor countries. Thus, it may be the case that the causality is running in the opposite direction to that which we desire.

This indicator should still be relevant in the euro area because, despite the nominal interest rate being the same for all member states, there was considerable variation in inflation (Barnes; 2010).

Demographic Variables

Demographics have been shown to be related to a country's international investment position (Lane and Milesi-Ferretti; 2002). Change in the demographic profile can result in an increase in the demand for loans and, therefore, an increase in the private credit to GDP ratio.

Cyprus, Iceland and Lithuania had the largest increase in the working age population. Germany and Austria experienced the largest decline. Scatter plots and correlations suggest that countries with greater increases in the working age population to total population ratio had larger changes in the private credit to GDP ratio.

A discussion of the demographic specification can be found in the appendix.

2.6 Analysis of Results

2.6.1 Graphical Analysis

Before conducting the regression analysis, it is desirable to examine the data graphically in order to get a better understanding of how the variables relate to each other. Even without resorting regressions, examining the graphs presented below allows us to challenge a certain interpretation of events.

Hume and Sentance (2009) suggest that the Bernanke (2005) "global saving glut" and Caballero (2006) theories are not sufficient to explain the rise of private credit in Europe because the scale of the net inflows of capital were not sufficiently large. The analysis below shows the importance of distinguishing between different types of capital flows. The results suggest that Hume and Sentance (2010) are largely incorrect. We will illustrate that the magnitude of debt flows is generally large enough to account for credit growth.

To give a sense of the scale of international financial positions, Figure 2.2 shows the IFI ratio in 2002 and 2007 divided into 5 components; portfolio equity, foreign direct investment, portfolio debt and other investments (other debt) and foreign exchange reserves (Lane and Milesi-Ferretti; 2007b). Luxembourg is excluded because the scale of their IFI ratio is so large it makes it difficult to examine the other countries. What is striking from the graph is the large increase and high proportion of total financial positions accounted for by portfolio debt and other investment.

The change in the net international investment position for the disaggregated investment categories is displayed in Figure 2.3. It is clear from the graph that many of the countries that experienced rapid private credit growth also saw a deterioration in their net

IIP in the “other investments” (debt) category. Spain and the UK experienced a fall in net portfolio debt assets.

Figure 2.4 differs from the previous graph in that it shows data (taken from IMF BOP statistics) on equity and debt flows rather than changes in stocks. The picture is broadly similar. Austria, Finland, Germany, the Netherlands, Norway, Sweden and Switzerland experienced net debt outflows. Countries that are associated with excess credit growth such as Iceland, the Baltics, Spain had large debt inflows.⁶ Although complete data is not available for many countries in the sample, Hoggarth et al. (2010) states that the biggest increase in flows was debt flows between banks.

Figure 2.5 shows a scatter plot of the change in private credit, net debt (portfolio plus other investments) and foreign bank claims. Figure 2.6 excludes Iceland, where the scale of flows was very large relative to GDP, to facilitate a comparison of the rest of the countries. It should be clear from these graphs that the growth in private credit and the change in net debt IIP and net bank debt flows, while not perfectly correlated, exhibited a close correlation and were of a similar size.

A similar graph, Figure 2.7, showing private credit and the change in net equity IIP and net non-bank debt flows does not exhibit such a close correlation. Indeed, debt and equity flows in number of countries appear to go in the opposite direction which would explain why private credit growth did not always lead to large current account deficits.

The acceleration in the growth in private credit and both bank and non-bank capital flows occurred simultaneously. The mean change in the private sector credit ratio between 2005 and 2007 was approximately 13 percent. Even excluding Ireland, Luxembourg, Iceland, Malta and Cyprus, the change in the mean IFI ratio between 2005 and 2007 was over one hundred percent of GDP. For the countries for which complete bank flow data are available, private credit grew by 11 percent while net bank debt flows were minus 10.5 percent of GDP.

The data excludes the “other” subcategory of “Other Investments” because of limited data availability. Nevertheless, the magnitude of the measured net debt flows was often greater than the value of the current account. Contrary to Hume and Sentance (2009) international capital flows in the form of debt and more specifically bank debt flows were sufficiently large to explain private credit growth.

⁶The obvious exception to this narrative is Ireland which had net debt outflows and net equity inflows between 2005 and 2007. This differs somewhat from the net IIP data which shows a much smaller change in net debt and net equity IIP than the flows would suggest. Unfortunately, not all of the categories of “Other Investments” are included in the debt flows data as this data was unavailable for many countries. Furthermore, Ireland has an extremely large gross IIP largely due to Dublin’s role as an international financial services centre (IFSC). The large gross IIP means that valuation effects may account for a particularly large part of the change in Ireland’s net IIP. The IFSC makes identifying the portion of flows attributable to Irish domestic activity difficult.

Similar difficulties arise when examining the data for other small countries that host financial centres such as Luxembourg (Lane and Milesi-Ferretti; 2010a). For example, Felletigh and Monti (2008) state that, although a substantial fraction of Italian portfolio asset holdings are reported as equity claims on Ireland and Luxembourg in the form of mutual fund shares, their ultimate destination tends to be outside the euro area and the underlying instruments are skewed toward debt rather than equity. For instance, US treasury bonds held indirectly by Italians through an Irish mutual fund will be recorded as an equity inflow and a debt outflow from an Irish perspective.

2.6.2 Baseline Specification

The results of the regressions in Table 2.2 can be considered the baseline specification. In column (1) all variables relating to external capital flows are excluded. In columns (2) and (3) a variable measuring the current account is included. As discussed previously, the current account can be loosely interpreted as representing aggregate net capital flows into, and out of, a given country, as it is the sum of the financial and capital accounts. The growth of private credit is a measure of domestic credit.

We expect larger increases in private credit to be correlated with current account deficits if that credit expansion is being financed using imported capital. The coefficient on the current account variable in column (2) is negative and statistically significant. This suggests that higher current account deficits were significantly correlated with more rapid private credit growth. The significance level of the current account variable is sensitive to the inclusion or exclusion of certain outliers. In particular, excluding Iceland means that the variable is no longer statistically significant at the 10 percent significance level. Excluding Malta means that the variable is significant at the 5 percent significance level.

When the other coefficients in the model are examined they are generally in line with the macroeconomic theory outlined in the literature above. The results indicate that faster GDP growth was correlated with faster private credit growth. A 1 percent increase in the growth rate of GDP is associated with a 0.33 percent increase in the growth rate of private credit. The result is highly statistically significant. There may be an issue with regard to endogeneity in the case of this variable. That is, private credit may positively affect GDP growth rather than the other way around. We will return to this issue below.

The coefficient on GDP per capita is positive and also statistically significant in columns (1) and (2). As countries became wealthier they experienced faster private credit growth. However, the inclusion of time dummies in column (3) tends to eliminate the significance of the GDP per capita variable, suggesting that it is explaining pure time series variation. The majority of private sector credit growth during the sample period occurred in the period between 2005 and 2007. As all of the countries were wealthier at the end of this period than at the beginning of the sample means there is a correlation between the two variables. The positive effect of GDP on private credit is largely removed in column (3) as a consequence of the inclusion of the time dummies.

Indeed, if we look at the data, the change in the ratio of private credit to GDP appears to be higher in the later years of the sample on average. Yet not all of the countries experienced increases in private credit as the credit boom was concentrated in certain countries. Germany actually experienced a decline in the ratio of private credit to GDP. Other countries, such as Austria, Poland and the Czech Republic, did not experience rapid growth in private credit either.⁷

Including the time dummy variables controls for increases in private credit to GDP ratio associated with the associated period but the coefficient does control for any cross-

⁷The positive coefficient on GDP is also consistent with Pels (2010) in that it runs contrary to a convergence-based explanation of capital flows and credit growth.

sectional variation. The decision to emphasise the results including or excluding time variables should be made with reference to these statistics as well as the theoretical point each regression is supposed to make.

The lagged ratio of private credit to GDP has a negative coefficient, although it is not statistically significant in any of the specifications in Table 2.2. Nevertheless, the coefficient on this variable is statistically significant in many of the specifications presented below. The negative coefficient suggests that countries where the private sector was already heavily indebted had slower growth rates of private credit.

When we include a lagged level of private credit*GDP per capita interaction term, the total size of this coefficient on lagged GDP becomes considerably smaller for countries that already had high levels of private credit. Wealthy countries that already had high levels of private credit had slower growth in private credit.

A euro membership dummy variable is also included and the coefficient on this variable is positive but not statistically significant in the baseline specification displayed in Table 2.2. We will see that this coefficient is positive and statistically significant in subsequent specifications which suggests that countries that joined the euro area experienced more rapid private credit growth than countries that remained outside non-euro countries. This may have been due to a number of factors, such as increased financial integration and the removal of exchange rate risk, as discussed in detail above in the literature review section.

8

The change in the real (policy rate) interest rate variable is negative but not statistically significant. According to Lane and Milesi-Ferretti (2002) if the supply of international funds is upward sloping, a debtor country should experience higher interest rates than creditor countries. Thus, it may be the case that the causality is running in the opposite direction to that which we desire in floating exchange rate countries. This may also explain the lack of statistical significance. Removing the real interest rate variable from the regression does not alter the key findings of the paper. This result applied even to countries in a currency union or with fixed exchange rates versus the euro. The coefficient remains statistically insignificant if we examine either euro area or non-euro area countries separately.

It may be the case that the positive coefficient on the euro variable is capturing the effect of the one-off fall in real interest rates in peripheral countries as a result of the introduction of the euro. The increase in confidence in peripheral countries and the fall in their real interest rates are closely related. Nevertheless, the overall size of the euro and real interest rate effects may be smaller than critics of the euro may have anticipated. There was little time series variation in the euro variable, however, and the majority of the growth in private credit occurred at the end of the period six years after the majority members joined the euro.

Although the literature reviewed above suggests that demographic factors are an important determinant of the growth of private credit the reported χ^2 statistics indicate that

⁸Although not shown in Table 2.2, if we include Cyprus and Malta, who joined the euro area on January 1 2008, as *de facto* in the euro area in 2007 then the coefficient on the euro membership remains statistically significant.

coefficients are not jointly significant in the majority of specifications.

2.6.3 Types of Capital Flows

We have seen that aggregate capital inflows, as represented by the current account, are correlated with private credit growth although this result is not robust to the inclusion of time dummies. It could be argued that this lack of robustness means that the current account and thus international capital flows were not important determinants of the growth in private credit (Hume and Sentance; 2009).

This paper argues that financial integration may impact on private credit growth through net debt and net equity flows. These flows may not necessarily be reflected in the aggregate current account balance as net debt and net equity flows may not have the same sign and may cancel each other out. The results presented below illustrate that, if we differentiate between debt and equity flows, international capital flows do explain a considerable proportion of the variation in private credit growth.

Table 2.3 includes the variables for net equity and net debt taken from IMF BOP statistics. The results suggest that private credit growth was correlated with net debt inflows with respect to the rest of the world. Although net equity flows are also statistically significant, the net debt flows variable is statistically significantly larger and is significant at a higher confidence interval.⁹

Including the disaggregated capital flows variables improves the overall explanatory power of the model considerably as is apparent from the increase in the size of the R^2 statistics. In columns (1) and (3) the lagged private credit and euro variables are statistically significant and have the anticipated signs. The magnitude of the euro effect, though positive, is not large.

The addition of time dummy variables in column (2) does little to alter the size or significance of the equity and debt variables. In column (3), lagged equity and debt IIP variables are included but the coefficients on these variables are neither jointly nor individually statistically significant. This result is not dependent on the inclusion or otherwise of the lagged private credit and GDP per capita*private credit variables.

The statistically significant difference between the debt and equity flows variable is robust to the exclusion of individual outliers or countries with extreme values such as Iceland, Ireland and Bulgaria.

The analysis above shows the importance of distinguishing between different types of capital flows when examining the role of international capital flows in funding private credit growth.

⁹Debt and equity flows data are missing for Romania, Belgium, Cyprus and Slovakia in the 1999-2001 period and Romania in the 2002-2004 period. The current account is no longer statistically significant if we run the regression presented previously on the remaining countries.

2.6.4 Instrumental Variables

In order to address endogeneity issues, a series of regressions utilising instrumental variables are implemented. Endogeneity is an issue in so far as private credit may positively affect GDP growth rather than the other way around. Although we have attempted to control for demand-side factors, the correlation between capital inflows and credit growth may be caused by increased credit demand rather than improved credit supply. By instrumenting for the capital flows variables we hoped to isolate the supply side factors resulting from the increased availability of funding from international sources.

The results of the IV regressions are presented in Table 2.5. Columns (1) and (3) present the results of Generalised Method of Moments (GMM) regressions while columns (2) and (4) present results of 2 stage least squares (2SLS) regressions. The 2SLS estimator is considered superior in small samples but GMM is unbiased in the presence of heteroskedasticity (see Verbeek (2004) pp 152 and Wooldridge (2002) pp192). The core results do not differ greatly if either the GMM or 2SLS estimation method is employed.¹⁰

Net equity and debt flows are instrumented using the lagged debt and equity IFI ratio, the lagged change in the net debt and equity international investment position.

The period average growth rate of GDP per capita is instrumented using variables for the lag of the growth rate of GDP, the growth rate of a country's trading partners, weighted by export share and the lagged change in the real effective exchange rate.

The results of this specification, with regard to the net debt and equity flow variables, are largely similar to those produced by the specification used to generate the results presented in Table 2.3 with very similar signs and coefficients. The net debt flows variable is of a similar size and significance in both the non-IV and IV specifications. The net equity flows variable is of a similar magnitude and sign but is no longer statistically significant. The period average growth rate of GDP per capita coefficient is not greatly altered by the change of regression specification either. It is not statistically significant, particularly if we include time dummies, as was the case in the fixed effects specification.

Excluding Iceland from the regression reduces the individual significance of the debt flows variable but the variable remains statistically significantly different from the equity flows variable at the 5 percent significance level. Excluding other outliers or extreme values does not alter the results.

Table 2.4 shows the regression results of the first stage of the 2SLS procedure. The excluded instrumental variables for net debt and equity flows are generally individually statistically significant. It has been shown that the weak instruments problem can arise even when there are statistically significant correlations between the instrumented variable and the excluded instruments (Baum et al.; 2007). The Kleibergen-Paap rk statistical test for weak identification does suggest that weak identification is a problem. The value of the f-statistic for this test is considerably less than the "rule of thumb" value of 10 suggested

¹⁰The number of observations is one less than the non-instrumented regression because Romania is excluded. This is because we only have one observation for Romania, referred to as a singleton group. As such, Romania does not provide any variation that is not absorbed by the country fixed effect. Excluding or including singleton groups makes no difference to the other results.

by Baum et al. (2007) and so the instrumental variables may not be valid. The weak instruments problem applies more to the net debt and equity flow variables than the GDP growth variable for which the Kleibergen-Paap rk statistic is generally greater than 10.

Using the limited information maximum likelihood estimator (LIML) or continuously updated estimator (CUE), which are more robust to the presence of weak instruments, does not alter the relative size or significance of the net debt and equity variables. Finally, the Hansen j-test statistic for overidentification of the instruments is not significant so we can not reject the null hypothesis that the instruments are valid on this basis.

Nevertheless, it is useful to examine the first stage regression results. Net debt and equity flows are negatively correlated, indicating that a country with larger net debt flows can expect smaller net equity flows (this correlation is sensitive to the exclusion of Ireland, Iceland, Malta and Bulgaria). The economic theory outlined above does not suggest that there should be large differences in the determinants of debt versus equity flows. The opposite sign on net debt and net equity flows illustrates how it was possible for countries to have internationally financed credit bubbles without having correspondingly large current account deficits. The first stage regressions suggest that countries that had large capital inflows, either debt or equity, in the previous period had positive equity outflows in the subsequent period.¹¹

The instrumental variables specification performs well for the GDP growth variable. One issue that emerges again, is the positive coefficient in the first stage regression on the change in the real interest rate. It is likely that this represents reverse causality. Excluding the change in the real interest rate variable does not change the main results a great deal and it was considered preferable to keep the change in the real interest rate in the second stage regression. Thus, the instrumental variable approach is replicated for the GDP growth variable in all subsequent tables.

Despite the weak instrument issue, the results support the hypothesis that private credit growth is closely tied to debt inflows. Countries that were financially integrated and sophisticated could sustain larger external positions. The resulting current account deficits represented an inflow of capital some of which was used to fund the growth of private credit.

These results apply to the pre-crisis period but may relate to those of Milesi-Ferretti and Tille (2010). They find that countries with larger net liabilities in debt instruments experienced more severe sudden stops in capital inflows in the immediate aftermath of the crisis.

2.6.5 International Investment Position

To further check the robustness of the differing results for debt and equity capital, we also examine the change in countries' debt and equity IIP. The IIP data differ from the data used in the previous section as they represent the change in the net position rather

¹¹Individuals may have borrowed to invest in property overseas or companies may have acquired overseas subsidiaries or undertaken FDI.

than the net flow. Much of the difference between the two measures should be accounted for by valuation effects (Lane and Milesi-Ferretti; 2007b). Examining the IIP data also means that we can check the robustness of the results to differences arising from variation in errors and omissions between the two data sources.

Columns (1) and (2) of Table 2.6 show regressions that control for changes in countries net debt and equity IIP. A deteriorating net debt IIP is negatively correlated with private credit growth. Columns (3) and (4) include variables for the change in the net equity and net debt IIP and the lagged net equity and net debt IIP. Once again the change in the net debt IIP is negatively and statistically significantly correlated with credit growth. The change in net equity IIP coefficient is statistically significant but has the opposite sign.

Both the lagged net equity and debt IIP variables are statistically significant. The positive coefficient on the net equity variable might be interpreted as countries being able to borrow more if they had a positive equity IIP to use as collateral. The lagged net debt IIP is negative and statistically significantly correlated with private credit growth. The results in columns (1) to (4) are consistent with the theory that banks were using international debt inflows, rather than equity, to finance private credit growth. The results are not sensitive to the exclusion of individual countries that have outliers or extreme values.

2.6.6 Bank and Non-Bank Debt Flows

When the Bank debt flows and non-bank debt flows variables created using the IMF BOP data are included, we observe that there is a clear distinction between bank debt flows and other kinds of debt flows (see Table 2.7) despite the limited number of observations. The bank debt variable is calculated as the sum of portfolio debt plus other investments, except the “other” subcategory of the “other” component.¹²

Net bank debt flows are statistically significantly correlated with private credit growth. The coefficient on non-bank debt flows is also statistically significant but the coefficient on bank flows is statistically significantly larger in all the regressions depending on the test that is implemented.¹³

If we also include equity flows, then this variable is not statistically significant and the bank debt flows generally remains statistically significantly larger than the non-bank debt flows variable. Although there are only 18 countries for which data are available this is evenly spread between EU-15 and accession states. A further two countries (two observations) have no effect on the results because they are singleton groups.¹⁴ Despite the reduced number of observations, the results are not sensitive to the exclusion of individual countries that are outliers or which may include extreme values. Even if relative outliers

¹²A negative value on the bank debt flow variable means that a countries’ banks (excluding valuation effects and errors and omissions) are running down their net stock of assets and/or increasing their net stock of liabilities.

¹³Tests reject the hypothesis $B_1 = B_2$ in all 4 specifications but only reject the hypothesis $B_1 = -0.56$ in column (1). The former test is what is widely implemented (Verbeek; 2004).

¹⁴If we run the regression presented above on this smaller group of countries there remains a statistically significant difference between the coefficients on the aggregate debt and equity flows variables.

or extreme values such Bulgaria and Iceland and Malta are simultaneously excluded, the difference between the bank and non-bank flow variable remains significant at the 5 percent significance level.

The results presented highlight the importance of differentiating between types of capital flows. Capital inflows can take a number of forms and need not necessarily lead to increases in private credit as the net external position and private credit are not jointly determined. Likewise, an increase in the stock of private credit does not necessitate a change in a country's external position. However, the results presented above provide evidence that international debt flows and bank flows were used to fund credit growth. Furthermore, debt flows and bank debt flows appear to be more closely correlated with credit growth than equity flows or capital flows other than bank debt.

2.6.7 Regulatory and Market Structure Indicators

It has been suggested that countries experienced rapid credit growth due to financial reform, inadequate bank regulation or excessive competition between banks (Giannone et al.; 2010). This section tests this theory by examining a number of regulatory and market structure variables.

A financial reform variable is taken from Abiad et al. (2008) and as such it is only available up until 2005. Column (1) of Table 2.8 displays the results of regressions using the lag of this variable and it is not statistically significant. The coefficient on the lagged first difference of the financial reform variable is negative and statistically significant (column 2). We would expect that countries engaged in financial reform had faster private credit growth. This is inconsistent with the theory suggested by this paper and evidence presented by Bakker and Gulde (2010).

It should be noted, however, that many of the countries under examination were at the upper limit of the financial reform index and that we only have a limited number of observations for this variable. As such one must interpret this result with caution. Our results contrast starkly with Giannone et al. (2010), which finds that this variable is statistically significant. This is likely to be related to the fact that their paper examines a larger and more diverse group of countries. The countries examined in this paper are almost all at or near the upper bound of the financial reform index. A large proportion of the countries examined in this paper were largely financially reformed at the beginning of the sample period.

The change in the banking supervision component of the financial reform variable is also positive but not statistically significant (see column (3)). This is the "wrong" sign if we expect better regulation to lead to less credit growth. It should be noted that there is little variation in this variable for many countries, so once again, one should not over emphasise these results. Perhaps countries with better perceived regulation could borrow more. Although the Basel III negotiations were ongoing, the issue of the quality of bank regulation only received more widespread attention in the aftermath of the crisis.

The private monitoring index and the capital regulatory index taken from Barth et al.

(2008, 2006, 2001) are included in the specification displayed in column (4).¹⁵ The private monitoring index is found to be statistically significant, whereas the capital regulatory index is not.

The capital regulation index indicates whether capital requirements reflect risk and loss elements and the level of capital stringency. This result should not be considered as proving that bank regulations and bank regulators had no influence on private credit growth.

Nevertheless, the lack of significance of the capital regulatory index is in line with previous literature. Cihak and Schaeck (2010) find that aggregate bank ratios are useful in identifying problems in banks but that this is limited by a number of factors. In extreme instances (when they are likely to be of interest) banks may resort to “creative accounting”. Barth et al. (2008) state that, although many countries followed the Basel 2 guidelines and strengthened capital regulations and gave greater powers to supervisory agencies, there was little evidence to suggest that this would stabilise their banking systems.

The private monitoring index provides information relating to audit and accounting practices and the degree of internationalisation of banks. While it is statistically significant in the regression specification it is not significant in many others. The variable is sensitive to the inclusion or otherwise of annual fixed effects as most of the data suggests that there was a decline in the strictness of bank private monitoring regulations between the 2003 and 2007 surveys.

It should be acknowledged that the regulations presented here do not capture how strictly and thoroughly bank supervisory agencies implemented the existing regulations. It is possible that some jurisdictions were stricter in their interpretation of the rules than others. It is also possible that, in some countries, inadequate bank regulation was a product of regulatory capture.

Columns (5) and (6) of Table 2.8 show the results of a regression including two explanatory variables which can be considered to be measures of bank market competition. The net interest margin equals the accounting value of a bank’s net interest revenue as a share of its total earning assets. Beck et al. (2009) state that higher levels of the net interest margin indicate lower level of bank efficiency although this measure can be interpreted as an indicator of bank competition. This variable is statistically significant in the specification used in column (5) which suggests that countries with more efficient or competitive banks had more rapid private credit growth.

The market structure variable included in column (6) is a composite of three indicators calculated using principle components. These are, the government owned share of the banking sector, the domestically owned share of the banking sector (Barth et al.; 2008, 2006, 2001) and the concentration ratio in the banking market (Beck et al.; 2009). Countries with more private ownership, more foreign ownership and a lower concentration ratio, that is more a competitive banking sector, had faster private credit growth. The market structure

¹⁵The years in these regressions include 2003 rather than 2004 as in the other regressions due to data availability.

variable is not statistically significant in this specification but this result is sensitive to changes in the specification.

The results are not sensitive to the exclusion of individual countries but are not generally robust to other changes in specification. The private monitoring index loses significance when time dummies are included. The net interest margin loses significance when the market structure variable is included also although to some extent this is not surprising as these are both measures of industry competitiveness.

Overall, the analysis suggests that bank competition and market structure did have some influence on credit growth. This is consistent with (Beck et al.; 2006) who find that lower bank concentration and increased bank competition are positively correlated with banking crises.

2.7 Interpretation and Conclusions

The results presented in this paper illustrate how private credit growth was financed using external sources of funding. We find that private sector credit growth is correlated with the current account balance. However, some countries had rapid credit growth without corresponding large current account imbalances. We show that this is because debt flows, and bank debt flows in particular, are the component of capital flows most closely associated with private credit growth.

As European countries became more financially sophisticated and more financially integrated, they were able to sustain larger external positions, as indicated by a greater dispersion of current account balances. In many countries a large proportion of capital flows were debt flows. The pattern of net equity flows did not always follow the same pattern as debt flows. Furthermore, a very high proportion of the change in a country's net debt position is accounted for by banks. In recipient countries, these debt flows could be used to finance rapid increases in private credit.

Moreover, considering the evidence presented here and in the related literature, it seems clear that the funding necessary to finance the increase in private credit growth was obtained through bank borrowing. Banks were the financial intermediaries that allowed households and the majority of corporations to gain access to international capital markets. The increase in international capital flows provided the funds necessary for the expansion of private credit.

The fact that banks used debt rather equity to fund credit growth is particularly noteworthy considering the perverse incentives and moral hazard resulting from bank bailouts. That is, banks may have preferred taking on debt to raising equity because of the possibility that, equity holders will absorb losses, while governments will move to protect debt

holders in times of crisis.¹⁶

We also provide limited evidence of the importance of bank regulation and market structure as a determinant of private credit. Although detailed data on bank regulation is available and was analysed, it is difficult to find a robust correlation between any individual regulatory indicator and private credit growth, or to assign greater importance to a particular set of regulations. This highlights the difficulties facing financial regulators wishing to formulate effective regulations to prevent a repeat of the current crisis and stabilise their banking systems.

Policy makers should be aware of the importance of differentiating between types of capital flows. The European Commission (2010) have emphasised that it will be necessary in future to monitor aggregate current account balances. This paper has shown that it is possible for a country to have rapid credit growth without running an equivalent current account deficit. Future economic surveillance should include monitoring of disaggregated capital flows.

¹⁶Although we touched on the subject in the first stage regressions, future research could focus on the determinants of debt flows or bank flows using bilateral data. Alternatively, we could focus more on the euro area and in particular the effect of the fall in interest rates in peripheral countries upon its introduction. Perhaps examining a larger number of countries would provide greater support for the role of regulation.

2.8 Appendix: Demographic Specification

The demographic specification used here attempts to control for variations in all demographic groups. The method is the same as that used by Lane and Milesi-Ferretti (2002); Schmitz (2009) which originates in Fair and Dominguez (1991) and Higgins (1998). We divide the population in $J = 12$ cohorts and the age variables enter the private sector credit equation as $\sum_{j=1}^{12} \alpha_j p_{jt}$ where p_{jt} is the population share of cohort j in period t and $\sum_{j=1}^{12} \alpha_j = 0$. Restrictions are made such that the coefficients lie along a cubic polynomial:

$$\alpha_j = \gamma_0 + \gamma_1 j + \gamma_2 j^2 + \gamma_3 j^3 \quad (2.5)$$

The zero sum restriction on the coefficients implies that

$$\gamma_0 = -\gamma_1(1/J) \sum_{j=1}^{12} j - \gamma_2(1/J) \sum_{j=1}^{12} j^2 - \gamma_3(1/J) \sum_{j=1}^{12} j^3 \quad (2.6)$$

We can then estimate $\gamma_1, \gamma_2, \gamma_3$ by introducing the age variables into the specification as:

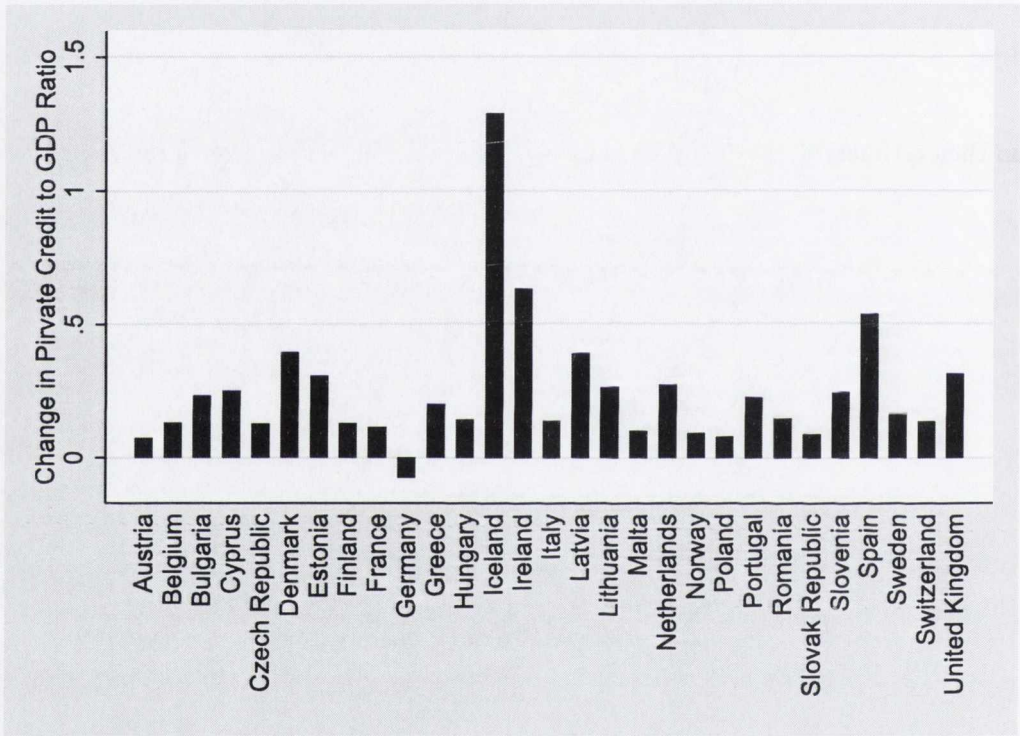
$$\gamma_1 DEM_{1t} + \gamma_2 DEM_{2t} + \gamma_3 DEM_{3t} \quad (2.7)$$

$$DEM_{1t} = \sum_{j=1}^{12} j p_{jt} - (1/J) \sum_{j=1}^{12} j \sum_{j=1}^{12} p_{jt} \quad (2.8)$$

$$DEM_{2t} = \sum_{j=1}^{12} j^2 p_{jt} - (1/J) \sum_{j=1}^{12} j^2 \sum_{j=1}^{12} p_{jt} \quad (2.9)$$

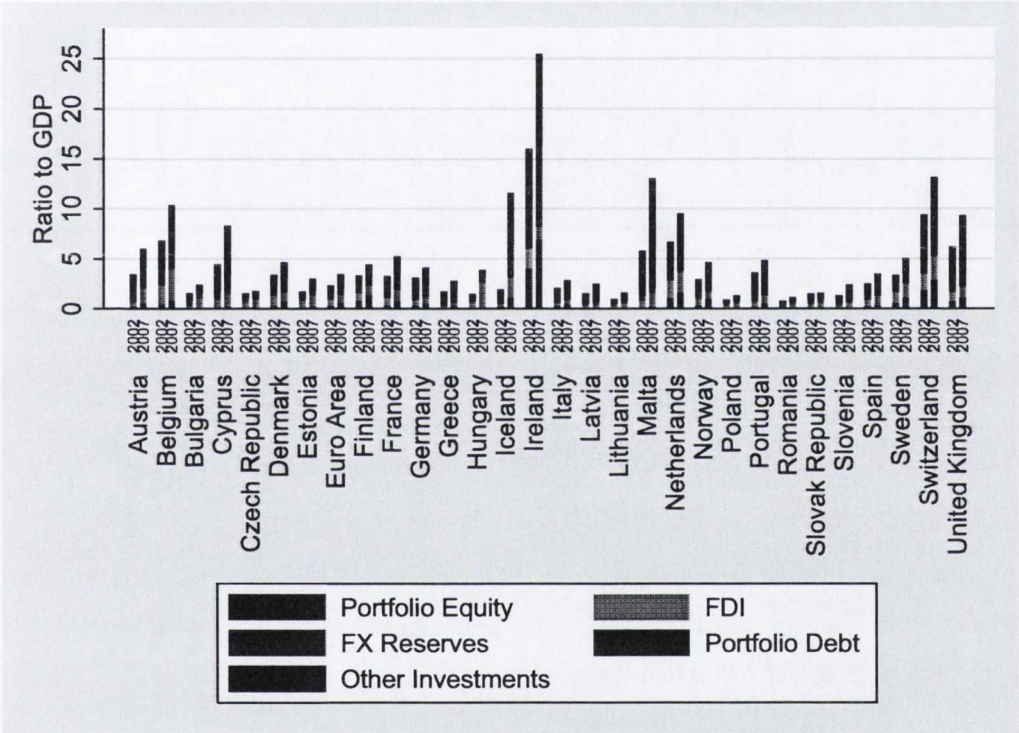
$$DEM_{3t} = \sum_{j=1}^{12} j^3 p_{jt} - (1/J) \sum_{j=1}^{12} j^3 \sum_{j=1}^{12} p_{jt} \quad (2.10)$$

Figure 2.1: Private Credit Growth: 2005-2007



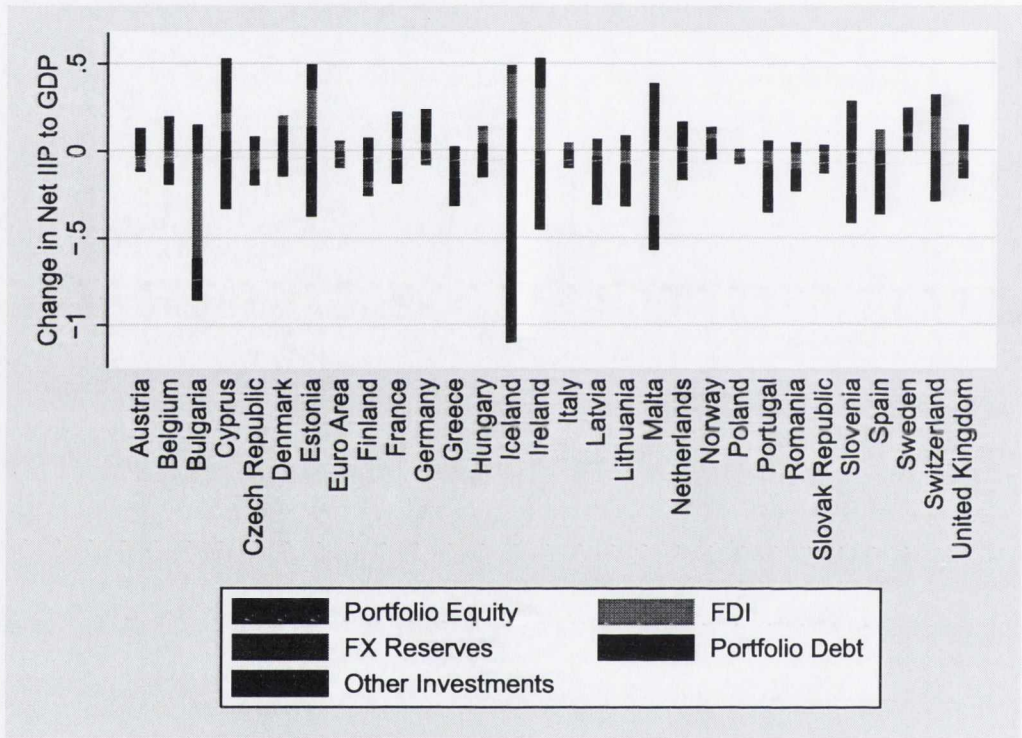
Source: Beck et al (2009). The figure shows the change in the ratio of private credit to GDP. The period displayed is 2005-2007.

Figure 2.2: Gross International Investment Position: 2002 and 2007



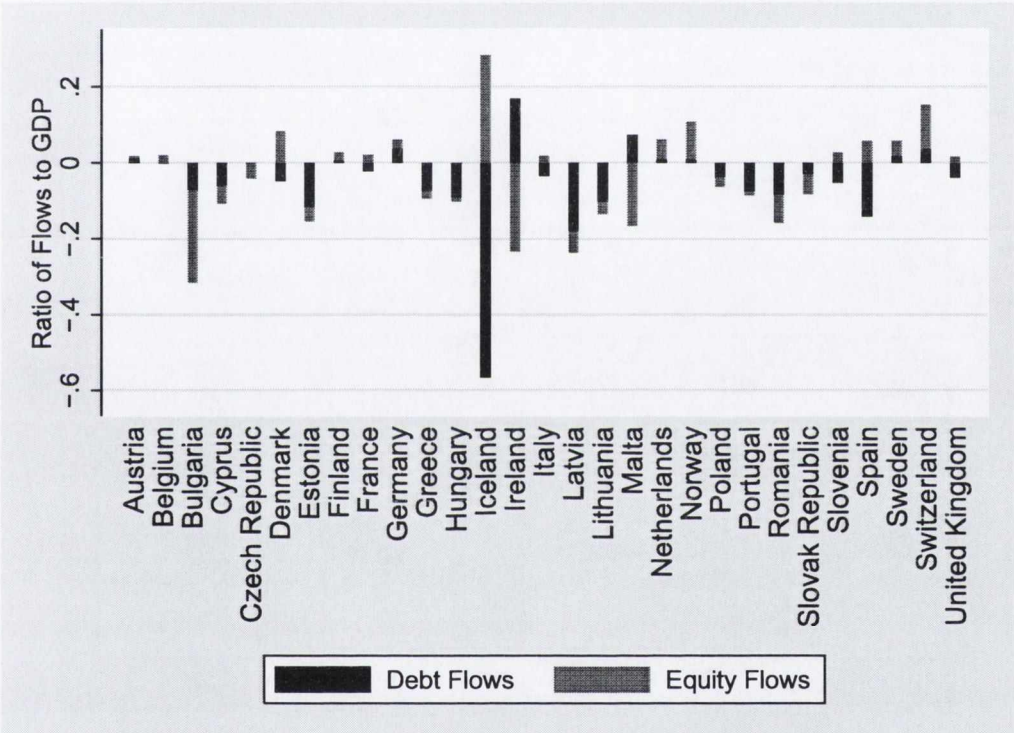
Source: Based on data from an updated and extended version of dataset constructed by Lane and Milesi-Ferretti (2007). The figure shows the sum of international assets and liabilities as a ratio to GDP. The data are disaggregated by asset type. The period displayed is 2005-2007.

Figure 2.3: Change in Net IIP: 2005-2007



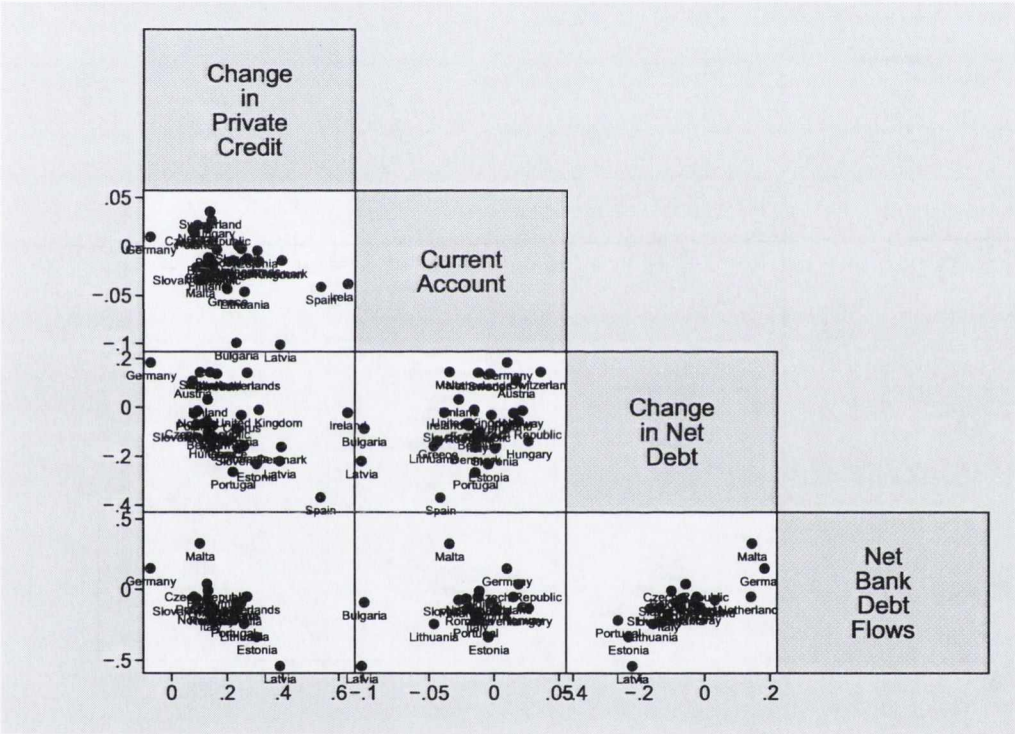
Source: Based on data from an updated and extended version of dataset constructed by Lane and Milesi-Ferretti (2007). The figure shows the change international assets minus liabilities as a ratio to GDP. The data are disaggregated by asset type. The period displayed is 2005-2007.

Figure 2.4: Net Debt and Equity Flows: 2005-2007



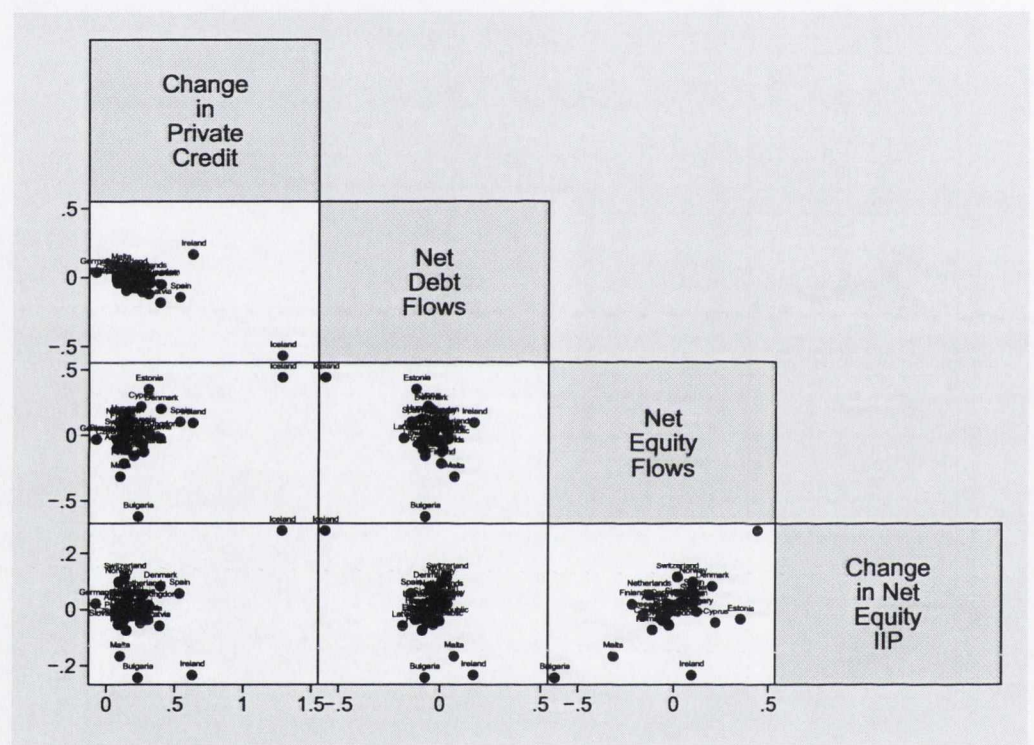
Source: Based on data from the IMF International Financial Statistics. The figure shows net international asset and liability flows as a ratio to GDP. The data are divided into debt and equity flows. The period displayed is 2005-2007.

Figure 2.6: Change in Private Credit, Current Account, Change in Net Debt IIP and Net Bank Debt Flows (excluding Iceland)



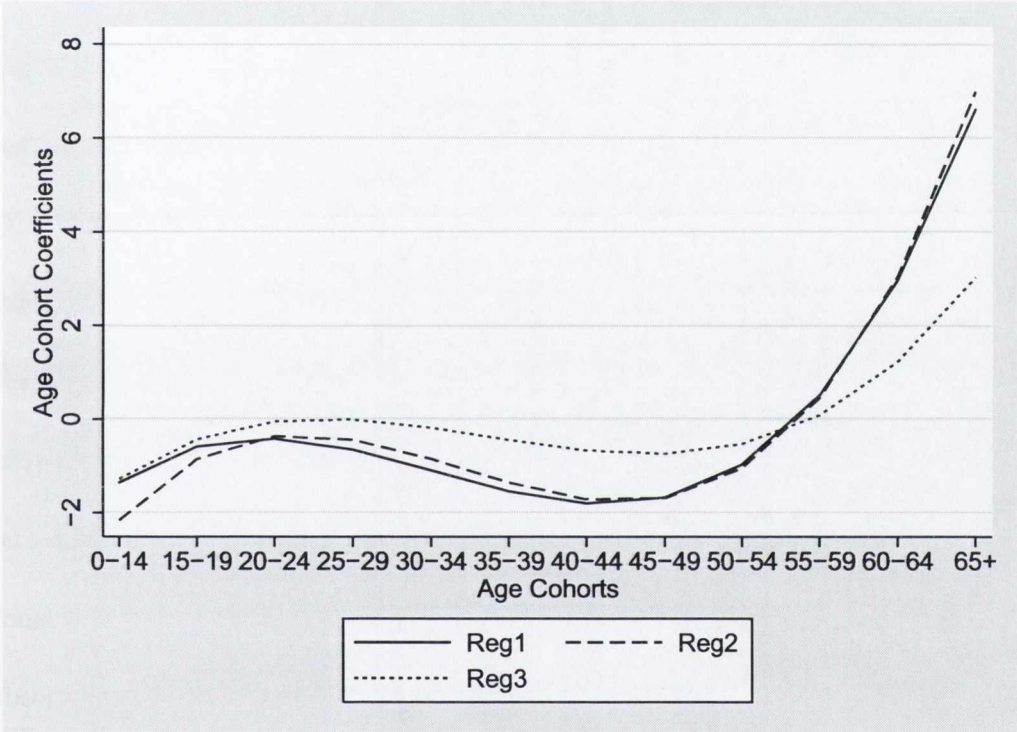
Source: Based on data from Beck et al (2009), an updated and extended version of dataset constructed by Lane and Milesi-Ferretti (2007) and the IMF International Financial Statistics. The Change in Net Debt refers to international assets minus liabilities as a ratio to GDP . Net Bank debt refers to international bank debt assets and liabilities flows as a ratio to GDP. The period displayed is 2005-2007.

Figure 2.7: Change in Private Credit, Net Debt Flows, Net Equity Flows and Change in Net Equity IIP



Source: Based on data from Beck et al (2009), an updated and extended version of dataset constructed by Lane and Milesi-Ferretti (2007) and the IMF International Financial Statistics. Net Debt Flows refers to net international debt asset and liability flows as a ratio to GDP. Net Equity Flows refers to net international equity asset and liability flows as a ratio to GDP. Change in Net Equity IIP refers to the change in international assets minus liabilities as a ratio to GDP. The period displayed is 2005-2007.

Figure 2.8: Demographic Coefficients: Baseline Specification



The figure shows the implied results calculated based on the coefficients demographic polynomial variable in the baseline regression specification.

Table 2.1: Bank Balance Sheet

Assets	Counterparties	Liabilities	Counterparties
Loans	MFIs General Government Other Residents	Deposits	MFIs General Government Other Residents
Securities other than shares		Capital	Equity Subordinated Debt Senior Debt
Shares and other Equity		Other Debt Securities Issued	Commercial Paper Repurchase Agreements Swapped FX liabilities
Remaining Assets	CB Reserves	Remaining Liabilities	Central Bank Financing

Note: Based on ECB (2009).

Table 2.2: Baseline Specification

	(1)	(2)	(3)
Current Account		-0.49*	-0.41
		(-1.80)	(-1.48)
GDP Growth	0.33*	0.36*	0.20
	(1.86)	(2.04)	(1.02)
Lagged GDP per Capita	0.36***	0.35***	0.43
	(4.52)	(4.64)	(1.64)
Lagged Private Credit	-0.26	-0.23	-0.19
	(-0.80)	(-0.67)	(-0.54)
GDP per Capita*Private Credit	-0.02	-0.01	-0.00
	(-0.38)	(-0.20)	(-0.036)
Euro	0.03	0.04	0.04
	(0.42)	(0.59)	(0.55)
Change in Real Interest Rate	-0.02	-0.13	-0.25
	(-0.042)	(-0.24)	(-0.57)
Period 3: 2005-2007			-0.01
			(-0.066)
Period 2: 2002-2004			-0.08
			(-1.03)
Constant	1.58***	1.47***	1.89
	(5.10)	(5.19)	(1.47)
Observations	87	87	87
Number of Countries	29	29	29
Within R^2	0.43	0.44	0.53
Between R^2	0.09	0.11	0.09
Overall R^2	0.12	0.14	0.12
Dem F-Stat p-value	0.62	0.52	0.94

Dependent variable is the change in Private Credit to GDP.

Time period: 1999-2007.

Robust t statistics in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 2.3: Sources of Funding: Debt and Equity Flows

	(1)	(2)	(3)
Net Debt Flows	-1.67*** (-6.17)	-1.64*** (-6.74)	-1.42*** (-5.08)
Net Equity Flows	-0.82* (-1.76)	-0.82* (-1.84)	-0.37 (-0.76)
Lagged Debt IIP			-0.09 (-1.10)
Lagged Equity IIP			0.10 (1.08)
GDP Growth	0.31** (2.58)	0.21 (1.59)	0.15 (1.25)
Lagged GDP per Capita	0.32*** (3.29)	0.26 (1.49)	0.22 (1.31)
Lagged Private Credit	-0.35* (-1.76)	-0.33 (-1.62)	-0.46*** (-2.84)
GDP per Capita*Private Credit	-0.01 (-0.33)	-0.01 (-0.24)	-0.04 (-1.08)
Euro	0.08** (2.30)	0.09** (2.63)	0.07* (1.86)
Change in Real Interest Rate	-0.15 (-0.45)	-0.34 (-0.92)	-0.19 (-0.53)
Period 3: 2005-2007		0.05 (0.60)	0.08 (1.21)
Period 2: 2002-2004		-0.01 (-0.18)	0.01 (0.14)
Constant	1.30*** (3.78)	1.03 (1.34)	0.86 (1.20)
Observations	82	82	82
Number of Countries	29	29	29
Within R^2	0.79	0.81	0.84
Between R^2	0.16	0.14	0.12
Overall R^2	0.33	0.33	0.26
Dem F-Stat p-value	0.24	0.55	0.57

Dependent variable is the change in Private Credit to GDP.

Time period: 1999-2007.

Robust t statistics in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 2.4: Instrumental Variables

	(1)	(2)	(3)	(4)
	GMM	2SLS	GMM	2SLS
Net Debt Flows	-1.41*** (-2.79)	-1.81*** (-3.28)	-1.73*** (-3.88)	-1.82*** (-3.91)
Net Equity Flows	-0.01 (-0.014)	-0.63 (-0.76)	-0.91 (-1.56)	-0.96 (-1.57)
GDP Growth	0.09 (0.65)	0.11 (0.80)	-0.04 (-0.28)	-0.04 (-0.27)
Lagged GDP per Capita	0.14 (1.04)	0.20 (1.38)	0.19 (1.21)	0.17 (1.07)
Lagged Private Credit	-0.62*** (-2.86)	-0.51** (-2.21)	-0.38** (-2.24)	-0.40** (-2.26)
GDP per Capita*Private Credit	-0.08 (-1.62)	-0.05 (-0.93)	-0.03 (-0.62)	-0.03 (-0.68)
Euro	0.06 (1.33)	0.08* (1.85)	0.09** (2.24)	0.10** (2.39)
Change in Real Interest Rate	0.00 (0.73)	0.00 (0.58)	0.00 (0.0063)	-0.00 (-0.0011)
Period 3: 2005-2007			0.08 (1.15)	0.07 (1.04)
Period 3: 2002-2004			0.00 (0.065)	-0.00 (-0.089)
Observations	81	81	81	81
Number of Countries	28	28	28	28
R^2	0.75	0.77	0.79	0.79
Debt=Equity F-Stat p-value	0.00	0.01	0.02	0.02
Hansen J-stat p-value	0.40	0.40	0.51	0.51
Kleibergen-Paap rk p-value	0.35	0.31	0.11	0.11
Kleibergen-Paap rk Wald f-stat	1.52	1.52	2.60	2.60

Dependent variable is the change in Private Credit to GDP.

Time period: 1999-2007.

Robust z statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 2.5: First Stage Regressions

	(1)	(2)	(3)	(4)	(5)	(6)
	Net Debt	Net Equity	GDP	Net Debt	Net Equity	GDP
	Flows	Flows	Growth	Flows	Flows	Growth
Lagged GDP per Capita	0.10 (0.81)	0.10 (1.41)	-0.44*** (-5.34)	-0.14 (-1.21)	0.22*** (3.48)	-0.41*** (-3.62)
GDP per Capita*Private Credit	0.02 (1.42)	0.04*** (3.02)	-0.05*** (-3.61)	0.02 (1.13)	0.05*** (3.56)	-0.06*** (-3.17)
Lagged Private Credit	0.09 (1.10)	0.17*** (2.82)	-0.21*** (-3.28)	0.05 (0.74)	0.19*** (3.44)	-0.22*** (-3.19)
Euro	0.02 (0.73)	0.03* (1.93)	-0.05 (-1.32)	0.04 (1.13)	0.01 (0.63)	-0.03 (-1.18)
Change in Real Interest Rate	-0.18 (-0.93)	-0.14 (-0.98)	1.54*** (4.06)	-0.33 (-1.26)	0.00 (0.028)	1.38*** (3.81)
Lagged GDP Growth	0.04** (2.31)	-0.04*** (-3.30)	0.05* (1.93)	0.05*** (3.47)	-0.06*** (-6.22)	0.07** (2.66)
Weighted Trade Partner GDP Growth	-0.01 (-0.10)	-0.00 (-0.039)	0.66*** (4.85)	-0.10 (-0.52)	0.16 (1.68)	0.31 (1.46)
Lagged Change Net Equity IIP	0.03 (0.93)	-0.07*** (-2.79)	0.05 (1.36)	0.01 (0.22)	-0.05** (-2.48)	0.05 (1.64)
Lagged Change Net Debt IIP	0.05 (1.67)	-0.07*** (-2.78)	0.08 (1.65)	0.07** (2.07)	-0.08*** (-3.89)	0.07 (1.64)
Lagged Debt IFI Ratio	-0.14** (-2.31)	0.09*** (2.94)	0.09* (1.97)	-0.14** (-2.55)	0.08*** (3.16)	0.10** (2.46)
Lagged Equity IFI Ratio	-0.12* (-1.88)	0.05 (1.37)	0.12*** (3.69)	-0.15** (-2.67)	0.06** (2.31)	0.12*** (3.46)
Change in REER	-0.20** (-2.24)	0.13** (2.40)	-0.48*** (-5.55)	-0.20** (-2.44)	0.16*** (2.78)	-0.58*** (-5.39)
Constant	0.49 (0.88)	0.28 (0.94)	-1.02*** (-2.92)	-0.82 (-1.39)	1.11*** (3.60)	-1.27** (-2.45)
Observations	79	79	79	79	79	79
Number of Countries	28	28	28	28	28	28
Within R^2	0.65	0.73	0.77	0.72	0.79	0.80
Between R^2	0.20	0.10	0.52	0.20	0.03	0.48
Overall R^2	0.09	0.04	0.53	0.10	0.03	0.51
Instrument F-Stat	1.73	3.31	6.15	1.63	4.38	6.16

Dependent variable is the change in Private Credit to GDP.

Time period: 1999-2007.

Robust z statistics in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 2.6: Sources of Funding: Debt and Equity IIP

	(1)	(2)	(3)	(4)
	GMM	2SLS	GMM	2SLS
Change in Debt Net IIP	-0.25*	-0.28**	-0.39***	-0.39***
	(-1.89)	(-2.01)	(-6.44)	(-6.25)
Change in Equity Net IIP	-0.04	-0.05	0.15**	0.15**
	(-0.50)	(-0.66)	(2.56)	(2.55)
Lagged Debt Net IIP			-0.29***	-0.28***
			(-3.95)	(-3.82)
Lagged Equity Net IIP			0.28***	0.29***
			(3.56)	(3.60)
GDP Growth	0.04	-0.01	-0.08	-0.09
	(0.17)	(-0.052)	(-0.35)	(-0.37)
Lagged GDP per Capita	0.27	0.29	0.04	0.04
	(1.56)	(1.60)	(0.21)	(0.22)
Lagged Private Credit	-0.38	-0.35	-0.69***	-0.70***
	(-1.62)	(-1.41)	(-4.70)	(-4.73)
GDP per Capita*Private Credit	-0.04	-0.04	-0.10***	-0.10***
	(-0.85)	(-0.72)	(-2.85)	(-2.88)
Euro	0.05	0.05	0.04	0.05
	(1.01)	(0.84)	(1.02)	(1.13)
Change in Real Interest Rate	-0.20	-0.05	0.07	0.03
	(-0.36)	(-0.082)	(0.14)	(0.065)
Period 3: 2005-2007	0.04	0.03	0.17**	0.17**
	(0.40)	(0.30)	(2.18)	(2.22)
Period 2: 2002-2004	-0.04	-0.06	0.04	0.04
	(-0.99)	(-1.21)	(0.91)	(0.90)
Observations	86	86	86	86
Number of Countries	29	29	29	29
R ²	0.59	0.59	0.78	0.78
Dem F-Stat	0.98	0.96	0.23	0.19
Hansen J-stat p-value	0.68	0.68	0.78	0.78
Kleibergen-Paap rk p-value	0.05	0.05	0.03	0.03
Kleibergen-Paap rk Wald f-stat	12.07	12.07	11.64	11.64

Dependent variable is the change in Private Credit to GDP.

Time period: 1999-2007.

Robust z statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 2.7: Sources of Funding: Bank and Non-Bank Flows

	(1)	(2)	(3)	(4)
	GMM	2SLS	GMM	2SLS
Net Other Debt Flows	-0.54 (-1.62)	-0.68* (-1.77)	-0.75*** (-2.64)	-0.67* (-1.88)
Net Bank Debt Flows	-0.97*** (-3.30)	-1.07*** (-3.30)	-1.09*** (-4.33)	-1.02*** (-3.30)
GDP Growth	0.04 (0.46)	0.07 (0.68)	0.06 (0.58)	0.06 (0.61)
Lagged GDP per Capita	0.18*** (2.73)	0.18*** (2.72)	0.36*** (3.79)	0.35*** (3.67)
Lagged Private Credit	-0.56*** (-3.37)	-0.56*** (-3.30)	-0.39** (-2.20)	-0.38** (-2.13)
GDP per Capita*Private Credit	-0.06** (-2.11)	-0.06** (-1.97)	-0.03 (-0.83)	-0.03 (-0.83)
Euro	0.13*** (5.04)	0.14*** (5.06)	0.12*** (4.21)	0.11*** (3.72)
Change in Real Interest Rate	0.24 (0.72)	0.27 (0.82)	0.15 (0.52)	0.14 (0.44)
Period 3: 2005-2007			-0.08 (-1.42)	-0.08 (-1.35)
Period 2: 2002-2004			-0.08*** (-2.61)	-0.08** (-2.42)
Observations	49	49	49	49
Number of Countries	18	18	18	18
R^2	0.88	0.88	0.90	0.90
Dem F-Stat	0.06	0.12	0.09	0.12
Hansen J-stat p-value	0.47	0.47	0.93	0.93
Kleibergen-Paap rk p-value	0.06	0.06	0.04	0.04
Kleibergen-Paap rk Wald f-stat	13.06	13.06	12.85	12.85

Dependent variable is the change in Private Credit to GDP.

Time period: 1999-2007.

Robust z statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 2.8: Regulation and Reform indicators

	(1)	(2)	(3)	(4)	(5)	(6)
	GMM	GMM	GMM	OLS	OLS	OLS
GDP Growth	0.05 (0.28)	0.03 (0.15)	0.03 (0.16)	0.05 (0.71)	0.13 (1.15)	0.21 (1.46)
Net Equity Flows	-0.53 (-1.15)	-0.59 (-1.32)	-0.58 (-1.13)	0.52 (1.67)	-0.79* (-1.79)	-1.16*** (-3.14)
Net Debt Flows	-1.38*** (-3.52)	-1.41*** (-3.59)	-1.40*** (-3.53)	-0.88*** (-3.15)	-1.19*** (-3.29)	-1.46** (-2.61)
Lagged GDP per Capita	0.13 (0.90)	0.14 (0.94)	0.14 (0.95)	0.08 (1.07)	0.35* (1.96)	0.63*** (3.13)
Lagged Private Credit	-0.50*** (-3.41)	-0.47*** (-3.45)	-0.47*** (-3.33)	-0.52*** (-6.87)	-0.36* (-1.99)	0.06 (0.22)
GDP per Capita*Private Credit	-0.05 (-1.49)	-0.04 (-1.40)	-0.04 (-1.32)	-0.09*** (-4.72)	-0.02 (-0.41)	0.07 (1.18)
Euro	0.11** (1.97)	0.11** (2.14)	0.11** (2.13)	0.11*** (6.12)	0.10*** (2.85)	0.09* (1.78)
Change in Real Interest Rate	-0.26 (-0.57)	-0.21 (-0.47)	-0.21 (-0.46)	0.56** (2.40)	-0.12 (-0.28)	-0.19 (-0.31)
Lagged Financial Reform	-0.01 (-0.47)					
Lagged Change in Financial Reform		0.00 (0.014)				
Lagged Change in BankingSupervision			0.00 (0.018)			
Private Monitoring Index				-0.01** (-2.16)		
Capital Regulatory Index				-0.00 (-0.32)		
Net Interest Margin					-2.13* (-2.04)	-1.65 (-1.66)
Market Structure						-0.00 (-0.056)
Constant				0.68** (2.16)	1.43* (1.81)	2.74*** (2.93)
Observations	68	68	68	52	79	62
Number of Countries	23	23	23	26	29	27
R^2	0.81	0.80	0.81	0.90	0.81	0.79
Dem F-Stat	0.63	0.54	0.53	0.00	0.40	0.47
Hansen J-stat p-value	0.97	0.89	0.90			
K.-P. rk p-value	0.03	0.03	0.032			
K.-P. rk Wald f-stat	10.01	9.85	10.39			

Robust z statistics in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Time Dummies included in all columns except column 4. Time period: 1999-2007.

Chapter 3

The Evolution of Irish Trade Margins 1984-2000

3.1 Introduction

Hummels and Klenow (2005) used cross-sectional international trade data to decompose countries' exports into extensive and intensive margins, with price and quantity components for the latter. These data, when regressed against figures for relative income and population measure indicate that larger countries were found to have exported a greater variety of goods, while richer countries exported higher quantities of goods at higher prices. This paper tests whether these results hold longitudinally for Ireland over the period 1984 to 2000. This period was characterised by sharp movements in relative income and population in Ireland and so the country provides an ideal test case.

A related topic that has received considerable attention in recent years is the benefits to both consumers and producers of increases in variety. Although numerous theoretical papers on these topics have existed for some time, it is only in recent years that empirical papers have begun to emerge. The key factor contributing to this progress has arisen from the use of data from international trade rather than that collected for consumer price indices. From this starting point, a wide variety of questions have been addressed.

Although Hummels and Klenow (2002, 2005) provides much of the methodological foundation for this paper, their work was purely cross sectional while this paper will focus on the evolution of international trade margins over time. This paper will also be novel in that it focuses on Ireland. The main question is, as Ireland became relatively wealthier, did the relative number of varieties and relative price of their exports changed and how? Did Ireland just trade more of what it always did or did it trade a wider variety and higher quality of products?

The rest of this paper is structured as follows. Section 4.2 reviews a selection of the existing literature relating to the above topics. Section 3.3 explains the decomposition method. Section 3.4 outlines the sources and characteristics of the data. Section 3.5 provides some stylised facts about Irish trade that emerge from the decomposition. Section

4.5 provides an explanation of these facts using the results of a statistical analysis. Section 3.7 offers some conclusions and recommendations.

The results of the regression analysis versus 18 European countries with more reliable data indicate that increases in Ireland's overall export share associated with increases in relative income and relative income per worker came via increases in the relative quantity of exports. This pattern is similar for both aggregate goods and differentiated goods. We then contrast these results with the predictions of the theoretical literature.

3.2 Literature Review

Although numerous theoretical papers on topics related to quality and variety in trade have existed for some time, the last decade has seen a renewed interest in the area. A large number of empirical papers have begun to emerge using of detailed data on international trade.

Previous methodologies tended to focus on a small number of products for which high quality data was available (Isquierdo and de los Llanos Matea; 2001). The theoretical foundations of the trade data literature is broad, extending from Dixit and Stiglitz (1975); Krugman (1979); Elhanan Helpman and Rubinstein (2008); Feenstra (2004) to Melitz (2003) and beyond. Using international trade data as a starting point, a wide variety of questions have been addressed empirically.

Hummels and Klenow (2005) form the template for this paper. Using cross-sectional international trade data, they decomposed exports into extensive and intensive margins, with price and quantity components for the latter. The extensive margin measures the fraction of world trade that occurs in those market-categories in which country it participates. The intensive margin measures a country's share of world trade in those market categories in which it participates. The price and quantity components of the intensive margin show whether a country's exports are high or low in price or quantity relative to the exports of other countries. They represent relative price and quantity indices.

Hummels and Klenow (2005) begin by outlining four theoretical economic models and their predictions regarding trade flows, specifically the measures explained above and their relationship with the independent variables, relative income per worker and relative workforce.

The first model, the Armington (1969) national differentiation model, is based on the assumption that each country produces a single variety in each category so there is no extensive margin and quality does not vary across countries.¹ A country with more workers increases its trade share simply by increasing quantities. This leads to a fall in the price component as the country moves along its export demand curve.

The second model, Acemoglu and Ventura (2002), expands upon the Armington model by including endogenous capital accumulation and an endogenous number of varieties.

¹Although the measure used below includes increases in the extensive margin based on an increase in the number of trade partner.

The number of varieties is proportional to the number of people employed. Thus, they predict that the extensive margin will be positively related to the size of the workforce. Furthermore, higher productivity countries will produce a larger quantity of each good and this will result in lower prices. The model implies that countries with a higher relative income per worker will export more intensively via relatively higher quantities but at relatively lower prices.

Krugman (1979, 1980) modelled countries as producing an endogenous number of varieties proportional to the size of the economy. The quantity of each variety sold (in a simple version of the model) is proportional to the size of the country but at the same unit price. This implies that the extensive margin will increase with the size of the economy but the intensive margin will not vary.

Finally, Hummels and Klenow (2005) outline a quality differentiation model in which quality levels vary across countries but productivity and variety do not. Countries with more workers will produce higher quantities of each variety while, because higher income countries produce higher quality goods, the relative income per worker is anticipated to be positively correlated with the price component. Thus, the intensive margin increases with both relative income per worker and relative workforce but the model predicts no relationship between the extensive margin and either of the explanatory variables.

When Hummels and Klenow (2005) ran regressions using these margins and indices as dependent variables, they found that 72 percent of the increase in overall exports associated with higher income per head emanates from the extensive margin. Similarly, they found that 63 percent of the increase in total exports associated with a larger labour force (a measure of economy size) arises from increases in the number of varieties of products exported.

Hummels and Klenow (2002) further decompose the intensive margin into its price and quantity components. However, in the case of exports, the importance of the intensive margin is small relative to the extensive margin. The results indicate that a 10 percent increase in the labour force is associated with a 2.5 percent increase in the quantity component of the intensive margin as compared with a 5.4 percent increase in the extensive margin.

The price component of the intensive margin increases just 0.4 percent with a 10 percent increase in the labour force. However both price and quantity components have a coefficient on income of approximately 0.2. This implies that the prices of exports are relatively much more strongly linked to the income per head of each country. It should be noted that the R^2 statistic for the price component is relatively small (0.25). Indeed, the R^2 statistic for the intensive margin is smaller than the same statistic for the extensive margin (0.62 for the former, 0.76 for the latter).

Hummels and Klenow (2005) then compared these results to a number of theoretical economic models in order to see whether these predictions matched the trade flows observed in the data. The Armington (1969) model leaves no space for the extensive margin effect of increases in relative income observed in the data and predicts a sign on the price

component that is not consistent with what Hummels and Klenow (2005) observed. The same is true for the relative income per worker variable in the Acemoglu and Ventura (2002) model. Furthermore, the second model over predicts the role of relative workforce in the extensive margin compared to the data. Likewise, the Krugman (1979, 1980, 1981) model over-predicts the role of relative income in explaining the extensive margin. Finally, although Hummels and Klenow (2005) quality differentiation model predicts the correct sign on relative income per worker and relative workforce variables in the price and quantity component equations, their model does not predict the positive relationship between relative income and extensive margin observed in the regressions.

There has been considerable progress in trade theory in recent years. Melitz (2003) expands on the Krugman (1979) model by introducing a model that incorporates firm heterogeneity into general equilibrium trade models. In the model, firms only export if a productivity level high enough to reach a cut-off productivity level.

An important result of the Melitz (2003) paper highlights the differing effect of reductions in fixed and variable trade costs.

If variable trade costs fall, the cut-off productivity level falls, so more domestic and foreign firms will export. More foreign firms will enter the domestic market meaning that the cut-off productivity required to be a domestic producer is higher, so there will be fewer domestic firms but more domestic exporters. As a result, firms will lose a proportion of their domestic sales but will gain foreign market share.

In contrast, if fixed costs fall only new exporters will gain foreign market share but not extant exporters. Although we are not using micro level data, we might therefore anticipate that a fall in fixed trade costs will only be reflected in the intensive margin (and the quantity component) but a fall in variable costs should be evident in both the extensive and intensive margin.

The effect of a fall in either fixed or variable costs on the price component is ambiguous as there will be a decline in alchian-allen effects but there may be an increase in unobserved varieties within category.

Chaney (2008) elaborates on Melitz (2003); Krugman (1979). A higher elasticity of substitution between varieties (greater substitutability, more competition and lower markups) makes the intensive margin more sensitive to changes in trade barriers whereas it makes the extensive margin less sensitive. A decrease in trade barriers allows new and less productive firms to export as high elasticity of substitution means that low productivity is a severe disadvantage. The impact of these new entrants on aggregate trade is small.

If the elasticity of substitution is low, each firm is sheltered from competition and a fall in trade costs leads to a smaller number of larger firms capturing a large market share. The impact of these new entrants on aggregate trade is large.

If trade costs are falling and we observe a change in the intensive margin but little change in the extensive margin this may imply that there is a high elasticity of substitution.

The above theoretical literature makes predictions that can be compared to the results presented in the subsequent sections. The following papers also introduce concepts that are

helpful when interpreting our results and results which can be compared to those generated in this paper.

Feenstra et al. (2004) suggest that estimates of real GDP could be improved by comparing the traditional expenditure side estimates with output-side estimates. The differences between these two estimates are the prices at which goods are exported and imported i.e. the terms of trade. In producing the improved estimates of real GDP, Feenstra et al. (2004) provide output-side estimate of Ireland's price level for exports, relative to 14 EU countries plus the US in 1996 of 90.2. By 1999 the equivalent estimates are 100.9. Thus, the relative price levels of Irish exports increased over the period. However, the analysis is only conducted for these two years.

Feenstra and Kee (2004) employ an alternative measure of relative product variety (extensive margin) which is based on that produced by Feenstra (2004) and is similar to that employed by Broda and Weinstein (2006) and Hummels and Klenow (2005). Broda and Weinstein focus on the times-series growth of US import varieties and so the variety measure uses a base year for comparison purposes. Hummels and Klenow (2005) conduct a cross-sectional analysis, so they use data for a base country (actually the rest of the world) for the purposes of comparison. Feenstra and Kee (2004) develop a measure that is consistent across both time and country dimensions by taking the union of all imported products in the U.S. over years and source countries. This matter is dealt with in more detail in an appendix attached to this paper.

Hallak (2003) examines the relationship between unit values, exporter endowments and exporter production techniques. As we have seen, early new trade models predict that countries with high productivity will have low export prices. The results from this paper's empirical investigation show that the opposite is the case. Using U.S. import data the author finds that import unit values are positively associated with exporter per capita GDP.

Hallak and Schott (2005) find that for Ireland (and China and Taiwan) price indices tend to underestimate the actual quality of their exports by a significant margin. The estimated impure price index for manufactured goods shows Ireland remaining close to the reference country, Germany, over the period 1980 to 1998.² The estimated impure quality index shows Ireland converging rapidly toward German levels.

Faruq (2006) examines whether factors such as capital endowments, research and development and foreign direct investment affect different qualities of products. The method used is that applied by Hummels and Klenow (2002) and employs HS 10-digit US import data. Faruq (2006) also investigates the effect on the results of taking only differentiated product categories. This is useful because it eliminates categories of goods which may be homogeneous such as commodities and would therefore be expected to have the same unit price everywhere if we control for trade costs. Product differentiation and quality improvements are characteristic of monopolistically competitive industries.

²The "impure" prices they refer to are not nominal prices, but estimates based on pure prices but adjusted for, among other things, a country-sector specific quality fixed effect.

Baldwin and Di Nino (2006) investigate the effect of the euro on intra-eurozone trade. They investigate the channel through which the advent of the euro promoted trade. Using 6-digit UN Comtrade data, they find that the euro boosted intra-eurozone trade via the extensive margin. This finding is consistent with the results presented below.

Alessandria and Kaboski (2007) argue that, rather than being indicative of variations in quality, the correlation between relative income and the relative price of imports, represent firms pricing to market. That is, a firm will charge consumers in a rich country more than they would consumers in a poor country.

3.3 Data Decomposition

3.3.1 Hummels and Klenow 2002

By comparing the prices and quantities of exports by different countries to given market-categories, Hummels and Klenow (2002) were able to estimate differences in varieties and relative prices and quantities across exporters. The decomposition employed below is based on the method and used by Hummels and Klenow (2002), except that in this case, the margins and indices include the time subscript t .

Hummels and Klenow (2002) decompose trade into what they call the intensive and extensive margins, where Overall is a country's overall share of world exports, EM is the extensive margin and IM is the intensive margin. P and Q are the relative price and relative quantity components (indices) of the intensive margin.

$$\text{Overall} = \text{EM} * \text{IM} \quad (3.1)$$

$$\text{IM} = \text{P} * \text{Q} \quad (3.2)$$

These values are then logged and regressed against log GDP and against log income per worker and log number of workers. Thus, the regression should show the effect of Irish economic growth and prosperity on the composition of trade. For exporting country j at time t :

$$\text{Overall} = \frac{x_{jt}}{x_{Wt}} \quad (3.3)$$

where x_{jt} is nominal exports of country j and x_{Wt} is the level of nominal world exports from all exporters to all markets.

$$\text{EM} = \frac{\sum_{i \neq j} \sum_{s \in X_{jist}} x_{Wist}}{x_{Wt}} \quad (3.4)$$

The extensive margin for country j measures the fraction of world exports that occur in those market-categories in which country j exports. This idea is based on the import variety growth measure from Feenstra (2004) except that it varies cross sectionally rather

than across time. According to Hummels and Klenow (2002), *ceteras paribus*, if a country concentrates all of its exports in a small number of market categories, it will have a higher intensive margin and a lower extensive margin. The extensive margin can be understood as a weighted count with each market category receiving a weight according to its share in world exports. Thus, it is indicative of the variety of products traded, weighted by their volume (monetary value) in world trade.

$$IM = \frac{x_{jt}}{\sum_{i \neq j} \sum_{s \in X_{jist}} x_{Wist}} \quad (3.5)$$

where x_{Wist} is world exports to country i in product category s at time t , and X_{jist} is the set of market-categories (I, s) pairs for which $x_{jist} > 0$, where x_{jist} is level of nominal exports of country j to country i in product category s at time t . The intensive export margin measures a country's share of world exports in those market categories in which it exports.

The intensive margin is further decomposed into price and quantity components. These are Fisher Ideal indices commonly used in the literature. The data is aggregated across market-categories to calculate the relative export price index and the export quantity index for each country. The relative export price index for exporter j is:

$$P = \left[\frac{\sum_{i \neq j} \sum_{s \in X_{jist}} p_{jist} q_{jist}}{\sum_{i \neq j} \sum_{s \in X_{jist}} p_{Wist} q_{jist}} \right]^{\frac{1}{2}} \left[\frac{\sum_{i \neq j} \sum_{s \in X_{jist}} p_{jist} q_{Wist}}{\sum_{i \neq j} \sum_{s \in X_{jist}} p_{Wist} q_{Wist}} \right]^{\frac{1}{2}} \quad (3.6)$$

where q_{jist} is the quantity of exports from country j to country i in category s at time t , p_{jist} is $\frac{x_{jist}}{q_{jist}}$ (that is the total value divided by the quantity), q_{Wist} is the quantity of world exports to country i in category s at time t , and p_{Wist} is $\frac{x_{Wist}}{q_{Wist}}$. According to Hummels and Klenow (2002) this index is a geometric-weighted average of two price indices, one using the country's own export quantities to weight market categories and the other using world export quantities to weight market categories. The export price index summarises the extent to which an exporter's prices are high or low relative to other prices in the same market category. Price variation within market-categories may be due, in part, to quality variation, but the two are distinct objects.

Similarly, the export quantity index is given by:

$$Q = \left[\frac{\sum_{i \neq j} \sum_{s \in X_{jist}} p_{jist} q_{jist}}{\sum_{i \neq j} \sum_{s \in X_{jist}} p_{jist} q_{Wist}} \right]^{\frac{1}{2}} \left[\frac{\sum_{i \neq j} \sum_{s \in X_{jist}} p_{Wist} q_{jist}}{\sum_{i \neq j} \sum_{s \in X_{jist}} p_{Wist} q_{Wist}} \right]^{\frac{1}{2}} \quad (3.7)$$

3.3.2

The price and quantity index differ somewhat between chapters 3 and 4. The indices used in chapter 4 correspond to those used in the Hummels and Klenow (2005) and the price and quantity indices used there are based on those of Feenstra (1994). In chapter 3 the

indices correspond to those used in Hummels and Klenow (2002) working paper. The price and quantity indices are what are referred to as Fisher “Ideal” indices.

The Fisher “Ideal” index is a widely utilised index and is used by a number of international institutions such as the OECD and Eurostat for producing purchasing power parity tables and other international comparisons. The Fisher index is ideal in that it avoids the “Gerschenkron Effect”, whereby a Laspeyres quantity index is higher the more the base country’s prices differ from those of the reference country. This problem is avoided by taking the geometric mean of the Laspeyres and Paasche indices. In the context of the prices and quantity indices it means that indicators are the geometric mean of the indices using the country j weights and the reference country weights. A useful example and illustration of this point is provided by Rossiter (2000). Faruq (2006) provides an example of the application of a Fisher “Ideal” index, as used here and in the Hummels and Klenow (2002) working paper, to a panel data set.

However, there are a number of issues with the Fisher method as outlined by Neary (2004). Briefly, Neary (2004) provides the following three criteria for choosing between index numbers. Firstly, a satisfactory multilateral index should be transitive. That is country i ’s real income relative to country k should be the same irrespective of whether the two are compared directly or via an arbitrary intermediate country l . The Fisher index does not satisfy this condition. Secondly, the Fisher index is not Matrix consistent in that, when it is applied to real income indices, it cannot be consistently disaggregated by commodity as well as by country. It is for this reason that the Fisher index is not employed in the Penn World Table. Finally, the Fisher index satisfies the condition of characteristicity. Country i ’s real income relative to country k ’s should be unaffected by changes in third countries. Nevertheless and in spite of these criticisms, the Fisher Ideal index it is a widely accepted and utilised index.

From a practical perspective, the use of these indices requires the elimination from the data of observations that have a very high price relative to the rest of the world while having an extremely small quantity. As the indices are sensitive to such observations, including them would lead to implausibly large variations in the indices from year to year. Thus only categories that had quantities greater than 50 were included. As mentioned above, however, these indices are widely used. In particular the extensive margin employed above is similar to that utilised by Kang (2004) in a time-series context and identical to that used by Kehoe and Ruhl (2009) in a bilateral time-series context.

3.4 Data

Firstly, it should be acknowledged that all of the trade data employed in the literature is flawed to a greater or lesser extent.

Hummels and Klenow (2002, 2005) use data from UNCTAD’s Trade Analysis and Information System (TRAINS) data for 1995. The data are 6-digit Harmonised System (HS) classification for 5017 goods including shipment values and quantities. The problem

with using this data set, however, is that there is a high proportion of missing values for the quantity data.

Similar data to that used by Hummels and Klenow (2002, 2005) were available for use in this paper from the UN Comtrade database, although the above omissions remained. Instead of employing these data, however, it appeared more advantageous to use the Feenstra et al. (2005) World Trade Flows data for the period 1984 to 2000. More complete information on quantities is available for this time-period in the data. As such, it is a longer series than that available from the Comtrade database. The data employed by Hummels and Klenow (2002, 2005) was purely cross-sectional.

Hummels and Klenow (2005) develop a model of international trade that incorporates the concept of quality differentiation. This predicts that increases in the overall share of trade will be transmitted via the intensive margin. Within this, the model predicts that wealthier countries will trade relatively expensive goods while larger countries will trade relatively greater quantities. As our data is of limited (4-digit) definition, a higher price component can be interpreted as indicating a more expensive, within category, unobserved variety.

Although it is only for 4-digit HS product categories, the Feenstra et al. (2005) dataset contains fewer missing data points (relative to the UN Comtrade dataset), particularly for quantities. This is due to the fact that the authors corrected the data. They did this by first recording the trade flow reported by the importing countries whenever possible, on the basis that these are more reliable than reports by exporters. If the importer report was not available, then the corresponding exporter report was recorded instead.

Despite these and other methods used by Feenstra et al. (2005), the data set still has a significant proportion of missing values, particularly for quantities. As such, the analysis in this paper only utilises that data where comparable quantities are available. Effectively this means that all data recording quantities in measures other than weight have been excluded.

The Feenstra et al. (2004) dataset does suffer from a serious issue relating to the fact that not all observations contain data relating to a comparable quantity measure. Furthermore, the extent to which this is a problem varies from year to year. The effect of this variability is likely to have implications for the reliability of the results.

With this in mind, two new variables were created in order to try to estimate whether there was a relation between the dependent variables and the proportion of observations (and the proportion of the value of trade) for which comparable quantity data (weight in tonnes) was available. The object of creating these variables was to gain an understanding of effect and magnitude of any bias arising from missing observations in the data. The analysis indicated that the higher the proportion of observations available, the higher was the extensive margin and the lower the intensive margin.

It was then observed that both the level and variability of the proportion of missing quantity observations was much lower in the case of a number of western European countries. Therefore it was decided to examine the components of Ireland's exports with respect

to the EU15 plus Iceland, Norway and Switzerland. The proportion of observations with comparable quantities remains reasonably consistent and above 88 percent of the total. From a consistency point of view, it is worth noting that the results of the stationarity and autocorrelation tests are similar for the ROW and EU15+3 subsample.

This analysis is also useful in that it was suggested that one potential explanation for the negative coefficient on the relative employment variable might be the rapid growth of the global employment generating a downward trend. In the case of the European employment the rate of growth should be more comparable to that of Ireland's. Thus one might have expected that the coefficient would no longer be negative when the regression was run with respect to European countries. The results presented in table below are compatible with this idea as the relative employment coefficient is only ever negative in the case of the extensive margin.

If we take data only for the EU-15 as well as Norway, Switzerland and Iceland, this method should not be of particular concern as the data recording does not fall below 88 percent (or rise above 95 percent) of observations or value of trade for any year.³

If we take the world as a whole, however, the data's coverage falls to between approximately 67-77 percent of observations or between approximately 60-77 percent of the value of trade. The quality of US import data is particularly poor despite considerable efforts by Feenstra et al (2005) to make corrections.

Another issue relating to these data is the use of 4-digit rather than 6-digit data as in Hummels and Klenow (2002, 2005). The issue of saturation is a matter of considerable concern. If a country participates in practically all categories of goods already, then it is impossible for there to be further large increases in the number of categories due to increases in income or population. As we can see from the graph this issue is not satisfactorily addressed by using 6-digit rather than 4-digit data.

Papers such as Faruq (2006) and Hummels and Klenow (2002, 2005) have used more disaggregate data but then the other issues outlined above (i.e. missing observations) become exacerbated. Although the BACI data provided by Gaulier et al (2008) is now considered to represent a superior correction of the UN Comtrade data base, the length of the time series provided by the Feenstra et al. (2005) data is longer and is therefore considered superior for the current analysis.

All things considered, the Feenstra et al. (2005) dataset appears to be a reasonable compromise between detail and comparability. This opinion is given credence by the fact that the Feenstra et al. (2005) data is the same as that employed by David Hummels in a subsequent paper on a related topic (Choi et al. (2006)).

The explanatory variables are relative to the rest of the countries in the sample and the data comes from Heston et al. (2006). The variables included are relative national income (Y), the relative number of workers (L) and the relative income per worker (Y/L). In the analysis, all variables are in natural logs.

A discussion of the merits and issues relating to the Hummels and Klenow (2005)

³Including the GDR and GFR prior to German reunification in 1991.

method and the implications of applying their approach to a time series can be found in Appendix 3.8.2.

We follow Hummels and Klenow (2005) in utilising GDP per worker and employment (the number of workers) rather than other population or participation measures. It is expected that a country with more workers will export more. Heston et al. (2006) define workers as:

"Workers includes all status categories of persons in employment, not only employees—including paid family workers but also employers, own-account workers, members of producers cooperatives, contributing family workers and workers not classifiable by status."

Although there are alternative measures of labour, such as the numbers of hours worked, that might also have been of interest the worker definition is preferred because of its superior data coverage and also because it is consistent with the Hummels and Klenow (2005) paper, thus facilitating comparisons of the results.

3.5 Descriptive Statistics and Irish Economy

We first examine the data derived from the Hummels and Klenow (2005) margins. Ireland's share of exports to the EU15+3 went, from 1.5 percent at the beginning of the period under examination, to 2.5 percent in 2000 (see Figure 3.2).⁴ At the same time, the extensive export margin went from 42 percent in 1984 to almost 62 percent in 2000. By 2000, 62 percent of European trade took place in market categories in which Ireland was a participant (see Figure 3.3).⁵ The intensive export margin actually increased slightly from 36 percent in 1984 to approximately 40 percent 2000 (see Figure 3.4). The export price component increased from 1.66 in 1984 to 1.9 in 2000 (see Figure 3.5). The quantity component declined marginally from 2.2 in 1984 to 2.1 in 2000. Looking at Figures 3.6 and 3.4, it becomes clear that this presentation of the data disguises large fluctuations in the interim period. Ireland's relative export quantities decline rapidly in the first three years of the period under examination. This fall continued more gradually until 1990 after which time the quantity component began to grow rapidly. 1992 also marked the beginning of a sustained period of increase in Ireland's relative income and relative income per worker.

It is worth noting that Ireland's share of exports started to increase after 1990 (see Figure 3.2). The extensive export margin is displayed in Figure 3.3. The intensive margin, declining at the beginning of the sample period from 2.1 percent in 1984 increased consistently from 1991 onwards, reaching 2.4 percent in 2000 (see Figure 3.4). This pattern was driven by the quantity component which declined precipitously in the period 1984 to 1987 and only began to recover in 1995.

⁴The European Countries in the sample referred to as EU15+3 are, in addition to Ireland: Austria, Belgium, Denmark, France, Finland, Germany, Greece, Iceland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom.

⁵Changes in the extensive margin of a country (Ireland) can occur for two reasons. Firstly, Ireland may change the market categories it participates in. Secondly, changes in the pattern of world trade, could affect the relative size of Ireland's market categories.

Before we examine the results we should first provide some background on the economic environment in Ireland during the period under examination. Ireland joined the EEC in 1973 and entered the European Exchange rate Mechanism (ERM) in 1979. Ireland in the mid-1980s was still adapting to these changes. Ireland suffered a deep recession in the aftermath of the 1979 oil crisis. In 1984, the first year examined in this study the recession was still ongoing. Unemployment stood at over 15 percent and was still rising, inflation was high and the government struggled to gain control of rising debt levels (Honohan; 1992). After a period of economic reform in the late 1980s, Ireland experienced a rapid turnaround in its economic fortunes in what became known as the Celtic Tiger period of the 1990s.

The later period of economic growth occurred as Ireland successfully pursued a policy of export-led growth. This policy centred around attracting foreign direct investment from primarily American multinationals seeking to establish production facilities in Europe, with the aim of exporting to larger European markets (Barry; 2004; Ruane and Ugur; 2005). This is also illustrated by the fact that both exports and income levels in Ireland are closely correlated with the stock of FDI liabilities. Furthermore Ruane and Ugur (2005) shows that wages tended to be higher in foreign owned firms.

As economic recovery progressed, unemployment fell and relative wages began to increase. Although productivity did improve and Ireland's export share increased, this was not primarily due to the emergence of indigenous firms but because of the establishment of large foreign owned production facilities aimed at supplying the European market. Irish indigenous firms must export relatively early in their development to gain economies of scale as the domestic market is small. According to Gleeson and Ruane (2006), although there is considerable firm turnover, Irish indigenous exports were dominated by existing exporters.

The data utilised include GDP rather than GNP per worker. The difference between the GDP and GNP is net factor income from the rest of the world. In most countries using GDP or GNP would make little difference. In Ireland, however, there is a large difference between the two as a result of the presence of large MNC who send their profits back to their home countries. At the end of the sample period GNP was approximately 85 percent of GDP. This difference is by far the highest gap in the OECD. As GDP reflects what is actually produced in a country rather than what is produced net of the profits that are later sent abroad, it was considered that GDP was the more appropriate measure. In other words, we are interested in what is produced within the country by the workers of that country rather than being concerned at the allocation of income within or outside that country.

An issue related to the choice of GDP versus GNP relates to what is known as transfer pricing. This issue is particularly relevant to Ireland where it is suspected that many MNCs exaggerate their amount of value added attributable to their Irish operations in order to take advantage of favourable taxation opportunities in Ireland including a relatively low corporation tax rate and treatment of revenues associated with intellectual property

(Walsh; 2003). Although the exact extent of transfer pricing discrepancies is not observable Honohan and Walsh (2002) estimate that, in 2000, aggregate exports would have been 27 percent lower and aggregate industrial production would have been 52 percent lower. As a result, GDP would also have been significantly lower. Thus some of the correlation that we find between GDP and exports may in fact be due to spurious transfer pricing.

While transfer pricing may inflate GDP, it would not be correct to attribute all of the profits generated to spurious transfer pricing related accounting exercises so the use of GNP would underestimate the total value of the income generated in Ireland. Furthermore, other studies suggest the effect of transfer pricing is more limited and that there has been a somewhat excessive emphasis has been placed on this explanation of Irish economic growth in the 1990s. Keating (1995) provides a minimalist calculation of the contribution of MNCs and finds that including only their labour costs reduced the estimated growth rate of national output in the 1990s by less than half of one percentage point. Lane (1998) firstly suggests, consistent with workforce data utilised here, that there was a significant increase in the level of employment suggesting that much of the output expansion that occurred was true growth and not simply an accounting illusion. Although the level and growth of GDP was higher than GNP in Ireland in the 1990s, the latter also grew extremely rapidly relative to that of our trading partners (Walsh; 2000). Secondly, there are strict regulations regarding transfer pricing which mean that it is not possible for multinationals to shift profits as they please. In particular, the United States Internal Revenue service introduced section 482 regulations that severely increased the monitoring of the transfer pricing practices of American multinationals. Finally, Lane (1998) finds that profits and the growth rate of wages were negatively correlated during part of the period under examination in this paper (1987-96), suggesting that domestic costs are a factor in profitability. Therefore, while it is important that we are aware of the existence and impact of transfer pricing it does not mean that we should disregard the results presented below.

3.6 Regression Analysis

In the results tables presented below, the explanatory variable relative income is the log of Irish national income relative to the EU15+3. The explanatory variable relative employment is the log of the number of workers in Ireland relative to the EU15+3 and the explanatory variable relative income per worker is the log of national income per worker in Ireland relative to the EU15+3.

Regressions were run with the following five dependent variables: Ireland's share of European exports, Ireland's extensive margin, Ireland's intensive margin, the price component of Ireland's intensive margin and the quantity component of Ireland's intensive margin. For comparison purposes, a summary of the results predicted by the Hummels and Klenow (2005) quality differentiation model are presented in Table 3.3.

3.6.1 Specification Tests

When Dickey-Fuller tests for stationarity were conducted, the null hypothesis of a unit root could not be rejected in the majority of instances. Ordinary Least Squares (OLS) is not the Best Linear Unbiased Estimator (BLUE) if the variables are non-stationary and we risk running a spurious regression.

From a theoretical point of view, one should note that all the variables are relative to the rest of the world. Aside from the population variable, it is not clear whether one might expect variables to have a stochastic trend over time. Ireland's share of world exports increased reasonably steadily throughout the period but can this be expected to continue into the future? Over the sample period, Ireland's share of the European work force grew from 0.78 percent to 0.87 percent. Although this growth has accelerated since the end of the sample period, it is not clear that Ireland's population growth will exceed that of the rest of Western Europe's into the future, nor is it clear if the rest of the world's population growth will indefinitely exceed Ireland's.

Examining the graphs of the data for Ireland versus the EU15+3 sub-sample, one can identify that some of the series are possibly non-stationary. Furthermore, it is possible that a number of variables may be cointegrated. When correlograms were generated, all the variables appeared to have significant autocorrelation for at least the first period except the intensive margin and the quantity component. This suggests that all the variables are at least unit root processes except, possibly, the intensive margin and the quantity index.

The usefulness of the Durbin-Watson test for autocorrelation is curtailed by the small sample size of the data. This means that the inconclusive region is relatively large. It is not surprising, therefore, that the results of the test are predominantly within this region. Nevertheless, on balance it seems reasonable to conclude that the variables are autocorrelated.

Augmented Dickey-Fuller tests were conducted and the null hypothesis of stationarity was rejected in the case of the majority of the dependent and independent variables, dependent upon the selection of the appropriate lag length. The choice of the lag lengths were based on a comparison of the Akaike and Schwarz-Bayesian Information Criterion. The results indicated that some variable, such as the relative employment variable, could even be $I(2)$. This is likely to be a result of the U shaped evolution of Ireland's economic performance over the period, with a rapid decline in relative employment, income and trade in the 1980s and a rapid expansion in employment in the mid- to late 1990s. It is not credible for Ireland's relative growth to continue to grow at an increasing rate relative to the rest of the world. Thus, the possibility of the variable being $I(2)$ was ignored dependent upon the residuals of the regressions being stationary.

In light of the above diagnostics and, following Pesaran et al. (1999) (as implemented by Bahmani-Oskooee and Rehman (2005)), a regression with the following specification was implemented using ordinary least squares (see also Asteriou (2006) Pp 335 for explanation of how to obtain long run coefficients).

$$\Delta overall_t = a + \beta_1 overall_{t-1} + \beta_2 \Delta Y_t + \beta_3 Y_{t-1} + \mu \quad (3.8)$$

where Y represents relative income. The advantages of this set up are that we can be confident of the stationarity of the dependent variables, can make inferences about the long run relationships and short run dynamics of the variables in a parsimonious way. The interpretation is not dependent upon prior knowledge of the order of integration of the levels series. The results give us the same information as would be provided by running a single equation error correction model without necessitating the estimation of a cointegrating equation. Thus, the specification also has the advantage of allowing comparability between the results on the cointegrating and non-cointegrating dependent variables. The disadvantage of this specification is that it may contain two $I(1)$ explanatory variables and uses one more degree of freedom than a regression on levels.

In this configuration, the null of no cointegration is defined by $H_0 : \delta_1 = \delta_2 = \delta_3 = \delta_4 = 0$. This is tested against the alternative $H_1 : \delta_1 \neq 0, \delta_2 \neq 0, \delta_3 \neq 0, \delta_4 \neq 0$ using an F-test but using critical values provided by Pesaran et al (2001). Comparisons of the Schwarz-Bayesian Information Criterion indicated that the lag length should be limited to one lag in all instances.

The conventional Durbin-Watson test for autocorrelation is not appropriate for regressions using lagged dependent variables. Durbin (1970) has proposed an alternative h -test but this is not applicable to small samples (Gujarati; 2003). In such circumstances the literature suggests the use of the Breusch-Godfrey test. When this was applied to the residuals of the above ARDL regressions, the results indicated that the overall and the price component regressions were not autocorrelated, but the null hypothesis of zero autocorrelation was rejected in the case of the extensive margin, the intensive margin and quantity component regressions. In order to address this issue and that of heteroskedasticity, the regressions were implemented using Newey-West Heteroskedasticity and Autocorrelation Consistent (HAC) standard errors. The difference in the results arising from the use of this method is minimal. Dickey-Fuller (DF) tests of the residuals indicated stationarity in the case of all regressions.

3.6.2 Regression Analysis

Information on the estimated short-run dynamics and long-run relationship between Ireland exports and relative income and employment is presented in Table 3.4. None of the short-run coefficients are statistically significant except in the case of regression on overall exports. The results indicate that an increase in the rate of change of Ireland's relative income is associated with an approximately proportionate increase in the rate of change of Ireland's share of exports to Europe. Although none of the other short-term coefficients are significant, the largest coefficients are on the intensive margin and on the quantity component.

The levels variables, which should capture the long-run relationships that we are in-

terested in, offer more significant results. The lagged level of the dependent variables are negative and statistically significant in the case of all of the variables except the extensive margin. The absolute value of the negative coefficient on the lagged dependent variable can be interpreted as an error correction coefficient. That is, the coefficient of the lagged dependent variable in the overall equation can be interpreted as indicating that approximately 45 percent of the deviation from the equilibrium between relative export share and relative income in time t , will be eliminated in the subsequent period. Thus, the larger the negative coefficient on the lagged dependent variable, the more rapid is the return to equilibrium. The largest coefficient on the lagged dependent variable is found in the regression on the price component.

These results suggest the existence of a cointegrating relationship. We will return to this issue shortly, using the method suggested by Pesaran et al (2001). This method is valid irrespective of the existence of a significant cointegrating equation.⁶

The lagged level of relative income variable is positive and significant at the 5 percent significance level in case of the regression for the quantity component. A one percent increase in relative income is associated with a 0.2 percent increase in the quantity component. This implies that, as Ireland grew wealthier relative to the rest of Europe, it exported more intensively by trading relatively higher quantities. This is also the case if we include a lagged first difference of the dependent variable in the left hand side of the equation.

It is also worth noting the low adjusted R^2 statistics, particularly in the case of the overall regression. This indicates that only three percent of the variation in the dependent variable is explained by the independent variables if we adjust for the number of explanatory variables. By this measure, 42 percent of the variation in the quantity component is explained by the explanatory variables.⁷

Next we test for cointegration by constructing an error correction term using the lagged level variables. If we use the overall regression as an example, the error correction term can be formulated as follows (see Rao 2005):

$$\text{Error Correction Term}_{t-1}^{\text{overall}} = \frac{1}{\beta_1} [\beta_1 \text{overall}_{t-1} - (\beta_3 Y_{t-1})] \quad (3.9)$$

Then, following Pesaran et al. (1999), we replace the lagged level variables in the

⁶If one assumes that there is no cointegrating relationship between the variables, then the negative coefficient on the lagged level of the dependent variable can be interpreted as indicating that, for example, the higher the level of overall export share in the time $t - 1$, the lower the rate of increase in overall share in time t .

⁷Alternative specifications including a greater number of lagged levels and first differenced terms were implemented. Although these sometimes improved the model performance, in the majority of instances the most parsimonious specification was found to perform best in terms of the Schwarz-Bayesian Information Criterion. The results were generally consistent with those presented below with one notable exception. The R^2 of the extensive margin regression improved markedly with the inclusion of a lagged first difference of the dependent variable when regressed on the relative income per worker and relative employment variables. When an f-test was run on the extensive margin regression presented below the null hypothesis of joint insignificance could not be rejected. This was due to the presence of a highly significant positive coefficient on the lagged relative income per worker variable and an even larger and more highly significant negative coefficient on the lagged relative employment variable. This result was considered spurious for reasons examined below.

regression with the error correction term. If the coefficient is negative and significant then the variables can be said to be cointegrated. That is, a one percent deviation from the long run equilibrium relationship in time $t - 1$ will be diminished by the percentage indicated by the absolute value of the coefficient on the error correction term in time t . In Table 3.7 none of the variables were found to be cointegrated with relative income. However, the validity of the regressions presented above is not dependent on the presence or otherwise of a cointegrating relationship as the regressions were run on first differences (Pesaran et al.; 1999). It is worth pointing out that the quantity component was very close to being statistically significant. That so few of the regressions generated a statistically significant cointegrating relationship is not surprising given the low number of observations.

A similar analysis was then conducted using the relative income per worker and relative employment variables, as in Hummels and Klenow (2005). The results are presented in Table 3.5. The lagged dependent variables were significant in all cases except that of the extensive margin. The largest coefficient was in the case of the intensive margin, implying that the speed of adjustment to a deviation from the equilibrium relationship between relative exports and relative income comes most rapidly through the relative quantities and prices of goods that Ireland trades and not through a change in the variety of goods exported.

Once again, the short-run variables are only significant in the case of the overall regressions. The results indicated that a one percent increase in the rate of growth of Ireland's relative income per worker is associated with a 0.7 percent increase in Ireland's share of exports to European Countries. The short-run coefficient on the relative employment variable is significant in the overall and price component regressions. A one percent increase in the rate of growth of the relative labour force is associated with a 2.0 percent increase in Ireland's share of exports to European countries, and a 2.2 percent increase in the relative price of those exports.⁸

The only significant long run variables are the relative employment variables in the intensive margin and price component regressions. The latter is particularly interesting as it is not predicted by the Hummels and Klenow (2005) quality differentiation model. This predicts that increases in relative income should be associated with increases in the price component as wealthier countries produce higher quality goods while a larger employment would be expected to produce relatively higher quantities.

One can look at the coefficients and interpret it as implying that, if an increase in the labour force is not associated with an increase in the quantity component, then a relatively greater amount of labour is being used to produce a relative similar amount of goods. If a firm was to use increase inputs to produce the same number of outputs, this would imply a reduction in productivity unless they could charge a higher price for the goods. In a competitive market one might expect that they could only sell the same quantity of goods at the higher price if the quality had improved. Thus, the coefficients might be interpreted

⁸This result also emerges if we include a lagged first difference of the dependent variable in the left hand side of the equation. When we do so, we also find a positive and significant value on the lagged level of the relative income per worker term in the quantity component equation.

as providing evidence that Ireland was involved in more labour intensive but higher quality activities.⁹

Alternatively, the positive coefficient on the relative labour force variable may in fact be reflective of a cost-push increase in prices as the increase in the relative labour force may capture capacity constraints within the economy. The fact that the goods would then be relatively more expensive would explain why the quantity component is not found to have increased significantly with the relative labour force as the increase in the price component would represent a shift to the left of the supply curve. The price component remained largely flat until 1993 before starting to increase. This coincides with the period when Irish unemployment finally began to decline, from 15.6 percent in 1993 to 4.2 percent in 2000.

When the Pesaran et al. (1999) method described above was implemented using the relative income per worker and relative employment variables, the results delivered little evidence to support the alternative hypothesis of cointegration. Using the critical values calculated by Pesaran et al (2001), none of the *f*-statistics were found to be statistically significant, nor were any of the error correction coefficients.

Next, following the procedure outlined by Faruq (2006) we examine the data relating to differentiated categories by using Rauch's (1999) classification of differentiated sectors. This is useful because it eliminates categories of goods which may be homogeneous such as commodities and would, therefore, be expected to have the same unit price everywhere if we control for trade costs.

The results for this subset of the data are presented below in Table 3.6. The results differ from those for all categories in a number of ways. The coefficient on the lagged dependent variable in the equation relating to the price component is no longer significant while the lagged overall export share coefficient is now larger and highly significant. The coefficient of -0.8 implies that 80 percent of any deviation from the equilibrium relationship between relative income and export share in time *t* is eliminated in the subsequent period. The long run coefficient on the relative income variable imply that a 10 percent increase in relative income is associated with a 6 percent increase in export share.

From the significance levels on the variables, it appears that this increase in export share comes through an increase in export intensity and in particular an increase in relative quantities. This is evidenced by the significant lagged dependent variables in the intensive margin and quantity component variables. The short run coefficients also indicate that the increase in export share is as a result of increase relative quantities.

When the Pesaran et al. (1999) cointegration test were conducted, it was found that relative export quantities and relative income are cointegrated (see Table 3.7). In this case, the *f*-statistic of 6.19 was found to be significant at the 95 percent significance level.

⁹It is not clear from looking at the CSO data that the proportion of the employment involved in manufacturing was constant over the period. Although it began to expand after 1995, the really rapid increases in the proportion of total employment in the service sector did not take hold in a major way until after the end of the sample period. Likewise the growth in the proportion of total employment in manufacturing did not appear slow down before 2001.

The t-statistic on the error correction coefficient in the quantity component was also found to be statistically significant, although only at the 10 percent significance level. It is important to bear in mind the number of observations.¹⁰ The coefficient on the error correction coefficient can be interpreted as above, so that a coefficient of -0.4 indicates that 40 percent of a deviation from the equilibrium relationship, between relative export quantities and relative income, in time t will be eliminated in the subsequent period. A coefficient of -0.4 indicates that 40 percent of a deviation from the equilibrium relationship, between relative export quantities and relative income, in time t will be eliminated in the subsequent period.

Table 3.8 shows the results from an analysis of differentiated product categories where the explanatory variables used are relative income per worker and relative employment. The results differ from those for aggregate categories in that the lagged dependent variable in the regressions on the price component is no longer statistically significant. The coefficient on the long-run workforce variable remains positive and statistically significant, however, implying that a 10 percent increase in the relative number of workers is associated with a 12 percent increase in the relative price of exports.

Finally, using the Pesaran et al. (1999) procedure to test for cointegration did not deliver any significant t-statistics on the error correction coefficient, although the f-test was significant at the 95 percent significance level in the case of the quantity component equation.

Overall, the results indicate that an increase in relative income is primarily associated with an increase in relative export intensity and specifically an increase in the relative quantities being exported. However, it does appear that the increase in relative employment over the period was associated with increased relative prices and not increased relative quantities as predicted by Hummels and Klenow (2005). The model specification implemented above did little to explain the increase in the extensive margin. Thus, the increase the percentage of trade taking place in categories in which Ireland participated does not appear to have been related to increases in relative income.

The increase in the extensive margin may have been related to falling trade costs (see Lawless and Whelan (2008); Bernard et al. (2005)) associated with European integration and had little to do with Ireland's relative income. This is consistent with a graphical examination of the data which shows that the extensive margin grew relatively consistently over the sample period. The assertion that European trade costs were falling is supported by the fact that European trade volumes were increasing consistently over the period (see Figure 3.12). This is also consistent with Novy (2008), who finds that U.S. trade costs fell 40 percent between 1970 and 2008.

Nevertheless, most of the increase in Ireland's export share came via the intensive margin. This may have been due to the fact that much of the export growth was due to a small

¹⁰Other cointegration tests, such as Johansen and Engle-Granger tests tended to indicate the intensive margin and quantity components were most likely to be cointegrated. The phrase 'most likely' is used in the sense that the results of these tests were highly sensitive to changes in lag length or the inclusion or exclusion of trend variables (restricted or unrestricted).

number of very large multinational firms in a limited number of industries. Furthermore, Chaney (2008) predicts that the effect of falling trade costs will come primarily through the intensive margin if the elasticity of substitution is high. At the end of the period, Ireland's exports were dominated by computer hardware and software (e.g. Intel and Microsoft) for which close substitutes were not readily available.

The theoretical model that delivers results most closely resembling what was observed in Ireland, is the Armington (1969) model. This predicts that an increase in workers will lead to an increase in trade share simply through increasing quantities. The associated fall in prices, arising from moving down the demand curve is not observed. The extensive margin should be correlated with the relative workforce according to both Acemoglu and Ventura (2002) and Krugman (1979) but this is not observed either. Neither did we find strong evidence of the expected correlation between the price component and relative income predicted by the Hummels and Klenow (2005) quality differentiation model.

In reality, none of the models satisfactorily explain an FDI based export led growth scenario in a small open economy. Although some theoretical trade papers on this type of economy exists (Ekholm et al.; 2007) there remains considerable scope for expanding this aspect of the new trade literature.

3.7 Conclusions

This paper examined the growth of Ireland's share of European trade and decomposed this trade into extensive and intensive trade margins. We then used these measures to investigate the effect of increases in the relative income and employment on trade.

The method applied to a cross-sectional data set by Hummels and Klenow (2002, 2005) was applied here in a time series context, creating a number of specification issues. This paper illustrates a number of potential solutions to these issues that represent adaptations from the original work.

Over the course of the period 1984 to 2000, Ireland experienced a rapid growth in income and income per worker relative to the rest of the world. This transition has been associated with an increase in Ireland's share of European exports.

The results of the regression analysis versus 18 European countries with more reliable data indicate that the response of overall export share to an increase in Ireland's relative income and relative income per worker came via increases in the relative quantities of exports. This pattern is similar for both aggregate goods and differentiated goods.

The price component of the intensive margin was found to be associated with the employment variable. The extensive margin accounted for much of the observed increase in Ireland's trade share, but much of this increase occurred prior to Ireland experiencing income growth.

That the price component increased with the number of workers, and the quantity component increased with relative income per worker, is contrary to the predictions made by Hummels and Klenow (2005) quality differentiation model. Overall, there was little

reliable evidence of increases in quality and variety of exports resulting from the growth of relative income.

Whether the models outlined above describe the chain of events that lead to Ireland export growth is questionable. The Krugman (1979) and Melitz (2003) style new trade models were constructed with large, relatively closed economies like that of the United States and the larger European countries in mind. In that context, it is plausible to think of domestic companies producing for the local market and then the most successful of those companies expanding and exporting.

During the period under examination, Ireland successfully pursued a policy export-led growth. This policy centred around attracting foreign direct investment from primarily American multinationals seeking to establish production facilities with the aim of exporting to larger European markets (Barry; 2004; Ruane and Ugur; 2005). Furthermore, Ruane and Ugur (2005) shows that wages tended to be higher in foreign owned firms.

As such, the aforementioned theoretical trade models do not perform particularly well in explaining Ireland's export share and trade margins. As Ireland is far from unique in being a small open economy pursuing an export led growth strategy this paper highlights some of the limitations on those cross country studies that test these models.

3.8 Appendices

3.8.1 Appendix 1: Dynamic Margins

3.8.2 Critical Analysis of the Hummels and Klenow (2002, 2005)

Hummels and Klenow (2002) apply the method outlined above to a cross-section of countries in the year 1995. This paper aims to apply the same method in a time-series context. An obvious question is whether this is a sensible thing to do.

What the measures outlined above will provide is a picture of how a country i (Ireland) compares to the rest of the world in each period. Thus, it indicates how Ireland's performance compares relative to the rest of the world but does not provide information on how Ireland's current performance compares with Ireland's performance in previous years. However, from the data we already know that both Ireland and the rest of the world as a whole experienced considerable growth in national incomes and trade. Thus, we utilise indices that use contemporaneous values from other countries, as a base rather than historical values from country i as countries relative performance is more interesting as conventional export price indices are already freely available.

Many of the issues associated with the use of indices arise from their application to income comparisons. In order to do this, it is required that a comparable basket of goods be selected with prices for these goods from a base year taken as the benchmark. The selection of the consumption basket leads to issues surrounding purchasing habits and differing consumer preferences across countries. This issue is not relevant to the price and quantity indices used above as these are only used to compare the prices and quantities of those goods that are categories in which a country participates. The effect of changes in the net number and magnitude of market-categories is reflected in the extensive margin but not in the price and quantity indices.¹¹

Stylised Facts

The dynamic margins were estimated for the EU15+3 subset only as it has been established that this is the most reliable data. Although this paper is primarily concerned with Ireland's relative performance as measured by the Hummels and Klenow (2005) margins, it is informative to examine the dynamic margins as this reveals much about how Ireland's absolute performance changed over time and also reveals the trends in European trade over the sample period.

Using the dynamic specification ensures that any variation in the measures is as a result in Ireland's export performance and not because of any variation in the unit value. The appearance of the dynamic margin is more clearly that of a non-stationary series arising from the fact that the denominator represents average values over the period while the numerator reflects the values for each year. The denominator for the overall share and

¹¹ Ireland still participates in approximately 62 percent of the market-categories in which it participated in 1984 although 31 percent of the market-categories it participated in 2000 were not present in 1984.

extensive margins are constant over time, but vary over time for the intensive margin as Ireland entered and left the various market categories. The appearance of the dynamic margins are more clearly that of non-stationary series arising from the fact that the denominator represents average values over the period while the numerator reflects the values for each year.

The nominal value of intra-European exports captured in the data increased over the period from approximately 420 billion to 1.3 trillion dollars per annum.

Feenstra and Kee (2004) refer to real values while the values provided in the data are in nominal terms. Both the nominal and deflated margins and indices are examined below. The GDP deflator (for each country) used is that provided by the World Bank World Development Indicators database. The initial price level is relative to the US in 1994 and is taken from Heston, Summers and Aten (2006).

It is difficult to make inferences about quality from the changes in the price indices as these are potentially biased, either upwards by increases in the price level or downwards if we use a deflator, as they do not take into account changes in quality. Thus, although the dynamic margins are useful, the use of the Hummels and Klenow (2005) margin is preferable if we wish to make inferences about export product quality.

Using this measure, Ireland's overall share of average intra-European exports went from 0.7 percent in 1984, to 3.3 percent in 2000. Indeed, the growth in the dynamic overall share appears to have accelerated from 1993 onwards (see Figure 3.7). Ireland's extensive export margin went from 25 percent in 1984 to 82 percent in 2000 (see Figure 3.8). Thus the value of the markets in which Ireland's exports participated accounted for over 80 percent of the value of total intra-European trade. It should be noted that using the dynamic extensive margin, it is possible for the value to exceed 100.¹² A large proportion of the growth in Ireland's extensive export margin was concentrated in three periods, from 1987 to 1989, in 1991 and in between 1995 and 1997. The most rapid period of relative income growth occurred after 1997.

The intensive margin also increase markedly over the period from 1.2 percent in 1984 to 4.6 percent in 2000 (see Figure 3.9). This implies that, in 2000, the value of Ireland's exports was 4.4 percent of the average over the period of the total value of the market-categories in which Ireland participated. It is also possible for this value to exceed 100 because of the use of the dynamic extensive margin.

The price component of the dynamic intensive margin appears markedly different to that of the Hummels and Klenow (2005) measure. The indicator increases rapidly from 1.16 in the mid-1980s reaching its peak in 1990 and 1993 at a level of approximately 1.9 before declining gradually toward the millennium to approximately 1.72 (see Figure 3.10). The contrast between this and the Hummels and Klenow (2005) measure implies that the relative price of other countries' intra-European exports must have been declining in the late 1990s.

¹²This is the case as the value of trade taking place in Ireland's market categories in a given year may exceed the average value of trade for all categories over the period.

The growth of quantity component of Ireland's dynamic intensive margin was rapid and consistent after 1993 as it went from 1 percent in 1984 to 2.7 percent in 2000 (see Figure 3.11). Thus, it appears that the apparent decline observed in the early 1980s using the Hummels and Klenow (2005) margin emanated from a rapid increase in intra-European trade between countries other than Ireland.

It is possible to extract the variation in EU-15+3 trade performance by dividing the Hummels and Klenow (2005) margins by the dynamic margins for Ireland. The numerators, the data relating to Ireland, will cancel out and we will be left with the ratio of the denominators.

By doing this, we can observe that the overall value of trade between the sampled European countries increased markedly over the period, by an average rate of 6.9 percent per annum for aggregate goods categories and about 8.4 percent for differentiated product categories. This is the same for both exports and imports as imports from one country represent exports from another (see Figure 3.12). The same statistic emerges if we divide the dynamic extensive margin by the Hummels and Klenow (2005) extensive margin as the denominators of each are equal. European incomes and the European employment grew reasonably consistently over the period.

The intensive margin statistic in this instance refers to the total value of European trade in the market categories in which Ireland participated in time t relative to the average value of European trade in Ireland's market categories of the entire sample period. This differs slightly from Ireland's dynamic extensive margin in that the denominator is the average value over time of the markets in which Ireland participates rather than the total value of European trade.¹³

The statistic for exports is presented in Figure 3.13. We know from looking at Table 3.1 that, while the relative quantities exported by Ireland increased markedly over the period of the late 1990's, other European countries export quantities were also increasing at the same time (see Figure 3.15). Overall European trade grew at an average of 6.9 percent per annum over the period although there appears to have been a brief decline in trade volumes in the early 1990s and particularly in the period 1992 to 1993 which coincided with the crisis in the European Monetary System. Similarly, the fall in Ireland's Hummels and Klenow (2005) quantity component in the period 1984 to 1997 occurred as Ireland's nominal export quantities remained flat while those of the rest of Europe were increasing.

Intra-European exports appear to have been characterised by increasing quantities and decreasing prices in the late 1990s. Quantities accounted for a higher proportion of the growth of the European Intensive margin. This may be explained by reduced trade costs and reduced barriers to trade (see Bernard et al. (2005)). Consistent with this, after 1995, the European export price component began to decline (see Figure 3.14). This decline was also observed in the Irish dynamic export price component although the decline was less

¹³Although it is not true here, if the alternative denominator in the dynamic intensive margin described above were used, then the dynamic intensive margin divided by the Hummels and Klenow (2005) intensive margin would be equal to the dynamic extensive margin. This is not the case here, however, as the market categories of the denominator in the dynamic intensive margin are allowed to vary over time.

steep. This explains why the Irish Hummels and Klenow (2005) export price component increased during this period.

The growth of trade of differentiated product categories exceeded that of aggregate trade growth. The 2.4 percent increase in the price level of differentiated goods which Ireland imported was considerably larger than the equivalent figure for exports of 1.6 percent. However, the opposite was true for differentiated quantities with the result that the intensive margin of differentiated goods for European trade in Ireland's market categories grew at approximately the same rate. At the same time, although the prices of goods in Ireland's market categories increased across Europe, the price of Irish exports in these market categories increased more rapidly than the rest of Europe.

When regressions were run using the dynamic data, this yielded further insights into Ireland's trade performance. The regression of the export quantity component yielded a highly significant long run coefficient on relative income and the implementation of the Pesaran et al. (1999) cointegration provided further evidence of a cointegrating relationship between the quantity component and relative income. This is related to the fact that, relative to a denominator fixed in time like that used in the dynamic measure, the increase in the quantities of goods Ireland exported was more pronounced. This was also true when the differentiated goods subsample was used. The effect of the quantity was more dominant on the export side than was the case when the Hummels and Klenow (2005) measures were applied. This arises from the fact that, compared to the quantity component, the movements extensive margin and price components were not accentuated when using the dynamic margins.

In summary, Ireland's increasing share of European exports occurred in a period when intra-European trade grew rapidly. It is important to recognise that the changes in Ireland's Hummels and Klenow (2005) margins represents changes Ireland's relative trade performance compared to a group of European countries that were involved in a process of market integration.

3.8.3 Appendix 2: Feenstra and Kee 2004 Dynamic Margins

Feenstra and Kee (2008) developed a dynamic extensive margin that is consistent across both the time and country dimensions. In their notation, the relative export variety of country h is measured by:

$$\Lambda_{iht}^h = \frac{\lambda_{it}^F(J)}{\lambda_{it}^h(J)} = \frac{\sum_{j \in J_{it}^h} p_i^F(j) q_i^F(j)}{\sum_{j \in J_i^F} p_i^F(j) q_i^F(j)} \quad (3.10)$$

The middle expression F is the reference country, i is sectors $i = 1, \dots, I$, t is a given year in the sample period, J is the set of goods exported by both h and F and λ is a measure of absolute export variety. The right hand expression is similar to that used by Hummels and Klenow (2002, 2005) and explained above. It represents the sum of the value (price p times q quantity) of F exports of products J which are exported by h in sector i at time t , divided by the sum of the average value of the reference country F exports of all

products exported (not just those in common with h) over the years of the sample. Thus, the measure indicates country h export variety relative to the average export variety in the sample period of reference country F . Feenstra and Kee (2008) use average worldwide exports from all countries to the U.S. for the years 1980 to 1988 and 1989 to 2000 as the comparison.¹⁴

The concept of using temporal mean values as a reference can be adapted not only to the extensive margin but also to the other margins and indices. Returning to the Hummels and Klenow (2002) notation, for exporting country j at time t :

$$\text{Share of World Exports} = \frac{X_{jt}}{X_F} \quad (3.11)$$

where X_{jt} = nominal exports of country j at time t and X_F = mean over the sample period of nominal rest of world exports from exporters ($i \neq j$) to all markets.

$$\text{Intensive Export Margin} = \frac{X_{jt}}{\sum_{i \neq j} \sum_{s \in X_{jist}} X_{Fis}} \quad (3.12)$$

where x_{Fis} = mean world exports to country i in product category s over the sample period, and X_{jist} = the set of market-category (i, s) pairs for which $x_{jist} > 0$, where x_{jist} = nominal exports of country j to country i in product category s at time t . The intensive export margin measures a country's share of world exports in those market categories in which it exports relative to the average over time of rest of world exports in those categories in which country i participated in that year.¹⁵ As such the denominator does vary in this instance as the selection of market categories in which Ireland participates does vary over time.

$$\text{Extensive Export Margin} = \frac{\sum_{i \neq j} \sum_{s \in X_{jist}} X_{wist}}{X_F} \quad (3.13)$$

The extensive margin for country j measures the fraction of world exports that occur in those market-categories in which country j exports compared to the mean over time of the total value of exports by the rest of the world. It should be noted that, unlike in

¹⁴Feenstra and Kee (2008) use U.S. data rather than world data because the U.S. data is more highly disaggregated. The sample period is divided in two, purely because of issues relating to data. The 1980 to 1988 data is 7-digit TSUSA data while the 1989 to 2000 data is 10-digit HS data. The transition from one data set to another leads to a fall in their measure of variety at the transition as the number of potential market-categories increases because of the higher level of data disaggregation. In their analysis, the authors control for this through the inclusion of a pre-1989 fixed effect.

¹⁵An alternative would be to use as the denominator the value of the rest of the worlds exports in all the categories in which Ireland participated over the entire period. This measure was constructed and delivered a smaller intensive margin which grew more rapidly in percentage terms. This is due to the fact that the denominator was larger, as the total number of varieties in which Ireland participated over the entire sample period is larger than the number of market categories for any individual year. The number of market categories that Ireland participated in grew over the period but it stopped participating in some categories also. The appropriateness of the use of this measure in a decomposition into the price and quantity components would be open to question, however, as Feenstra (2004) outlined an alternative price index that adjusts for new and disappearing varieties. These measures are employed by Galstyan and Lane (2008) discussed in the literature review.

the case of the Hummels and Klenow (2002) decomposition method, the product of the extensive and intensive margins does not equal the share of world exports. This is due to the fact that the denominator in the intensive margin is no longer equal to the numerator in the extensive margin.

The intensive margin can be further decomposed into price and quantity components. This is aggregated across market-categories to calculate the export price index and the export quantity index for each country. The export price index for exporter j is:

$$\text{Export Price Index} = \left[\frac{\sum_{i \neq j} \sum_{s \in X_{jist}} p_{jist} q_{jist}}{\sum_{i \neq j} \sum_{s \in X_{jist}} p_{Fis} q_{jist}} \right]^{\frac{1}{2}} \left[\frac{\sum_{i \neq j} \sum_{s \in X_{jist}} p_{jist} q_{Fis}}{\sum_{i \neq j} \sum_{s \in X_{jist}} p_{Fis} q_{Fis}} \right]^{\frac{1}{2}} \quad (3.14)$$

where q_{jist} = the quantity of exports from country j to country i in category s at time t , $p_{jist} = \frac{x_{jist}}{q_{jist}}$ (that is the total value divided by the quantity), q_{jist} = the quantity of world exports to country i in category s at time t , and $p_{Fis} = \frac{x_{Fis}}{q_{Fis}}$, the mean over time of the price of rest of world exports in country i in category s is equal the the average value x_{Fis} divided by the average quantity q_{Fis} . This export price index summarises the extent to which an exporter's prices are high or low relative to the average over time of the rest of the worlds exports prices in the same market category. The comparison only relates to those categories in which Ireland is participating at time t .

Similarly, the export quantity index is given by:

$$\text{Export Quantity Index} = \left[\frac{\sum_{i \neq j} \sum_{s \in X_{jist}} p_{jist} q_{jist}}{\sum_{i \neq j} \sum_{s \in X_{jist}} p_{Wist} q_{Fis}} \right]^{\frac{1}{2}} \left[\frac{\sum_{i \neq j} \sum_{s \in X_{jist}} p_{Fis} q_{jist}}{\sum_{i \neq j} \sum_{s \in X_{jist}} p_{Fis} q_{Fis}} \right]^{\frac{1}{2}} \quad (3.15)$$

This export quantity index summarises the extent to which an exporter's quantities are high or low relative to the average over time of the rest of the worlds exports quantities in the same market category. As was the case with the Hummels and Klenow (2002) method, the product of the price and quantity indices equals the intensive margin.

As we have mentioned, the advantage of this measure is that it is consistent across both time and country dimensions. Thus, we can say that a change in the extensive margin is due to a change in the variety of Ireland's exports and not due to a change in the reference country. Another advantage of this method is that it clarifies the situation regarding stationarity. The reference country is now constant over time, so it is not unreasonable to expect that Ireland's relative export, income and population will be non-stationary. The measure of relative income, relative income per worker and relative number of worker were all calculated with reference to the average of time in the reference countries. We will continue to use the EU15+3 subsection of the data for the data quality reasons outlined above.

3.8.4 Appendix 3: Tests for Causality

Another critical issue relates to causality and endogeneity. This was investigated using the Granger Causality Test (Enders 2004). The tests reported here were implemented using two lags although alternative lag lengths were also explored as the tests of causality and optimum lag length were conducted contemporaneously. The causality tests were concentrated upon relative income and relative income per worker variables as these exhibited greater statistical significance than the relative employment variable in the majority of model specifications.

The potential chain of causality may run from income to exports or the effect on the dependent variable of changes in the independent variable may be reflected in the same time period. Did Ireland relative incomes increase after it started exporting or did exports increase after an increase in relative incomes? One could think of a company hiring more workers *ex ante* to produce exports, or alternatively increasing wages *ex post* on the back of successful exports.

In general, the values of the F-stat that emerged from the Granger Causality test were greater when the margin and index variables were the independent variables but there were numerous instances when both or neither chains of causality were significant. In the majority of cases these values exceeded the critical values, thus indicating that the null hypothesis that relative income or relative income per worker does not cause changes in exports could be rejected. However, the only consistent finding was that this was not the case for the price component of the intensive margin, where the causality appeared to operate in the opposite direction. That is, changes in the relative prices of Ireland's exports appeared to have occurred subsequent to changes in relative income.

After exploring a number of possibilities, a "General to Specific" modelling method was utilised, as outlined by Enders (2004) and applied by de Brouwer and Ericsson (1998). As we have seen, in the case of the data versus the rest of the world (ROW), both the overall export share and Price Index variables were found to be cointegrated with the relative income variable. This implies that there is a long run equilibrium relationship between these variables, and that any deviation from this equilibrium will be eliminated in the long run. With this in mind a vector error correction (VEC) model was implemented.¹⁶

An examination of the AIC and BIC in the case of the regression on the price component indicated that the optimal lag length was two. Furthermore, the AIC and BIC and t statistics also indicated that it was not appropriate to include a time trend in the error correction model. The results of this regression are presented below.

The anticipated results are a negative coefficient on the error correction term in the equation with the first difference of the price component as the dependent variable, and a

¹⁶A VEC model, is essentially the same as a recursive Vector Autoregression (VAR) on first differences with the addition of a error correction term. This additional variable is derived by running a simple OLS regression of the contemporaneous values of the two (or more) cointegrated variables (and also sometimes a time trend term). This is referred to as the cointegrating equation and it gives the long-run relationship between the variables. The residuals of this regression then represent the deviations from this relationship and so form the error correction term (see Enders 2006).

positive coefficient on the error correction term in the equation with the first difference of relative income as the dependent variable. The former result is observed in the case of the error correction term in the change in the price component equation and the coefficient is statistically significant. However, in the case of the error correction term in the change in income equation, the result is the 'wrong sign' and is not statistically significant at the 10 percent significance level.

As a result, a restriction was imposed of the error correction term in the change in income equation such that it was set equal to zero. The resulting Chi-square statistic was 0.18 giving a probability value of 0.68. The corresponding probability value for the speed of adjustment term in the change in prices was 0.00. Thus, we can set the error correction term in the change in income equal to zero. This implies that income is weakly exogenous (Enders 2004) as the adjustment to deviations from the cointegrating relationship appear to occur almost entirely via changes in price component. This is consistent with the results indicated by Granger causality tests. The price component appears to respond to changes in income and not *visa versa*.

Following the de Brouwer and Ericsson (1998) method, a single equation Autoregressive Distributed Lags model was specified as follows:

$$p_t = \beta_0 + \beta_1 Lp_{t-1} + \beta_2 Ly_t + \epsilon_t \quad (3.16)$$

This can be reparameterised as an error correction model of the form:

$$\Delta p_t = \alpha_1 ec_{t-1} + \alpha_2 \Delta Lp_{t-1} + \alpha_3 \Delta Ly_{t-1} + \epsilon_t \quad (3.17)$$

as outlined in Asteriou 2006. The results are presented in Table 3.9. The results indicate that the error correction term is highly significant and is approximately equal to one, indicating that a one Standard Deviation from the cointegrating equilibrium relationship will be absorbed within one year.

When a similar procedure was applied to the overall variable versus relative income and the price component versus relative income per worker, similar conclusions were reached. However, in the overall versus relative income per worker case, the chi-squared value did not indicate that relative income per worker was weakly exogenous. In this case, an unrestricted vector error correction model with one lag was implemented using the EViews computer programme. These results appear to confirm what was suggested by the Granger causality tests. This indicates that overall export share and relative income per head are endogenous, whereas the chain of causality appears to run from relative income and relative income per worker to the relative price of exports. Thus, as a country grows richer it will export at higher prices.

The results presented in Table 3.9 indicate that, although relative income and the price component of the intensive export margin are cointegrated, the relative income variable can be considered to be weakly exogenous. Thus, all the adjustment to any deviation from the equilibrium relationship, as defined by the cointegrating equation given in Table 3.9,

comes through the price component. This evidence, combined with that of the Granger causality tests, indicate that the increase in the relative price of Ireland's exports appear to have been as a result of increases in relative income and not vice versa. This chain of causality appears to be robust for the price component in the various sub-samples of the data, but weak exogeneity was not found to apply in a considerable majority of cases with respect to the other variables.

As a result, there may be some endogeneity bias in the estimates presented in this paper. While it is difficult to imagine instruments for an instrumental variable approach, another solution would be to implement a vector error correction model. However, the validity of such method given the number of observations is questionable.

Table 3.1: Exports: Annual Average Percentage Change 1984-2000

	ROW	ROW	EU15+3	EU15+3	EU15+3
		Diff.		Diff.	Dynamic
		Products		Products	Margins
Overall Export Share	3.4	2.0	3.2	2.5	10.0
Extensive Margin	4.5	3.2	2.5	1.8	9.5
Proportion overall Increase	133.2	157.3	78.6	72.0	
Intensive Margin	-1.1	-1.2	0.7	0.7	7.7
Proportion overall Increase	-33.2	-57.3	21.4	28.0	
Price Component	1.7	1.6	0.8	0.8	2.3
Proportion overall Increase	51.0	79.3	24.9	32.0	
Quantity Component	-2.8	-2.8	-0.1	-0.1	5.5
Proportion overall Increase	-84.2	-136.6	-3.5	-4.0	

Notes: Based on Feenstra et al (2004) data and authors calculations. Diff. products refers to differentiated product categories.

Table 3.2: Exports: Annual Average Percentage Change in Intra-European Trade 1984-2000

	Aggregate	Differentiated
	Products	Products
Overall Export Share	6.9	8.4
Extensive Margin	6.9	8.4
Intensive Margin	7.0	7.8
Price Component	1.5	1.6
Quantity Component	5.5	6.2

Notes: Based on Feenstra et al (2004) data and authors calculations.

Table 3.3: Hummels and Klenow (2005) Quality Differentiation Model

Indep. Var. →	Relative Income	Relative
	Per Worker	Employment
Dep. Var. ↓		
Extensive Margin	0	0
Intensive Margin	1	1
Price Component	1	0
Quantities	0	1

Notes: This table displays the coefficients predicted by the Hummels and Klenow (2005) Quality Differentiation Model.

Table 3.4: ARDL using Hummels and Klenow (2005) Export Margins and Relative Income Explanatory Variable

	(1)	(2)	(3)	(4)	(5)
Dependent Var. (First Difference)	Overall Share	Extensive Margin	Intensive Margin	Price Component	Quantity Component
Dependent Var. (Lagged Level)	-0.45 [0.15]**	-0.14 [0.10]	-0.51 [0.20]**	-0.65 [0.22]**	-0.58 [0.15]***
Relative Income (First Difference)	1.12 [0.40]**	-0.13 [0.42]	0.59 [0.70]	0.21 [0.57]	0.30 [0.30]
Relative Income (Lagged Level)	0.36 [0.24]	0.01 [0.06]	0.29 [0.20]	0.16 [0.13]	0.20 [0.08]**
Constant	0.01 [0.78]	-0.03 [0.29]	-0.29 [0.66]	1.13 [0.73]	-1.32 [0.47]**
Observations	16	16	16	16	16
Adjusted R^2	0.04	0.30	0.31	0.20	0.43

Notes: Newey-West Standard errors in brackets,*significant at 10; **significant at 5; ***significant at 1 percent significance level.

Table 3.5: ARDL using Hummels and Klenow (2005) Export Margins and Relative Income per Worker and Relative Employment Explanatory Variables

	(1)	(2)	(3)	(4)	(5)
Dependent Var. (First Difference)	Overall Share	Extensive Margin	Intensive Margin	Price Component	Quantity Component
Dependent Var. (Lagged Level)	-0.45 [0.14]***	-0.29 [0.21]	-0.82 [0.20]***	-0.67 [0.23]**	-0.56 [0.26]*
Relative Income per Worker (First Difference)	0.77 [0.41]*	0.02 [0.44]	0.54 [0.66]	0.28 [0.48]	0.27 [0.42]
Relative Income per Worker (Lagged Level)	0.41 [0.27]	0.18 [0.16]	0.15 [0.19]	-0.08 [0.15]	0.21 [0.14]
Relative Employment (First Difference)	1.95 [0.77]**	-0.51 [0.52]	2.90 [1.06]**	2.27 [0.94]**	0.24 [0.95]
Relative Employment (Lagged Level)	-0.22 [0.49]	-0.55 [0.48]	1.74 [0.89]*	1.04 [0.47]*	0.10 [0.66]
Constant	-2.79 [2.28]	-2.75 [2.39]	5.57 [3.75]	5.35 [2.36]**	-1.70 [2.43]
Observations	16	16	16	16	16
Adjusted R^2	0.12	0.27	0.43	0.47	0.31

Notes: Standard errors in brackets,*significant at 10; **significant at 5; ***significant at 1 percent significance level.

Table 3.6: ARDL using Hummels and Klenow (2005) Export Margins for Differentiated Product Categories and Relative Income Explanatory Variable

Dependent Var. (First Difference)	(1) Overall Share	(2) Extensive Margin	(3) Intensive Margin	(4) Price Component	(5) Quantity Component
Dependent Var. (Lagged Level)	-0.81 [0.25]***	-0.17 [0.18]	-0.46 [0.20]**	-0.39 [0.23]	-0.48 [0.16]**
Relative Income (First Difference)	1.95 [0.54]***	0.11 [0.49]	1.06 [0.66]	-0.62 [0.56]	1.74 [0.33]***
Relative Income (Lagged Level)	0.59 [0.23]**	0.01 [0.07]	0.22 [0.15]	0.21 [0.15]	0.02 [0.10]
Constant	-0.46 [0.42]	-0.03 [0.29]	-0.66 [0.68]	1.23 [0.69]	-1.92 [0.58]***
Observations	16	16	16	16	16
Adjusted R^2	0.52	-0.04	0.39	0.079	0.50

Notes: Standard errors in brackets,*significant at 10; **significant at 5; ***significant at 1 percent significance level.

Table 3.7: GETS Long Run Estimates using Hummels and Klenow (2005) Export Margins for Differentiated Product Categories and Relative Income Explanatory Variable

Dep. Var.↓	f-stat	Relative Income coefficient	Lagged Error Correction Term	Cointegrated
(1) Overall Share	5.32**	0.48 [0.19] (2.56)	0.09 [0.09] (-1.04)	no
(2) Extensive Margin	0.73	0.00 [0.02] (0.06)	-0.16 [0.14] (-1.15)	no
(3) Intensive Margin	2.78	0.10 [0.08] (1.20)	-0.19 [0.16] (-1.19)	no
(4) Price Component	3.15	0.20 [0.10] (2.07)	0.06 [0.19] (0.30)	no
(5) Quantity Component	6.19**	0.01 [0.08] (0.15)	-0.45 [0.13] (-3.53)*	yes

Notes: All Regression are case 3: unrestricted intercept and no trend.
Coefficients normalised on the dependent variable.
F-test tests null hypothesis: $y_1=1=depvar=0$.
T-test refers to the test of the Error Correction Term.
***significant at 1 percent significance levels using the critical values provided by Pesaran et al (2001). indicates that the result is inconclusive.

Table 3.8: ARDL using Hummels and Klenow (2005) Export Margins for Differentiated Product Categories and Relative Income per Worker and Relative Employment Explanatory Variables

	(1)	(2)	(3)	(4)	(5)
Dependent Var. (First Difference)	Overall Share	Extensive Margin	Intensive Margin	Price Component	Quantity Component
Dependent Var. (Lagged Level)	-0.75 [0.31]**	-0.63 [0.37]	-0.75 [0.18]***	-0.32 [0.24]	-0.41 [0.21]*
Relative income per Worker (First Difference)	1.63 [0.67]**	0.48 [0.35]	1.04 [0.60]	-0.51 [0.52]	1.54 [0.53]**
Relative income per Worker (Lagged Level)	0.52 [0.26]*	0.44 [0.28]	-0.02 [0.14]	-0.12 [0.17]	0.10 [0.16]
Relative Employment (First Difference)	3.12 [0.64]***	-0.87 [0.75]	4.05 [0.80]***	2.57 [1.03]**	1.24 [1.22]
Relative Employment (Lagged Level)	0.31 [0.50]	-1.25 [0.76]	1.80 [0.69]**	1.29 [0.60]*	-0.63 [0.76]
Constant	-1.61 [1.73]	-6.20 [3.76]	5.85 [2.91]*	6.33 [2.95]*	-4.75 [3.06]
Observations	16	16	16	16	16
Adjusted R ²	0.58	0.076	0.59	0.43	0.45

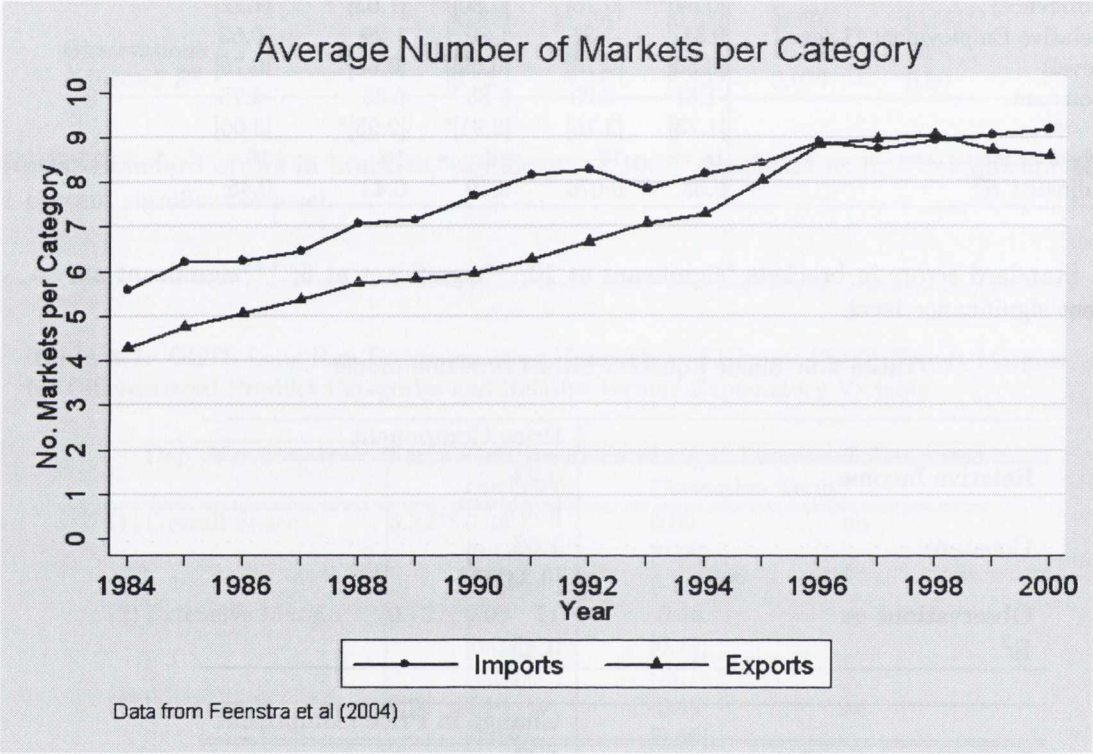
Notes: Standard errors in brackets,*significant at 10; **significant at 5; ***significant at 1 percent significance level.

Table 3.9: Single Equation Error Correction Model

	Price Component
Relative Income	0.23 [0.07]***
Constant	1.68 [0.34]***
Observations	17
R ²	0.42
	Change in Price Component
Error Correction Term	1.05 [0.32]***
Lagged Change in Price Component	-0.59 [0.29]*
Change in Relative Income	0.65 [0.42]
Lagged Change in Relative Income	0.16 [0.47]
Constant	-0.01 [0.02]
Observations	15
R ²	0.59

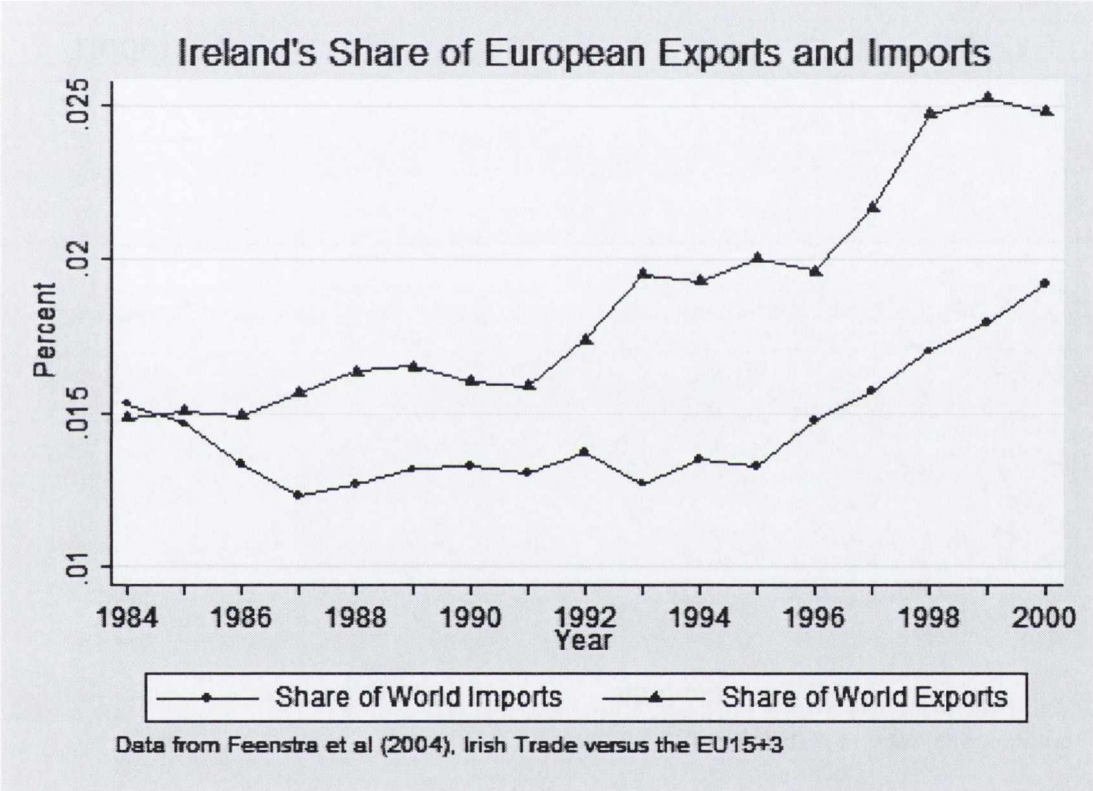
Notes: Standard errors in brackets,*significant at 10; **significant at 5; ***significant at 1 percent significance level.

Figure 3.1: Average Number of Markets per Category



Source: Authors calculations based on Feenstra et al (2004) data. The period displayed is 1984 to 2000.

Figure 3.2: Ireland's Share of European Exports and Imports
Share EU.png



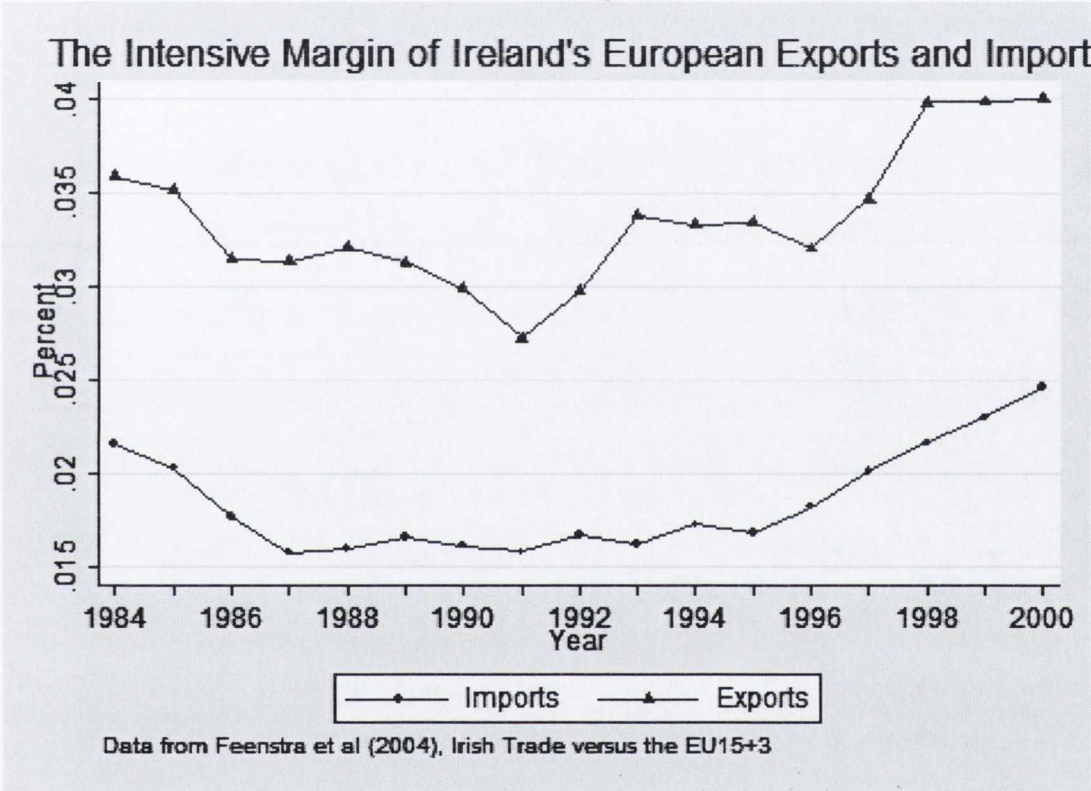
Source: Authors calculations based on Feenstra et al (2004) data. The period displayed is 1984 to 2000.

Figure 3.3: Ireland's European Extensive Import and Export Margins.
EM EU.png



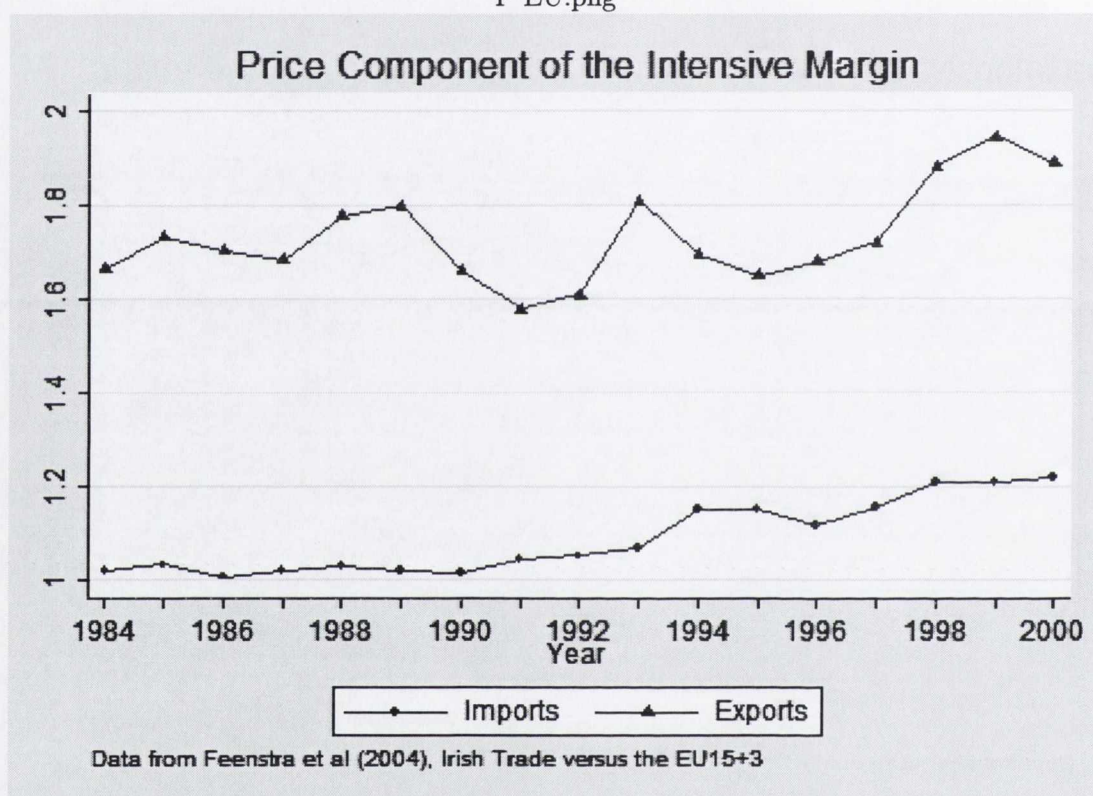
Source: Authors calculations based on Feenstra et al (2004) data. The period displayed is 1984 to 2000.

Figure 3.4: Ireland's European Intensive Import and Export Margins
IM EU.png



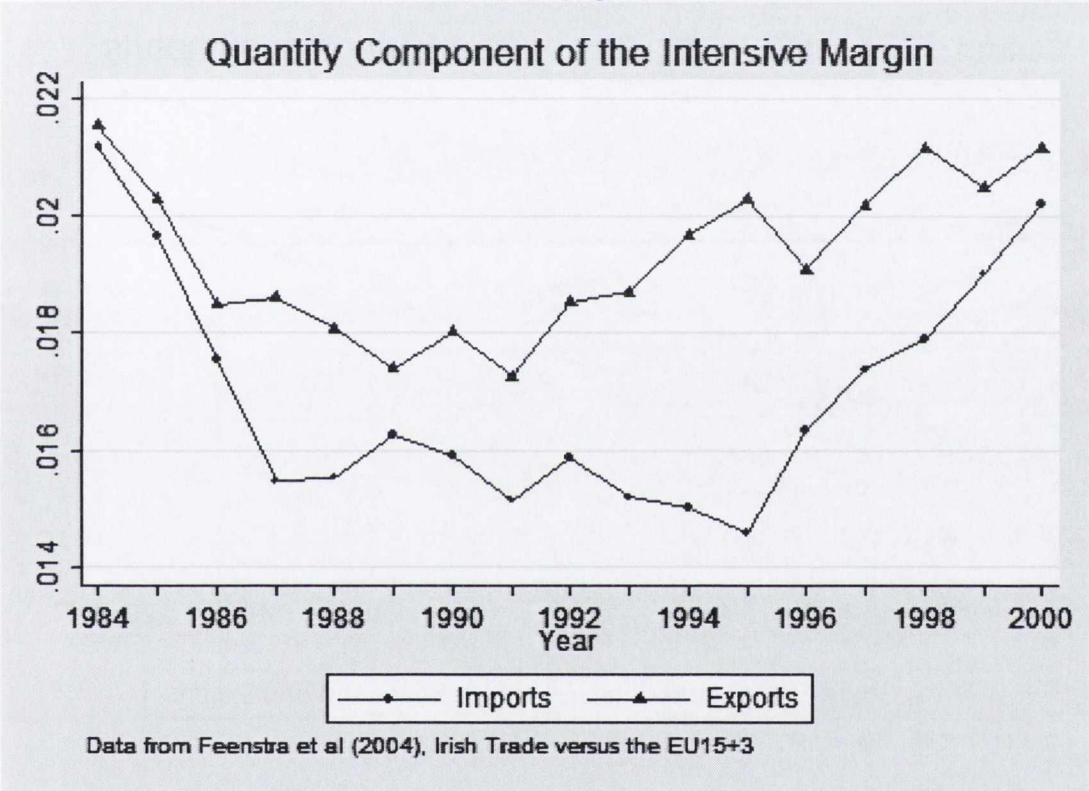
Source: Authors calculations based on Feenstra et al (2004) data. The period displayed is 1984 to 2000.

Figure 3.5: Ireland's European Import and Export Price Indices
P EU.png



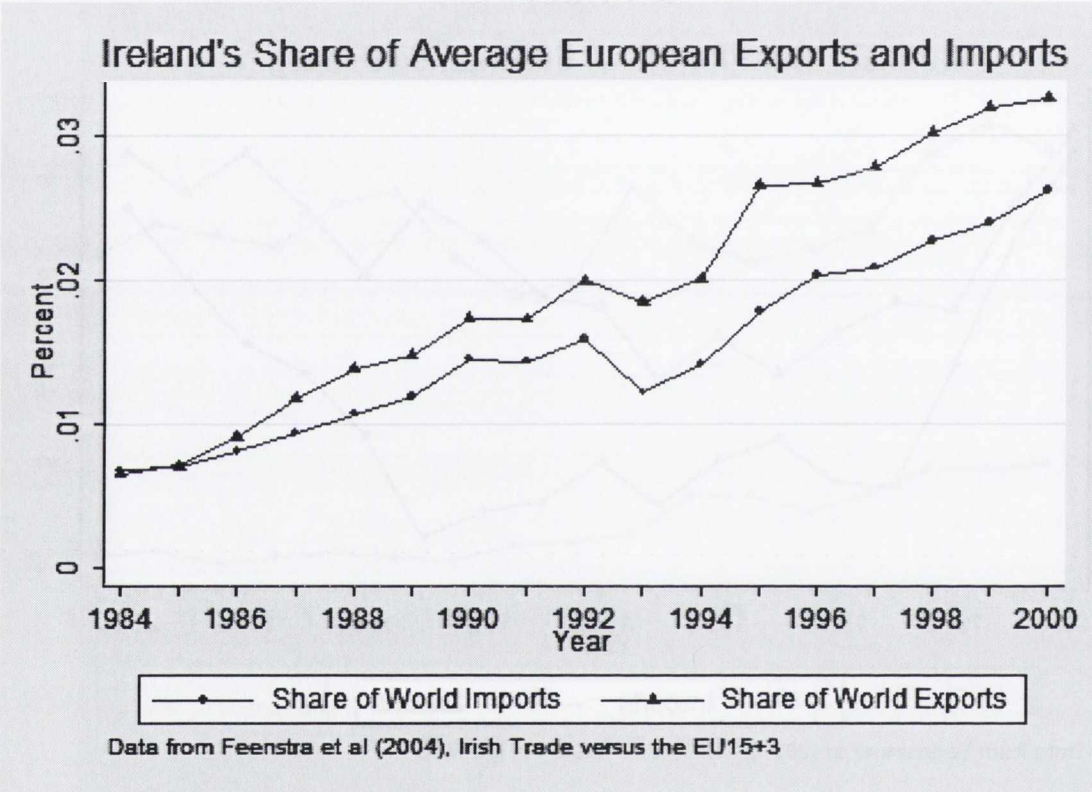
Source: Authors calculations based on Feenstra et al (2004) data. The period displayed is 1984 to 2000.

Figure 3.6: Ireland's European Import and Export Quantity Indices
Q EU.png



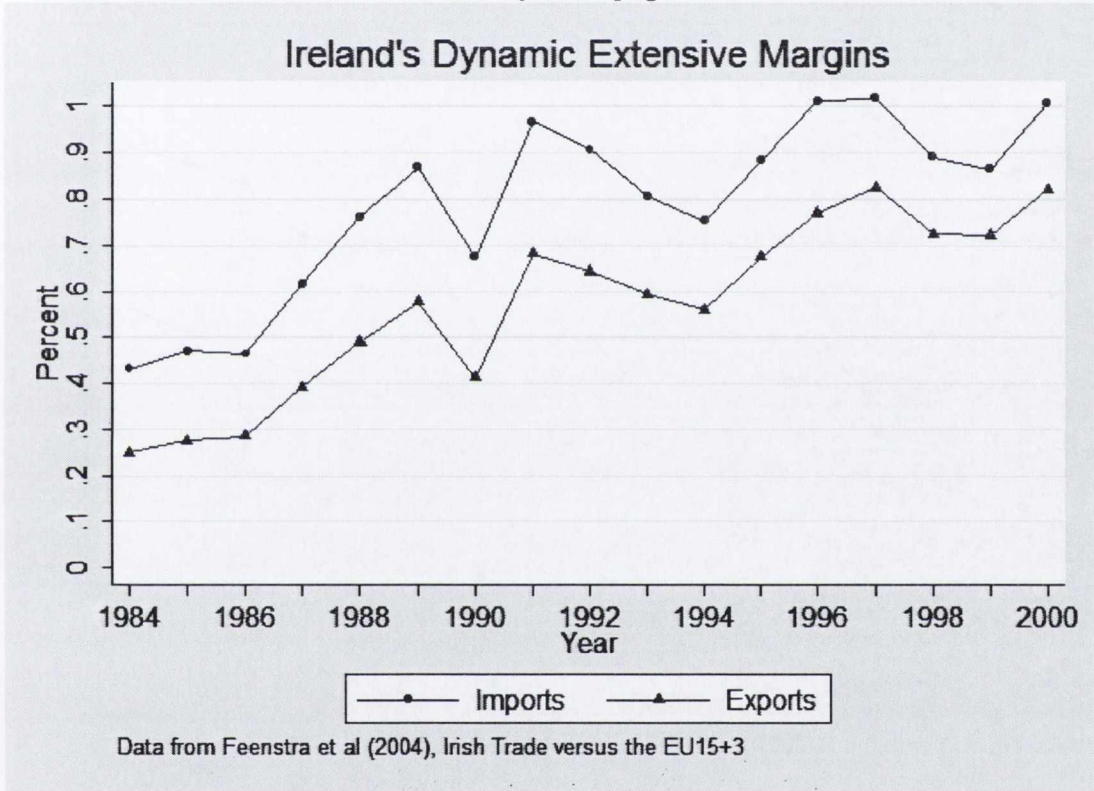
Source: Authors calculations based on Feenstra et al (2004) data. The period displayed is 1984 to 2000.

Figure 3.7: Ireland's Share of Average European Exports and Imports
Share Dynamic.png



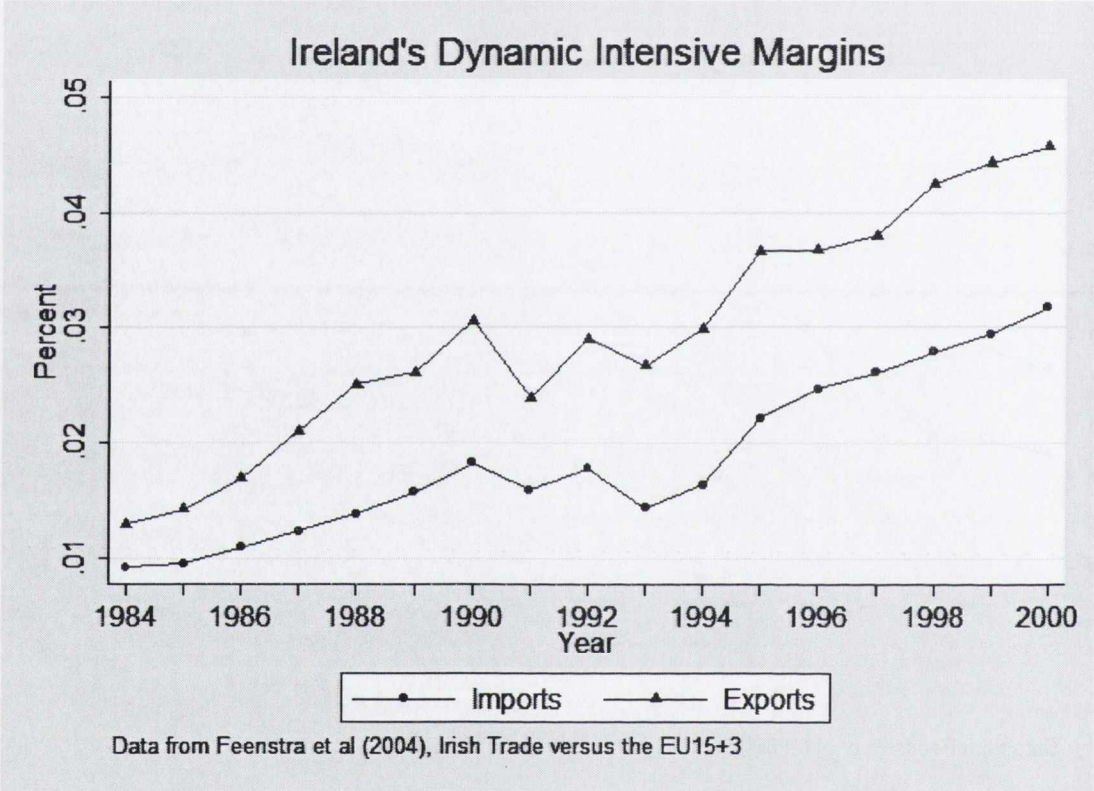
Source: Authors calculations based on Feenstra et al (2004) data. The period displayed is 1984 to 2000.

Figure 3.8: Ireland's Dynamic European Extensive Import and Export Margins.
EM Dynamic.png



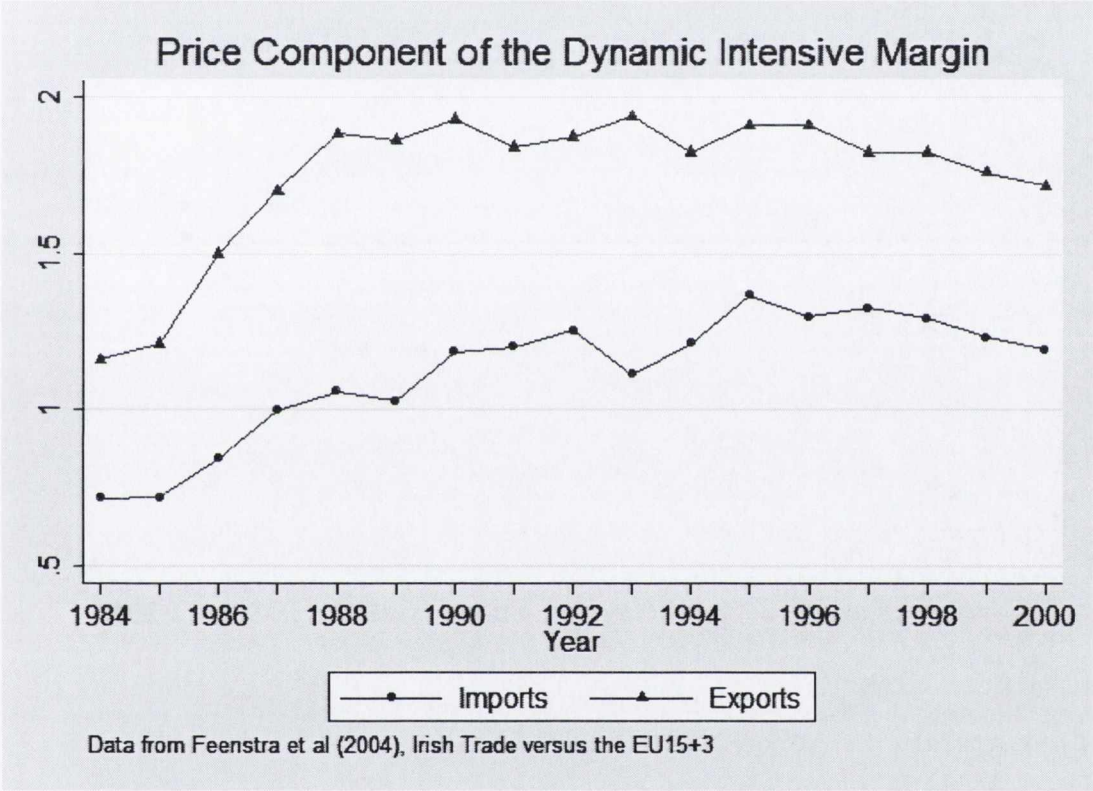
Source: Authors calculations based on Feenstra et al (2004) data. The period displayed is 1984 to 2000.

Figure 3.9: Ireland's Dynamic European Intensive Import and Export Margins
IM Dynamic.png



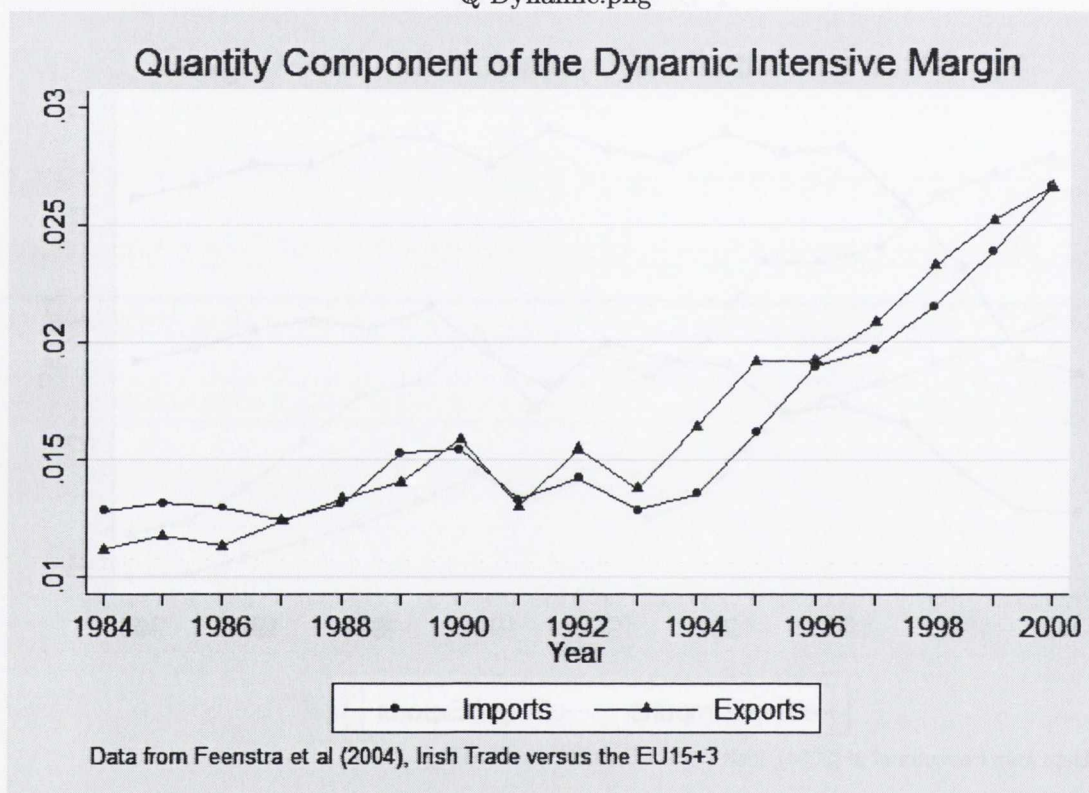
Source: Authors calculations based on Feenstra et al (2004) data. The period displayed is 1984 to 2000.

Figure 3.10: Ireland's Dynamic European Import and Export Price Indices
P Dynamic.png



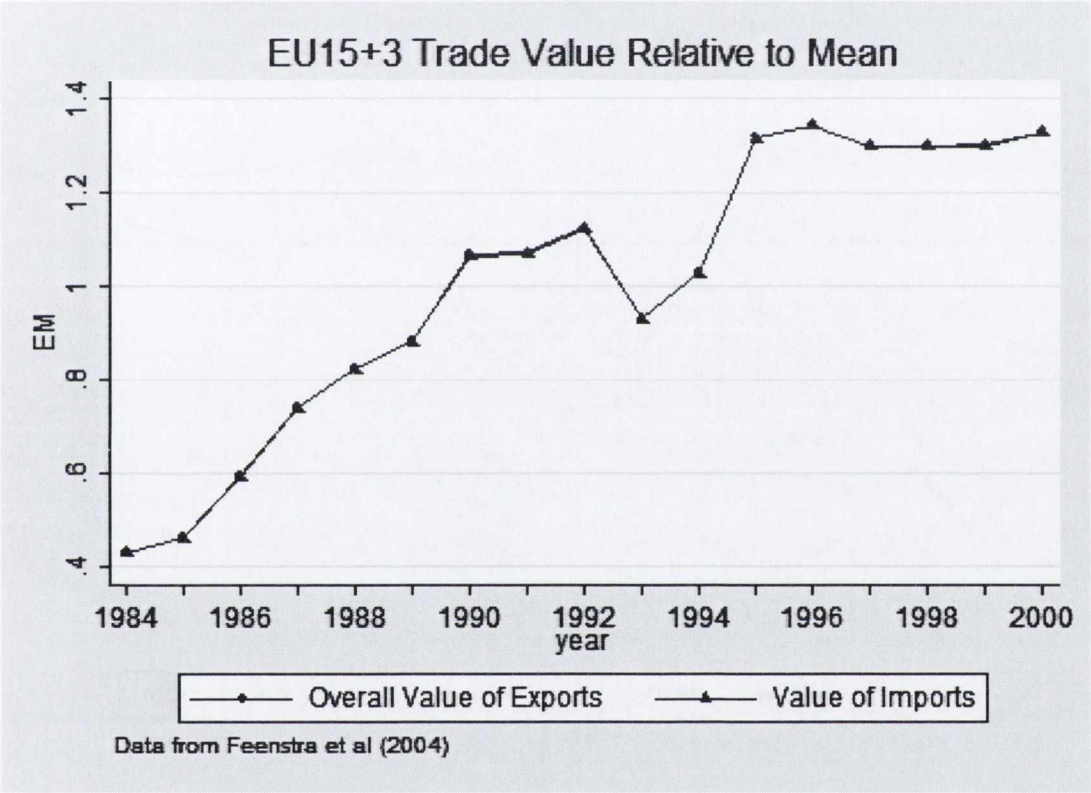
Source: Authors calculations based on Feenstra et al (2004) data. The period displayed is 1984 to 2000.

Figure 3.11: Ireland's Dynamic European Import and Export Quantity Indices
Q Dynamic.png



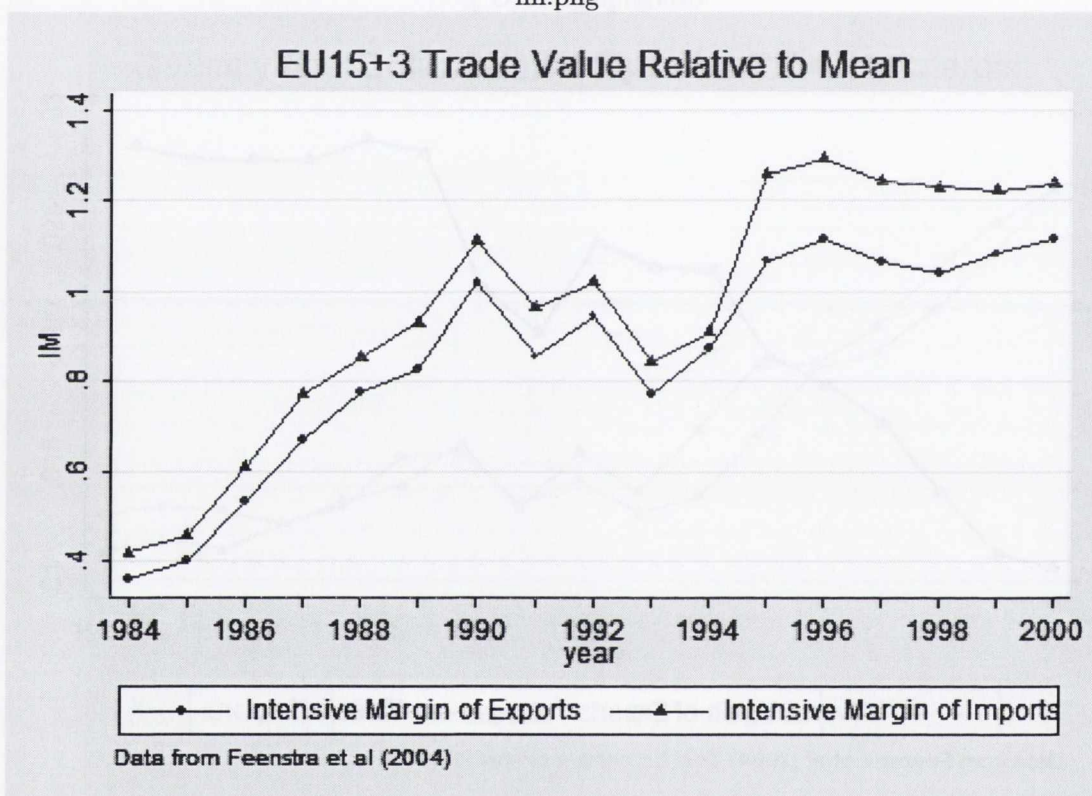
Source: Authors calculations based on Feenstra et al (2004) data. The period displayed is 1984 to 2000.

Figure 3.12: EU15+3 Overall Imports and Exports
overall.png



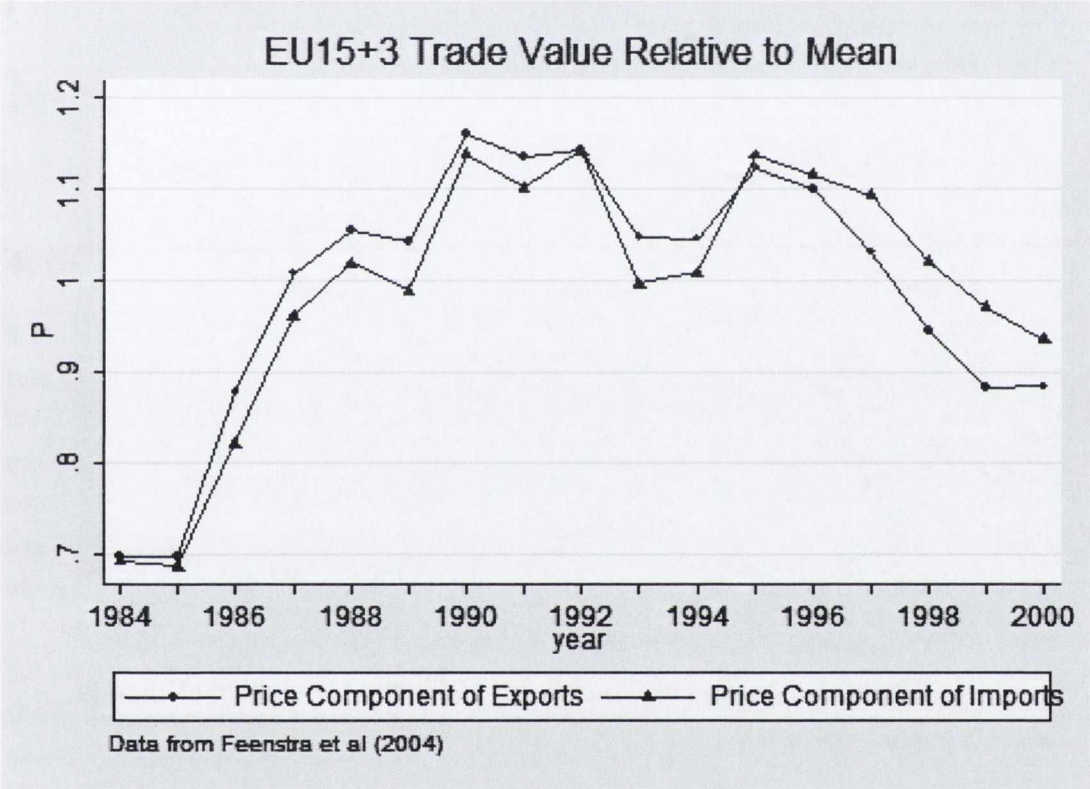
Source: Authors calculations based on Feenstra et al (2004) data. The period displayed is 1984 to 2000.

Figure 3.13: EU15+3 Import and Export Intensive Margin
im.png



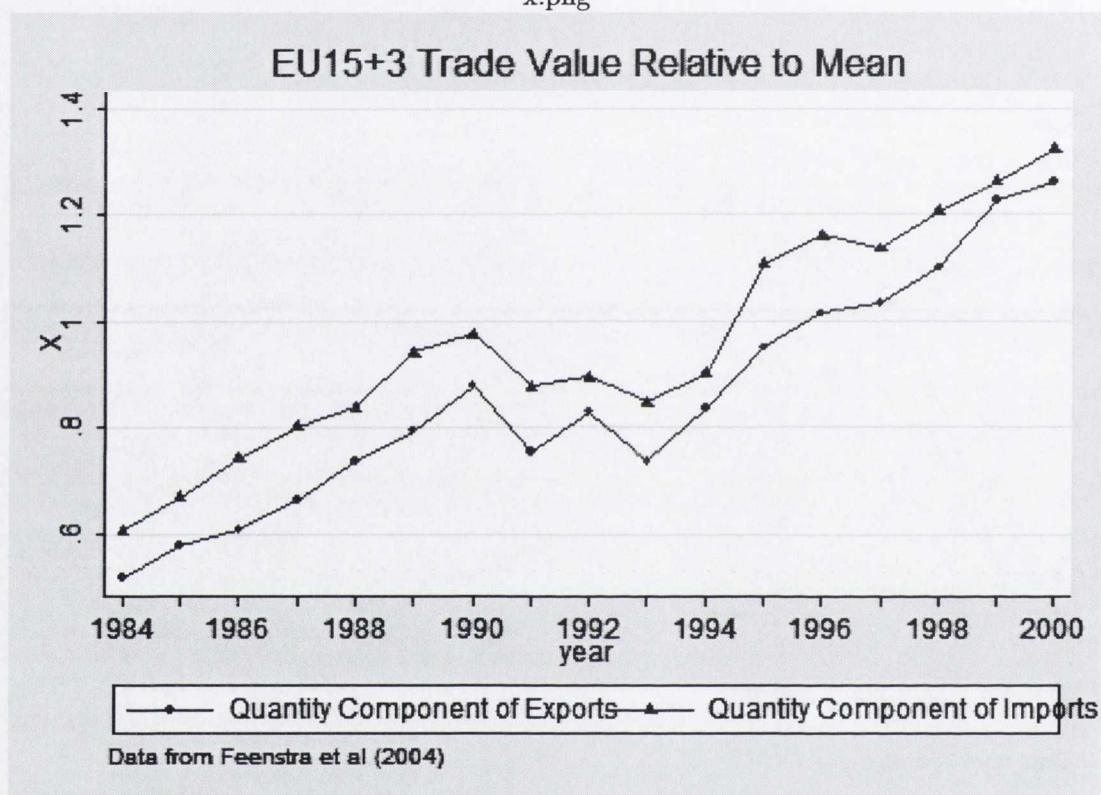
Source: Authors calculations based on Feenstra et al (2004) data. The period displayed is 1984 to 2000.

Figure 3.14: EU15+3 Import and Export Price Component
p.png



Source: Authors calculations based on Feenstra et al (2004) data. The period displayed is 1984 to 2000.

Figure 3.15: EU15+3 Import and Export Price Component
x.png



Source: Authors calculations based on Feenstra et al (2004) data. The period displayed is 1984 to 2000.

Chapter 4

The Evolution of International Trade on the Extensive and Intensive Margins

4.1 Introduction

The period from 1995 to 2005 was characterised by a sizable increase in the value of international trade and a growing public awareness of the increasing level of international integration generally referred to as globalisation. China and other Asian countries have received considerable media attention focusing on their increased share of trade with wealthy countries and their contribution to global trade and financial imbalances. Furthermore, Europe continued its own efforts at creating a single market via the EU and the introduction of the euro.

This paper seeks to identify what is the relation between a country's trade share and its income level and whether this relation has changed in recent years. In order to address this question, we employ the trade decomposition method used by Hummels and Klenow (2002, 2005). This involves dividing the overall trade share of a given country into the extensive and intensive margins. The latter is further decomposed into price and quantity components. This means that it is possible to observe estimates of relative export variety and relative quantities.

The data used for the analysis come primarily from the European Commission External Trade database. It contains data relating to both intra- and extra-EU trade. Trade data from the CEPII BACI database are also employed as they allow comparisons over a wider number of reporter countries.

This paper improves upon Hummels and Klenow (2005) by applying their method to more reliable, more detailed data which covers multiple years. The paper also innovates by incorporating time varying coefficients. The results of the analysis suggests that all countries, particularly those with low incomes, trade more with the EU now than at the beginning of the sample. In the 49 country sample, this is shown by the declining coefficient

on the relative income variable in the regressions with overall export share as the dependent variable. The importance of the intensive margin in explaining the additional trade share of wealthier countries with the EU-15 has diminished. This manifests itself by consistency of magnitude of the relative income coefficient in the extensive margin while the coefficient on relative income in the intensive margin regressions declined.

A country's relative income has a smaller effect on trade share than was previously the case, primarily because relatively low income countries now export large quantities of goods also. Variety and quality (as proxied by the price component) are the remaining characteristic of wealthy countries exports. These results can be explained using theories that suggest that trade volumes and varieties will increase with a reduction in trade costs such as Melitz (2003) and Chaney (2008).

This paper also highlights the interrelation between the extensive margin and the price component generated by the limited level of disaggregation of the data. This knowledge also supports the assertion that variety is the key trade characteristic of relatively high income countries.

The rest of the paper is divided into 5 sections. Section 4.2 provides a brief review of some of the related literature, section 4.3 outlines the decomposition method. Section 4.4 outlines the data sources and presents some descriptive statistics. Section 4.5 presents the results of regressions and provides analysis. Finally, section 4.6 highlights the main findings and delivers some concluding remarks.

4.2 Related Literature

Although numerous theoretical papers on topics related to quality and variety in trade have existed for some time, it is only in recent years that a large number of empirical papers have been produced. An important factor contributing to this is the use of data from international trade rather than that collected for consumer price indices. Previous methods tended to focus on a small number of products for which high quality data were available (Isquierdo and de los Llanos Matea; 2001). The theoretical foundations of the trade data papers is broad, extending from Dixit and Stiglitz (1975) and Krugman (1979), Flam and Helpman (1987) to Feenstra (1994) and Melitz (2003). Using international trade data as a starting point, a wide variety of questions have been addressed empirically.

Hummels and Klenow (2005) forms the template for this paper. Using cross-sectional international trade data, they decomposed exports into extensive and intensive margins, with price and quantity components for the latter. Market-categories are defined by both the product code and the country of origin.¹ The extensive margin measures the fraction of world trade that occurs in those market categories in which country it participates. The intensive margin measures a country's share of world trade in those market categories in

¹Each HS 4-digit, or in our case CN 8-digit, code is interpreted as a product category. A market-category is defined as a unique product-exporter combination. So exports of code 1063910, live pigeons, is one category, but live pigeons exported from Romania represent a different market-category than exports of live pigeons from Bulgaria.

which it participates. The price and quantity components of the intensive margin show whether a country's exports are high or low in price or quantity relative to another country's exports. They represent relative price and quantity indices. Hummels and Klenow (2005) find that the extensive margin accounts for around 60 percent of the overall exports of larger economies.

Hummels and Klenow (2005) begin by outlining four theoretical economic models and their predictions regarding trade flows, specifically the measures explained above and their relationship with the dependent variables, relative income per worker and relative workforce.

The first model, the Armington (1969) national differentiation model, is based on the assumption that each country produces a single variety in each category. There is no extensive margin and quality does not vary across countries.² A country with more workers increases its trade share simply by increasing quantities. This leads to a fall in the price component as the country moves along its export demand curve.

The second model, Acemoglu and Ventura (2002), expands upon the Armington model by including endogenous capital accumulation and an endogenous number of varieties. The number of varieties is proportional to the number of people employed. They predict that the extensive margin will be positively related to the size of the workforce. Furthermore, higher productivity countries will produce a higher quantity of each good and this will result in lower prices. The model implies that countries with a higher relative income per worker will export more intensively via relatively higher quantities but at relatively lower prices.

Krugman (1980) modelled countries as producing an endogenous number of varieties proportional to the size of the economy. The quantity of each variety sold (in a simple version of the model) is proportional to the size of the country and all varieties are sold at the same unit price. This implies that the extensive margin will increase with the size of the economy but the intensive margin will not. As all of the firms in the economy are assumed to be identical and all trade costs are variable either none or all of the firms will trade. If all firms trade, then a further reduction in variable trade costs will not lead to an increase in the extensive margin and will operate only on the intensive margin as the existing firms will trade more. Therefore, the model predicts that variable trade costs have a stronger impact on trade the higher the elasticity of substitution.

Finally, Hummels and Klenow (2005) outline a quality differentiation model in which quality levels vary across countries but productivity and variety do not. Countries with more workers will produce higher quantities of each variety. Relative income per worker is anticipated to be positively correlated with the price component because higher income countries produce higher quality goods. The intensive margin increases with both relative income per worker and relative workforce but the model predicts no relationship between the extensive margin and either of the explanatory variables.

²Although the measure used below includes increases in the extensive margin based on an increase in the number of trade partners.

When Hummels and Klenow (2005) ran regressions using these margin and indices as dependent variables, they found that 72 percent of the increase in overall exports associated with higher income per head emanates from the extensive margin. Similarly, they found that 63 percent of the increase in total exports associated with a larger labour force (a measure of economy size) arises from increases in the number of varieties of products exported.

Hummels and Klenow (2002) further decompose the intensive margin into its price and quantity components. However, in the case of exports, the importance of the intensive margin is small relative to the extensive margin. The results indicate that a 10 percent increase in the labour force is associated with a 2.5 percent increase in the quantity component of the export margin as compared with a 5.4 percent increase in the extensive margin.

The price component of the intensive margin increases by just 0.4 percent with a ten percent increase in the labour force. Both price and quantity components have a relative income coefficient of approximately 0.2. This implies that the prices of exports are relatively much more strongly linked to the income per head of each country. It should be noted, however, that the R^2 statistic for the price component is relatively small (0.25). Indeed, the R^2 statistic for the intensive margin is smaller than the same statistic for the extensive margin (0.62 for the former, 0.76 for the latter).

On the consumer side, early papers such as Dixit and Stiglitz (1975) and Krugman (1979) posited the potential gains from increased variety. According to the latter, an increase in import varieties could occur either via a fall in trade costs or through growth in the foreign country. If trade costs fall, countries will gain through the import of new varieties. If the foreign country grows it will produce and export more varieties.

An empirical investigation of the proposition that consumers may derive higher levels of utility from the availability of a greater number of varieties is explored by Broda and Weinstein (2006). They suggest that firms with relatively high productivity choose to compete on quality using their productivity advantage to produce high-quality, high-price varieties rather than concentrating on a low-cost strategy. Hallak (2003) produces results that show that, as countries become more capital and skill abundant, they produce more highly priced and vertically differentiated varieties.³

Kaplinsky and Santos-Paulino (2006) examine trends in the unit prices of European Union imports of manufactured goods for the period 1988-2000. The data employed comes from the European Commission COMEXT database of external trade. The data used are HS 2-, 4-, 6-, and 8-digit categories (up to 10 thousand product categories) on a monthly basis. The authors use Augmented Dickey Fuller tests to identify which unit price series (by country and product category) contain a unit root, that is, the price series is non-stationary. They find that, with the exception of upper middle income exporters, there is a general tendency for the incidence of non-stationarity to increase with the degree of

³Vertically Differentiated: Differentiated on the basis of quality. (Ferrari vs Fiat)
Horizontally Differentiated: Similar in overall quality, but offering different combinations of characteristics (Blue Toyotas and Red Toyotas.)

sectoral disaggregation as the data move from 2- to 4- to 6-digit levels disaggregation.

Our work is related to several of these previous empirical contributions and represents another application of international trade data to the study of trade variety. Most obviously, this paper relates to Hummels and Klenow (2005) but improves on this work by applying their method to data that is more complete, more up to date, more highly disaggregated and includes a time dimension. The interpretation of our results makes reference to the new trade theory literature such as Melitz (2003).

Melitz (2003) is highly cited and is one of the key papers in the “new new trade” literature (Baldwin and Rober-Nicoud 2004). In the 1980s, papers like Krugman (1979) incorporated imperfect competition and increasing returns to scale and Melitz (2003) expands on this by introducing a model that incorporates firm heterogeneity into general equilibrium trade models that are consistent with the firm-level facts documented papers such as Bernard et al. (2005).

Each nation is assumed to have a single primary factor, labour, which is an index of country size and a single consumption-good sector. There are a continuum of firms, M , each producing a different variety. All firms have the same fixed cost but have different productivity levels. This can be thought of as leading either to the production of a symmetric variety at a lower marginal cost or a higher quality variety at the equal cost. Either way firms choose the same profit maximising markup. The model uses Dixit-Stiglitz monopolistic competition and ice-berg trade costs.

In autarky, a firm’s market share deviates from $1/M$ when its productivity (and therefore its marginal cost) deviates from the country average. More productive firms produce more, have higher revenues, charge lower prices and have higher profits. If a firm’s productivity level is below the autarky cutoff level, it does not produce as it cannot make positive profits.

In free trade, only the firms with a productivity level high enough reach the export cutoff export. There are three types of firms; first, there are firms that do not reach the domestic cutoff and which therefore close down, second, there are firms that reach the domestic cutoff but not the export cutoff and which only sell to the domestic market and third, there are firms that have productivity not less than both cutoffs and these firms sell in both domestic and foreign markets. The addition of foreign firms operating in the domestic market means that there is an increase the productivity level required for domestic firms to remain in production. Therefore, a move to free trade will reduce the number of domestic firms operating in the domestic market while those firms that reach the export cutoff productivity level will export. These firms will increase in size and, consequently, this increases the aggregate productivity level. This will also lead to an increase in aggregate welfare as, although the varieties consumed by domestic consumers may decrease (typically they increase), the productivity effect will dominate.

An important result of the Melitz (2003) model relates to what happens if there is a reduction in the variable trade costs. This decreases the cutoff productivity required to be an exporter. More domestic and foreign firms will export. More foreign firms will enter the

domestic market meaning that the cutoff productivity required to be a domestic producer is higher. So there will be fewer domestic firms but more domestic exporters. Firms will lose a proportion of their domestic sales but exporting firms will gain foreign market share.

In contrast, if fixed costs fall, only new exporters will gain foreign market share but not extant exporters. In either case, the more productive firms grow larger while some of the least productive exit the market, resulting in an increase in the aggregate level of productivity. The number of firms in the model is a positive function of the number of workers and the aggregate price level is a positive function of the number of firms. Welfare also relates positively to the number of firms as this will lead to greater product variety.

In the context of the results presented in this paper, it is important to note that the original Melitz (2003) model assumes identical nations. Furthermore, unlike in reality, there is no variation in trade costs between countries which means that any firms that exceed the export cutoff level of productivity will export to all markets.

Feenstra and Kee (2004) examine the effect of increases in export variety on total factor productivity. Using panel data relating to US imports from the rest of the world, export market share is regressed against a measure of relative export variety as well as a number of other control variables, including relative factor endowments. The theoretical basis of this relationship is based upon Melitz (2003). One can gain an intuitive understanding of the model by thinking of the following scenario: If the set of firms that export is determined on the basis of productivity, where only the most productive firms export, then a decrease in trade barriers exposes both exporting and non-exporting firms to increased competition. As a result, some of the least productive firms, those which do not export, will be forced to exit the market. At the same time, the productivity threshold for exporting is reduced, so more of the most productive firms will now be exporters. Thus, the average productivity of firms increases.

The export variety measure is taken as indicative of the number of firms that export. This model therefore predicts that, the higher the level of export variety, the higher the level of productivity. As higher labour productivity is associated with increasing wages, one might therefore expect a higher variety of outputs to be associated with higher income levels.

In a subsequent paper Elhanan Helpman and Rubinstein (2008) develop an international trade model with heterogeneous firms that predicts positive as well as zero trade flows across pairs of countries and allows the number of exporting firms to vary across destination countries. This facilitates the decomposition of the impact of trade frictions on trade flows into the intensive and extensive margins. The definition of the extensive margin used in Elhanan Helpman and Rubinstein (2008) refers to the fraction of firms that export and is therefore related, but not equivalent, to the measure referred to in this paper.

Elhanan Helpman and Rubinstein (2008) find that the response of trade to changes in trade costs is related to the income level of the trading countries. They divide trade flows into North-North, North-South and South-South.⁴ Their model predicts, and it is

⁴By this definition the EU 15 data used here only covers North-North and North-South trade.

confirmed in their data analysis that, when trade costs related to distance fall, the responses of the extensive margin of trade are more important for less developed countries.

Chaney (2008) expands on Krugman (1980) and Melitz (2003) by allowing for asymmetric countries with asymmetric trade barriers. In the aforementioned Krugman model, if the elasticity of substitution between country varieties is low, then consumers will be willing to pay higher prices for a particular variety and therefore, the effect of trade barriers will be limited. Chaney (2008) predicts the opposite. Contrary to Krugman (1980), a low elasticity of substitution means that each firm has some market power and the low productivity new entrants (marginal firms) arising from a reduction in trade costs will be able to command a significant market share. A low elasticity of substitution implies that consumers will not be willing to pay a premium for imported varieties. Consequently, low productivity firms will have a small market share and make little difference to aggregate trade.

The literature presented above provides a number of models of international trade. Although it would be surprising if relatively simple models could explain the pattern of trade flows exactly, some of the models discussed above provide useful insights which help explain what is observed. The predictions of the trade models can be compared to the empirical results generated in the following sections. In the interpretation and conclusion section, we propose a potential improvement that could be made to the models presented above by incorporating an elasticity of substitution that varies systematically across countries according to income levels.

4.3 Data Decomposition

By comparing the prices and quantities of exports by different countries within market categories, Hummels and Klenow (2002) were able to estimate differences in varieties and relative prices and quantities across exporters. The decomposition employed below is based on the method used by Hummels and Klenow (2002) except that in this case the margins and indices include the time subscript t .

Hummels and Klenow (2002) decompose trade into, what they call, intensive and extensive margins, where Overall is a country's overall share of world exports, EM is the extensive margin and IM is the intensive margin. P and Q are the relative price and relative quantity components (indices) of the intensive margin.

$$\text{Overall} = \text{EM} * \text{IM} \tag{4.1}$$

$$\text{IM} = P * Q \tag{4.2}$$

These values are then logged and regressed against log GDP and against log income per worker and the log number of workers.

Hummels and Klenow (2005) use Feenstra (1994) methodology that was originally

intended as a means of incorporating new varieties into a country import price index when assuming a constant elasticity of substitution utility function. Feenstra shows that expanding the set of imported goods effectively lowers the import price index. The formula for the exact price index is actually based on earlier work by Vartia (1976).

The intuition behind the Feenstra (1994) paper is that consumers perceive the expansion of new varieties as equivalent to a reduction in prices, and the variety adjusted price indices precisely capture this effect. By using the Feenstra (1994) construction one is able to not just characterize the decomposition of sales into price, quantity, and variety margins, but to link it to welfare changes. Although (Hummels and Klenow; 2005) did not explicitly explore this property of the indices they could be directly employed for that purpose.

The design of the Fisher Ideal index, however, is more concerned with minimising bias relating to relative price changes. An index formula is biased if, for some small relative changes in prices and quantities, its values deviate from a center of gravity as defined by (Vartia and Vartia; 1984). Thus, the use of either index is justifiable depending on whether one is more concerned with the effect of new varieties or the effect of relative price changes. As chapter 3 uses less disaggregated data (so fewer observed new varieties but potentially more price variation because of the presence of more unobserved varieties) than chapter 4 the relative importance of these two effects is different and, therefore, different indices were utilised in each chapter.

Hummels and Klenow (2005) adapt the Feenstra (1994) method so that instead of comparing varieties imported over time, they compare varieties imported from different exporters at a point in time. Comparing export prices for country j relative to reference country k requires an adjustment for the size of the set of goods exported, referred to here as the extensive margin. I_{jmt} is the set of observable categories in which country j has positive exports to m at time t . In the following empirical implementation, I is the number of CN eight-digit product codes as outlined in the data section below. The reference country k is the rest of the world net of j . m is not included in k either as m cannot export to itself.

For the shipments of exporting country j to m relative to reference country k (the rest of the world) at time t , the extensive margin is defined as:

$$EM_{jmt} = \frac{\sum_{i \in I_{jmt}} p_{kmit} x_{kmit}}{\sum_{i \in I_t} p_{kmit} x_{kmit}} \quad (4.3)$$

The extensive margin for country j measures the fraction of world exports that occur in those market categories in which country j exports. This idea is based on the import variety growth measure from Feenstra (1994) except that it varies cross-sectionally rather than across time. According to Hummels and Klenow (2002), *ceteris paribus*, if a country concentrates all of its exports in a small number of market categories, it will have a higher intensive margin and a lower extensive margin. The extensive margin can be understood as a weighted count with each market category receiving a weight according to its share in

world exports. Thus, it is indicative of the variety of products traded, weighted by their volume (monetary value) in world trade.

$$IM_{jmt} = \frac{\sum_{i \in I_{jmt}} p_{jmit} x_{jmit}}{\sum_{i \in I_{jmt}} p_{kmit} x_{kmit}} \quad (4.4)$$

IM_{jmt} equals j nominal exports relative to k nominal exports in those categories in which j exports to $m(I_{jmt})$. The ratio of country j to country k exports to m equals the product of the two margins:

$$EM_{jmt} IM_{jmt} = \frac{\sum_{i=1}^I p_{jmit} x_{jmit}}{\sum_{i=1}^I p_{kmit} x_{kmit}} \quad (4.5)$$

The intensive margin is further decomposed into price and quantity components based and Feenstra (1994). The data are aggregated across market categories to calculate the relative export price index and the export quantity index for each country.

It is important to remember that the measures used in the data decomposition are shares of total European and world trade, the total value of which increased markedly during the period.⁵

Hummels and Klenow (2005) use the Feenstra (1994) derived exact price index for a country's intensive margin. Country m 's imports from j versus k are given by:

$$P_{jmt} = \prod_{i \in I_{jmt}} \left[\frac{p_{jmit}}{p_{kmit}} \right]^{w_{jmit}} \quad (4.6)$$

One of the key differences between the price indices used in chapter 3 and chapter 4 is the way the weightings are applied to each category. In chapter four the w_{jmit} is the logarithmic mean of s_{jmit} (the share of category i in country j exports to m at time t) and s_{kmit} (the share of category i in k exports to m at time t where $i \in I_{jmt}$):

$$s_{jmit} = \frac{p_{jmit} x_{jmit}}{\sum_{i \in I_{jmt}} p_{jmit} x_{jmit}} \quad (4.7)$$

$$s_{kmit} = \frac{p_{kmit} x_{kmit}}{\sum_{i \in I_{jmt}} p_{kmit} x_{kmit}} \quad (4.8)$$

$$w_{jmt} = \frac{\left[\frac{s_{jmit} - s_{kmit}}{\ln s_{jmit} - \ln s_{kmit}} \right]}{\left[\sum_{i \in I_{jmt}} \frac{s_{jmit} - s_{kmit}}{\ln s_{jmit} - \ln s_{kmit}} \right]} \quad (4.9)$$

⁵It is possible that a country's intensive margin might fall and its extensive margin increase despite maintaining a constant export volume in its market categories because of changes in the size of the market categories in which a country participates.

Using the price component used in the Hummels and Klenow (2002) working paper rather than that used above from Hummels and Klenow (2005) journal article, tended to deliver higher values of the price component as it appeared to be more sensitive to observations with very high relative unit prices and very low quantities.

Finally, the quantity index was then derived by dividing the intensive margin by the above price index.

The geometric mean of each country j 's decomposition across M_{-j} markets to get:

$$IM_{jt} = \prod_{m \in M_{-j}} (IM_{jmt})^{a_{jmt}} \quad (4.10)$$

$$EM_{jt} = \prod_{m \in M_{-j}} (EM_{jmt})^{a_{jmt}} \quad (4.11)$$

$$P_{jt} = \prod_{m \in M_{-j}} (P_{jmt})^{a_{jmt}} \quad (4.12)$$

$$X_{jt} = \prod_{m \in M_{-j}} (X_{jmt})^{a_{jmt}} \quad (4.13)$$

The weight a_{jm} is the logarithmic mean of the share of m in the overall exports of j and W_{j-m} at time t respectively (normalized so that a_{jm} 's sum to 1 over the set M_{-j}).

The price component calculated in this case is calculated with reference to weights arising from the relative share of a country in a given market category relative to the world. Thus, extreme price observations corresponding to very small quantity observations do not have an undue effect on the overall price indices and could, therefore, be allowed to remain in the data.

4.4 Data and Descriptive Statistics

The data utilised are eight digit, combined nomenclature (CN) Eurostat trade data. These CN data are based on six digit Harmonised System (HS) data, the CN eight digit categories being subdivisions of six digit HS categories. At its most extensive and detailed the data consists of in excess of 18 million observations. The eight digit data has almost twice as many categories as the six digit HS data. There is a disadvantage to using this data, however, as a proportion of the categories are reclassified each year, thus affecting the precise values of the various margins. Given the macro focus of the analysis, however, it was considered that the advantage of having twice the definition outweighed the cost in the comparability of the individual categories.⁶ The CN eight digit data are also utilised by Pula and Santabarbara (2011).

The reporter countries included in this analysis are the EU-15, that is: Austria, Belgium, Germany, Denmark, Spain, Finland, France, Great Britain, Greece, Ireland, Italy,

⁶If 6-digit data are used, the broad pattern of the data does not change but the extensive margin increases and the intensive margin decreases.

Luxembourg, the Netherlands, Portugal and Sweden. The data for Luxembourg are included in that of Belgium for the period prior to 1999. Initially, the partner countries were the above plus Canada, Switzerland, China, Hong Kong, Hungary, Japan, the Republic of Korea, Malaysia, Norway, Poland, Singapore, Thailand, Turkey, Taiwan and the United States of America. These partner countries were selected as they are the largest exporters to the EU-15. The data set was subsequently expanded to include data for Algeria, Argentina, Australia, Brazil, Bulgaria, Chile, Czech Republic, India, Indonesia, Iran, Israel, Kazakhstan, Libya, Morocco, Mexico, New Zealand, Nigeria, Romania, Russia, Saudi Arabia, Slovakia, Slovenia, South Africa, Tunisia and Ukraine. This gives a total of 55 partner countries.

When the CEPII BACI data are employed, these 55 partner countries are also reporters. This means that the data relates each of the 55 countries exports to 54 partners. While this is obviously a very desirable property of the data it should be noted that there remains an issue relating to missing data observations in the BACI data and the data set covers a shorter time period.

In order to control for the effect of remoteness on the various trade margins, where appropriate a term was included for the remoteness between the economic centre of gravity of each country and Luxembourg. This variable came from CEPII. More sophisticated remoteness measures were also employed based on papers by Rikhil Bhavnani and Tamirisa (2002) and Battersby and Ewing (2005). The latter measure of remoteness was calculated as follows:

$$R_i = d_{Wi} = \left(\frac{\sum_{j \neq i} Y_j}{\sum_{j \neq i} \frac{Y_j}{d_{ij}^\beta}} \right)^{\frac{1}{\beta}} \quad (4.14)$$

where Y_j represents country j GDP, and where d_{Wi} represents the distance to the rest of the world weighted by country GDP. When applied using a fully specified gravity equation, β represents the value of the coefficient on distance. Battersby and Ewing (2005) assume that β takes a value of 1 as they state that this is close to some empirical estimates and simplifies the calculation. This paper also assumes that β takes a value of 1. Higher values of β imply a greater distance effect, while lower values tend to decrease it. As we shall see below, the more rudimentary distance from Luxembourg remoteness variable actually performed better in terms of statistical significance in the EU-15 sample. Luxembourg, Belgium and Holland are the countries with the lowest remoteness measure for the data relating to Europe.

The remoteness variable controls for trade costs that vary with distance, as it costs more to transport goods over longer distances (transport costs can be considered variable costs). These are not the only trade costs, however, because when goods enter a destination, they are subject to a variety of trade policy-related barriers that raise the costs of trading such as tariff and non-tariff barriers. There may also be trade and transportation costs that occur

within borders.⁷ If goods are invoiced in the destination country currency, as is usually the case there may be costs related to exchange rate risk if the trading partners do not share the same currency (Fitzgerald and Haller; 2009; Deveraux; 2007). The sample period has coincided with further trade liberalisation both within the EU and via the WTO and bilateral trade agreements. The expansion of the European Union and the introduction of the euro is also particularly important for the European data. All of these issues will have contributed to falling trade costs not associated with remoteness which will not be captured by the remoteness variable.

Although these trade costs are not directly observable, papers such as Anderson and van Wincoop (2004), Novy (2008) and Chen and Novy (2009) attempt to estimate them from trade data. Chen and Novy (2009) find that trade costs have fallen faster in the EU than in other developed countries over the period 1999-2003. They attribute this to the EU single market program, the introduction of the euro and the Schengen agreement⁸. They also find a strong role for technical trade barriers that are the focus for considerable attention at WTO negotiations. Anderson and van Wincoop (2004) find that trade costs are large for developed countries and even larger for developing countries. They also suggest that high value to weight items are less penalised by transport costs.

Over the period 1995-2005 the value of exports to the EU-15 for the 55 sampled countries increased from 1.36 trillion euro to 2.52 trillion euro per annum. As can be seen in Figure 4.1, Germany has consistently had the highest share of exports to the rest of Europe at around 26 percent of the total while Kazakhstan and New Zealand had the lowest share. Over the period, the US share declined somewhat while the shares of Ireland and China increased.

At the same time, the general trend was toward increasingly extensive trade. Most countries' extensive margin increased over the period while their intensive margin declined (see Figures 4.2 and 4.3), though overall trade volumes increased. The share of all countries must sum to 1. For a given overall share, an increase in the extensive margin must correspond to a decrease in the intensive margin. Within the intensive margin, the price component for most countries increased while the quantity component declined (see Figures 4.4 and 4.5). So it appears that the trend for the sampled countries over the period 1995-2005 was for a greater variety of exports to a greater number of markets at relatively higher prices and smaller quantities.

In general, small quantities are associated with higher prices in the data. For a given overall share of trade, an increase in the extensive margin will lead to smaller quantities in each category as well as a decrease in the intensive margin. *Ceteris paribus*, within the

⁷Chen and Novy (2009) describe trade costs as follows: "Broadly defined, trade costs include any cost of engaging in international trade such as transportation costs, tariffs, non-tariff barriers, informational costs, time costs, different product standards, exchange rate costs and local distribution costs, among others."

⁸Baldwin and Di Nino (2006) is one of a series of papers written by Baldwin, with a selection of co-authors, on the effect of the euro on intra-eurozone trade. The aim of the paper is to investigate the channel through which the advent of the euro promoted trade. Using 6-digit UN Comtrade data, this paper finds that the euro boosted intra-eurozone trade via the extensive margin. That is the single currency has increased the variety of products traded and not just the volumes.

intensive margin a reduction in the quantity component is frequently associated with an increase in the price component. Thus, increases in the extensive margin may contribute to an increase in the price component.

The countries that have the highest extensive margin with respect to the EU-15 are Germany, France and the Netherlands. These general patterns and characteristics do not change a great deal when subsamples are examined.

Data on income and employment were taken, where possible, from the International Monetary Fund, International Financial Statistics (IFS) database.⁹ The income and employment variables are in levels rather than in relative terms as in Hummels and Klenow (2005) as this simplifies the interpretation of the coefficients.

4.5 Regressions

4.5.1 49 Country Sample

Following Hummels and Klenow (2002, 2005) the regression equation was specified as:

$$overall_j = \alpha_t + \beta_{1t}Y L_j + \beta_{2t}L_j + \beta_{3t}R_j + \beta_{4t}EU dummy_j + \epsilon_j \quad (4.15)$$

where *overall* refers to country *j*'s overall share of exports to the EU 15 at time *t*. *YL* refers to the income per worker employed, and *L* refers to the number of workers employed in country *j* at time *t*. *R* refers to the remoteness measures outlined above.¹⁰ All variables are in natural logs.

For the purposes of this paper, the regression was run separately for each year 1995-2005 on exports from 48 countries to the EU 15. Thus, the values of the coefficients were allowed to vary over time. Hummels and Klenow (2005) only run the regression on data for one year so it is not possible to see whether the relation between the variables changed over time. The results of the regression using the above specification are presented in Table 4.1. The same regressions were then run with the extensive and intensive margin and price and quantity components as dependent variables (see Tables 4.2, 4.3, 4.4 and 4.5). In this way, it is possible to identify what proportion of the variation in overall share associated with a given explanatory variable is associated with each margin and component (see Tables 4.6, 4.7 and 4.8). The Wald test is applied to test whether the coefficients at the beginning of the sample period are statistically significantly different from those at the end of the sample.

The results shown in Table 4.6 indicate that the proportion of a country's overall share of European Trade associated with relative income accounted for by the extensive margin actually increased from 37 to 57 percent, with a corresponding decrease in the intensive margin. This implies that in 1995, 37 percent of the higher export share of wealthier

⁹IFS data were not available for Saudi Arabia, Singapore and Taiwan so the relevant data were taken from the Nation Master, Statistics Singapore and National Statistics, Republic of China respectively.

¹⁰Hummels and Klenow (2005) did not include a remoteness or an EU dummy variable.

countries was accounted for by exporting a larger number of varieties. By 2005, this increased to 57 percent.

The extensive margin is increasingly important in explaining the additional trade share of wealthier countries. This manifests itself by consistency of magnitude of the relative income coefficient in the extensive margin while the coefficient on relative income in the intensive margin regressions declined. When the Wald test was applied the relative income coefficient in the extensive margin regression remained reasonably stable over the sample period, while there was a decline in the same variable's coefficient in the overall regression that was statistically significant at the 99 percent significance level (see Table 4.1). This decline was delivered by 0.32 decline in the intensive margin, which was significant at the 99 percent significance level (see Table 4.3).

The decline in the intensive margin coefficient on relative income was the result of changes in the quantity component (see Table 4.5). The coefficient on the relative income variable in the quantity component regressions was very close to being statistically significant at the beginning of the sample period but not towards the end. The Wald test indicates that it is statistically different at the end of the period compared to at the beginning of the period.

Within the intensive margin, the relative income coefficient in the price component equations remained reasonably stable over the sample period (see Table 4.4). The price component used here is sometimes considered as a proxy for quality as the positive coefficient suggests that higher income countries can charge higher prices per unit (weight).

The most obvious reason for a consumer to be willing to pay such a premium is that he prefers this product, that is, it is of higher quality¹¹.

The results presented in Table 4.6 show a considerable fall in the proportion of overall share associated with relative income that is attributable to the quantity component. This can be interpreted as indicating that export quantities are no longer a characteristic of wealthy countries, as less well off countries now export large quantities of merchandise to Europe also. Rather, it is the variety of exports that remains a characteristic of high income countries.

In the later price component regressions, the labour coefficient on the number of workers is negative, though not statistically significant (see Table 4.4). The coefficient in the quantity component regression is positive, as countries with a larger number of workers export more goods¹².

Hummels and Klenow (2005) find that the extensive margin accounts for around 60

¹¹Hummels and Skiba (2004) explore this and other alternative hypotheses to quality differentials for explaining differences in prices across destination countries. One obvious hypothesis is that firms are not perfectly competitive. They argue that even if we assume that firms are monopolistically competitive prices would then include both marginal cost of production and a mark-up.

Alessandria and Kaboski (2007) argue that, rather than being indicative of variations in quality, the correlation between relative income and the relative price of imports represent firms pricing to market. That is, a firm will charge consumers in a rich country more than they would consumers in a poor country.

¹²If we assume imperfectly competitive markets, countries with more workers may be further down the products demand curve and thus be subject to a lower price, thereby providing an incentive to produce a larger number of varieties.

percent of the greater exports of larger economies. The results here indicate that the extensive margin only accounts for around 30 percent of the greater exports of larger countries. The UN data used by Hummels and Klenow (2005) is not as detailed or as reliable as the data used here although they did include a larger number of countries. As we have selected countries on the basis of the share of trade with the EU, our sample includes a smaller number of small and low income countries. It is also worth noting that, when Hummels and Klenow (2005) used more detailed data on exports to the U.S., they found that the proportion of extra trade associated with the number of workers attributable to the extensive margin fell to 53 percent.

Of the variation in overall share explained by remoteness at the beginning of the sample period, 61 percent was due to the intensive margin specifically the quantity component. In excess of 30 percent was attributable to the extensive margin (see Table 4.8). The proportion attributable to the intensive margin increased over the period. There were considerable variations in the value of the coefficient on remoteness in the price component regressions presented in Table 4.4 but the coefficient was not statistically significant.

The price component might be expected to increase with remoteness due to Alchian-Allen effects but decrease due to the negative effect of remoteness on the extensive margin. Alchian-Allen effects predict that countries that are more remote experience higher fixed costs to trade, meaning that only higher value products can be sold profitably in more distant markets.¹³ Thus, the ambiguous sign and lack of statistical significance is not surprising. The coefficients on the remoteness variable indicate that more remote countries trade less, with smaller quantities and fewer varieties.

From Table 4.5 we can see that there was an increase in the coefficient on remoteness in the quantity component regressions over the sample period and the results of the Wald test imply that this is statistically significant at the 10 percent significance level. This suggests that the trade costs that vary with remoteness have an increasingly negative effect on relative quantities.

Using transaction based data, Bernard et al. (2007) actually find that distance has a positive effect on the intensive margin. Lawless and Whelan (2008) explain this as being the result of fixed costs reducing the number of firms that participate in exporting, being primarily those marginal firms that would only have exported small quantities if the cost of exporting were slightly lower. If these firms no longer export then the average quantities of the firms that do export will be larger as only large firms will export. This effect is not captured in this paper because of the more aggregated nature of the data. In this paper,

¹³Choi et al. (2006) use 4 digit data from the UN Comtrade database but primarily data developed by Feenstra et al. (2005).

These data are used to construct a "price dis-similarity index". Comparable data on income distributions come from the Luxembourg Income Study (LIS). This covers 30 countries over 20 years. These data are used to construct an "income dis-similarity index". They then test whether these indices are correlated. When estimating values for omitted quantity data, Choi et al. (2006) incorporate the idea of Alchian-Allen effects. That is, the presence of international transportation costs lead firms to ship high quality goods abroad while holding lower quality goods for domestic consumption.

This concept was examined, and was not rejected as a valid hypothesis in Hummels and Skiba (2004). The results of this paper may be subject to bias arising from this phenomenon.

the effect of distance on the intensive margin, the total quantity or value of a good exported from one country to another, is negative. At the same time, the value of the remoteness coefficient declined in magnitude over the sample period. The Wald test indicated that this decline was statistically significant at the 99 percent significance level.

A decline in trade costs associated with distance should lead to increase in the overall share of more distant countries. If fixed (in terms of quantities) costs associated with distance decline, then this should operate primarily through the extensive margin as more firms will be able to export a wider variety of product to a larger group of markets (more distant countries). However, there would be no increase in relative quantities arising from a decline in fixed costs.¹⁴

At the same time, the magnitude of the EU dummy coefficient varies widely over the period. In the final year of the sample EU membership only has a positive statistically significant effect on the extensive margin. It should be noted that a large number of Eastern European countries joined the European Union in 2004. Nevertheless, before 2003 the extensive margin was the primary channel through which EU members higher trade share materialised. This suggests that EU membership may reduce the fixed costs of trade.

4.5.2 Subsample Results and Issues

A sub-sample of EU-15 source and destination countries were compared in isolation.¹⁵ The results for this group differed considerably from those generated by the 48 country sample. Indeed, many of the apparent trends were strikingly different from those described above. For instance, the results suggest that, at the beginning of the sample period, 31 percent of the higher export share of wealthier countries was associated exporting a wider variety of products to a wider variety of destinations (see Table 4.9). By 2005, however, the equivalent figure had declined to just 3 percent. There was also a simultaneous increase in the price component of the intensive margin.

When the standard deviation, maximum and minimum, of the larger sample was examined, the following patterns were discernible (see Table 4.10): The standard deviation of the extensive margin becomes smaller over time and both the maximum and minimum values are closer to the mean. For the EU-14 countries this is driven primarily by the increasing extensive margin of smallest and most distant countries such as Greece, Finland

¹⁴This is not an entirely satisfactory explanation as, although the difference between the remoteness coefficients at the beginning and the end of the sample period are not statistically significantly different according to the Wald test, there does appear to be an increase in the coefficient on remoteness. Perhaps the fall in other trade costs, those not associated with remoteness, released a constraint on world trade. The resultant, more natural flow of trade would follow a pattern of trade more closely corresponding to that dictated by geographic factors, or what trade would look like if there were no barriers to trade other than transport costs. For instance, due to political factors, Russia may choose not to trade with Georgia, or the US with Cuba. Accordingly, Russia and America might prefer to purchase wine from France and Cigars from Brazil even though Georgia and Cuba are closer. If at some point trade resumed between the aforementioned partners, it seems logical that there would be a substitution away from the more distant countries good and towards goods from the more proximate country. This would manifest itself in a larger coefficient on distance.

¹⁵14 observations as it was necessary to treat Belgium and Luxembourg as one country as this was the format of the data in the first half of the sample.

and Portugal, as they began exporting in more market categories. In other words, the most extreme observations in the subsample converged to the mean over time. At the same time, the largest and least remote countries, Germany, the Netherlands and Belgium, saw no increase in the extensive margin.

The key constraint on the extensive margin of the largest, least remote countries is that, because of the data, they can only produce a maximum of 100 percent of the 6 or 8 digit market categories to 100 percent of the markets in the sample. By increasing the number of markets in the larger samples, this increased the scope for the maximum values to increase. However, when the 14 country sub-sample was examined the number of markets was even more constrained and the upper limit of the extensive margin was reached.

In order to confirm this, the extensive margin was calculated on the basis of countries participation in the export product categories only (not taking into account market destination). It becomes clear that the upper bound of the extensive margin has indeed been reached as the maximum value is, when rounded to two decimal places, 100 percent (see Table 4.11). That is the largest exporting country in the larger sample participates in 100 percent of product categories. By 2005 the smallest exporting country actually exports in product categories that account for 15 percent of exports, up from 5 percent in 1995. As a consequence, the standard deviation is seen to decline over the sample period.

When regressions were run on the data for the 14 country sub-sample it became clear that the summary statistics for the price component are also increasing.¹⁶ The level of statistical significance of the relative income variable in the price component regressions increases over the course of the sample period. In 1995 this coefficient is not significant even at the 10 percent level, whereas between 2002 and 2004 the coefficient is significant at the 10 percent level and the absolute value of the coefficient has increased from 0.06 to 0.37. The standard deviation of relative income per worker in the 14 country sample is greater than 25 percent of the mean and considerably larger for the bigger samples as they include more low income countries. So a country with an income per worker one standard deviation above the sample average can expect to have an export price index that is almost 10 percent higher than the average.

The fact that the price component increases over the sample period is likely due to the fact that a higher price component can be taken as being representative of a country exporting an unobserved, within category, variety which has a higher price. Logically, if a country exported a homogenous good at a higher price, nobody would buy it because it would be possible to buy the exact same good at a lower price from somewhere else. Table 4.9 shows that, although not statistically significant, there is a corresponding decline in the extensive margin coefficient on relative income per worker. This can be interpreted as indicating that countries have reached the upper bound of the 6 or 8 digit extensive margin measure and that any subsequent increase in variety is due to unobserved, within category,

¹⁶This may represent scale effects in the summary statistics as the values are in current euro (see Table 4.10). However, the variables in the regression analysis are all logged. As a consequence, scale effects are eliminated in the regression analysis.

varieties. If these new categories vary in price from the old categories, for instance by being more expensive, then this will become apparent through a change (increase) in the price component. This scenario is consistent with what is observed. The statistically significant increase in the price component can be interpreted as an increase in the extra export share of wealthier countries accounted for by their exporting more expensive varieties.

Furthermore, the limited size of the extensive margin is also explains the fact that the relative workforce variable was found to be positively related the price component in the 49 country sample. The results indicate that larger countries have higher extensive margins and it seems logical to suggest that this increase in variety is not confined to the observed 8-digit (or 6-digit) varieties but also unobserved within category varieties.

That the extensive margin and price component are increasing over the sample period implies that more varieties are being exported. As discussed in section 5, this is consistent with what would occur if there was a fall in trade costs according to theory papers such as Melitz (2003) and Chaney (2008). This also seems logical given what occurred in Europe at the time as the sample period covers a decade where European market integration continued and exchange rate risk was eliminated for many of the sample countries as a result of the introduction of the Euro.

4.5.3 BACI Data

Data from the BACI database were also utilised as this allows one to look at the pattern of trade for a larger group of reporters. Within the European Commission data, the reporter countries are limited to those in the EU, whereas the BACI data are based on United Nations Comtrade Data which cover all countries contained in the 48 country sample. The European Commission data only tells us about trade versus the 15 EU reporter countries. It is possible that the patterns observed and outlined above are unique to Europe.

Before proceeding, it is worth noting that there are a number of issues with the BACI data. The main problem arises from the absence of comparable quantity data for a considerable portion of observations in the original Comtrade data. Where quantities are not available, the BACI dataset has inserted estimates. In the context of this paper, the data are of limited use because of the short sample period. Nevertheless, investigating differences in the results arising from the inclusion of more reporter countries was considered worthwhile.

In contrast to the European regressions, there is little evidence of a decline in the relative income coefficient in the overall export share regression and certainly no statistically significant change (see Table 4.12). Table 4.17 below presents the proportion of overall trade attributable to each of the margins and components that are associated with relative income per worker. These measures are for 48 partner countries' trade with 48 reporter countries (rather than 48 partner countries' trade with 15 reporter countries). The reporters (importers) in this case have, on average, lower incomes than European countries. The remoteness measure used in these regressions is the Battersby and Ewing (2005) measure discussed above.

The results from the BACI data presented in Table 4.17 show that the intensive margin accounts for over 70 percent of the proportion of overall share associated with income per worker while over 60 percent was accounted for by the quantity component. The equivalent number for the European Commission dataset was around 40 percent and 0 percent at the end of the sample period. For non-European countries, the relationship between exporter income and export quantities appears to be stronger, although the coefficients are highly significant in both sets of regressions. This may be due to the lower income levels of the reporter countries in the larger sample. That the coefficient is not statistically significant is also a noticeable feature of the BACI results, but this is hardly surprising considering the short sample period. The exception to this is price component which appears to be increasing. The results of a Wald test indicate that the increase in the income per worker coefficient from the beginning to the end of the sample period is significant at the 10 percent significance level.

The BACI data are only 6-digit and, thus, contain approximately half as many product categories as the European Commission data. It is possible, therefore, that the increase in the price component observed here is symptomatic of the same issue outlined in the case of the 14 country sample. Once again, at 15 percent, the extensive margin has a much smaller role in explaining the extra export share of larger countries than was reported in Hummels and Klenow (2005). As was the case for the European Commission data, the sample of countries here is smaller than that used by Hummels and Klenow (2005) and includes fewer very small, very poor countries. As was the case for the EU-15 data, the effect of distance appears to operate increasingly through its effect on relative quantities as illustrated by the increasing coefficient and the ratio presented in Table 4.19. By 2004, essentially all the variation in a country's trade share associated with remoteness was explained by differences in the intensive margin. This pattern is similar to that discussed for the European Commission data although the change in the coefficient was not found to be statistically significant. Once again it is clear from the results presented in the table that there is an interaction between the extensive margin and the price component as the signs on both variables remoteness variable switch in 2004.

4.6 Interpretation and Conclusions

A relatively simple narrative that can be used to explain the results is that trade costs have fallen over time (Novy; 2008). It may have fallen more rapidly for low income countries that have more recently begun to be integrated into the globalised economy, than was the case for high income countries (Frensch; 2008).¹⁷ At the same time, the estimated fixed costs of trade with the EU have fallen faster than in other developed countries over the period 1999-2003 (Chen and Novy; 2009). The fall in trade costs has led to an increase in the volume of world trade and in particular the share of trade of low or middle income

¹⁷Although only one element of trade costs, some evidence is provided by the WTO trend in average tariffs data. Developing countries average tariff in 1995 was 16.6% and declined to 10.7% in 2005. Over the same period high income OECD countries average tariff declined from 6.3% to 3.4%.

countries in South East Asia and Eastern Europe.¹⁸

There has also been an increase in intra-European trade. This trade and economic integration has allowed low income countries to specialise in the production of large volumes of relatively homogenous or low quality goods. These goods are characterised by high elasticity of substitution where productivity advantages arising from the relatively low input costs found in low income countries are critical (Schott 2009).¹⁹ The evidence presented here suggests that high income countries (or countries with relatively large endowments of human and other capital) have continued to export differentiated or relatively high-quality goods characterized by low elasticity of substitution where costs are of lower importance (Lionel Fontagne and Zignago; 2007; Hallak; 2003; Broda and Weinstein; 2006).

There are differences in the elasticity of substitution of firms and industries that are related to country income that determine the effects of a decline in trade costs. As described in Chaney (2008) a higher elasticity makes the intensive margin more sensitive to changes in trade barriers whereas it makes the extensive margin less sensitive. As trade costs have fallen, those relatively high elasticity/low income countries have had relatively larger increases in their intensive margins while low elasticity/low income countries have had relatively larger increases in their extensive margin. However, due to data constraints, the full extent of the extensive margin in high income countries is not observable. Thus, the income coefficient on the intensive margin and quantity component have fallen as relatively poor countries have increased their relative export quantities. At the same time, the income coefficient on the price component has remained the same and the decline in the extensive margin is small and not statistically significant, despite the limitations in its measurement outlined above.

This paper applies the Hummels and Klenow (2005) method to more reliable, more detailed data which cover multiple years. The paper also innovates by incorporating time-varying coefficients. The results of the analysis suggest that all countries, particularly those with low incomes, trade more with the EU now than at the beginning of the sample. In the 49 country sample, this is shown by the declining coefficient on the relative income variable in the regressions with overall export share as the dependent variable. The extensive margin is increasingly important in explaining the additional trade share of wealthier countries. This manifests itself by consistency of magnitude of the relative income coefficient in the extensive margin while the coefficient on relative income in the intensive margin regressions declined.

¹⁸Alternatively, growth of production capacity in developing countries is also likely to have increased export supply and, therefore, global trade as described by O'Rourke and Williamson (1999) for historical data. This is consistent with an export-led growth pattern Haddad et al. (2011). In the traditional view, low-income countries would necessarily specialise in low quality homogenised, high elasticity of demand goods as they are not endowed with sufficient human and other capital. More recent literature such as Pula and Santabarbara (2011) suggest that the advent of global production networks may mean that low cost countries now compete more directly with developed economies using imported capital and technology. Pula and Santabarbara (2011) find that the relative prices of China's exports may understate the quality of Chinese exports.

¹⁹A considerable body of literature on income volatility exists which reports that developing countries are more likely to have higher export concentration (M. Jansen and Piermartini; 2009; Haddad and Shepard; 2011).

A country's relative income has a smaller effect on trade share than was previously the case, primarily because relatively low income countries now export large quantities of goods. Variety and quality (as proxied by the price component) are the remaining characteristic of wealthy countries exports. These results are consistent with theories that suggest that trade volumes and varieties will increase with a reduction in trade costs such as Melitz (2003) and Chaney (2008).

This paper also highlights the interrelation between the extensive margin and the price component generated by the limited level of disaggregation of the data. This knowledge also supports the assertion that variety is the key trade characteristic of relatively high income countries.

Table 4.1: Cross-Sectional Regressions for the exports of 48 countries to Europe with overall export share as dependent variable over the period 1995-2005

	1995	1997	1999	2001	2003	2005	Wald Test 1995=2005
Income per Worker	0.784 [0.115]***	0.774 [0.092]***	0.638 [0.085]***	0.499 [0.077]***	0.49 [0.088]***	0.406 [0.074]***	0.00 0.71
Number of Workers	0.662 [0.063]***	0.69 [0.053]***	0.683 [0.047]***	0.62 [0.046]***	0.617 [0.050]***	0.64 [0.045]***	0.71
Remoteness	-0.491 [0.088]***	-0.58 [0.074]***	-0.585 [0.071]***	-0.617 [0.077]***	-0.614 [0.079]***	-0.52 [0.078]***	0.72
EU Dummy	0.378 [0.304]	0.191 [0.261]	0.192 [0.259]	0.018 [0.277]	0.016 [0.281]	0.273 [0.235]	0.63
Constant	-10.077 [1.148]***	-9.331 [0.911]***	-7.835 [0.979]***	-5.802 [0.847]***	-5.839 [1.051]***	-5.945 [1.100]***	
Observations	48	48	48	48	48	48	
R ²	0.86	0.88	0.88	0.86	0.85	0.84	

Notes: Robust standard errors in parenthesis, *significant at 10; **significant at 5; ***significant at 1 percent significance level.

Table 4.2: Cross-Sectional Regressions for the exports of 48 countries to Europe with extensive margin as dependent variable over the period 1995-2005

	1995	1997	1999	2001	2003	2005	Wald Test P-Value
Income per Worker	0.293 [0.086]***	0.306 [0.068]***	0.266 [0.059]***	0.242 [0.047]***	0.269 [0.051]***	0.232 [0.041]***	0.12
Number of Workers	0.202 [0.043]***	0.203 [0.037]***	0.186 [0.034]***	0.173 [0.028]***	0.181 [0.031]***	0.188 [0.026]***	0.62
Remoteness	-0.191 [0.052]***	-0.204 [0.047]***	-0.182 [0.046]***	-0.166 [0.039]***	-0.161 [0.038]***	-0.082 [0.037]**	0.01
EU Dummy	0.13 [0.147]	0.081 [0.122]	0.047 [0.118]	0.116 [0.095]	0.068 [0.097]	0.325 [0.095]***	0.08
Constant	-2.696 [0.913]***	-2.715 [0.712]***	-2.348 [0.661]***	-2.201 [0.521]***	-2.584 [0.561]***	-2.951 [0.541]***	
Observations	48	48	48	48	48	48	
R ²	0.63	0.7	0.66	0.71	0.72	0.75	

Notes: Robust standard errors in parenthesis, *significant at 10; **significant at 5; ***significant at 1 percent significance level.

Table 4.3: Cross-Sectional Regressions for the exports of 48 countries to Europe with intensive margin as dependent variable over the period 1995-2005

	1995	1997	1999	2001	2003	2005	Wald Test P-value
Income per Worker	0.491 [0.069]***	0.468 [0.080]***	0.371 [0.087]***	0.257 [0.074]***	0.221 [0.083]**	0.174 [0.084]**	0.00
Number of Workers	0.459 [0.044]***	0.487 [0.045]***	0.497 [0.046]***	0.447 [0.045]***	0.436 [0.049]***	0.452 [0.049]***	0.90
Remoteness	-0.299 [0.064]***	-0.376 [0.067]***	-0.404 [0.064]***	-0.451 [0.069]***	-0.453 [0.073]***	-0.437 [0.085]***	0.13
EU Dummy	0.247 [0.217]	0.11 [0.220]	0.145 [0.228]	-0.098 [0.241]	-0.052 [0.247]	-0.052 [0.240]	0.22
Constant	-7.381 [0.793]***	-6.616 [0.907]***	-5.487 [0.996]***	-3.601 [0.781]***	-3.255 [0.944]***	-2.993 [1.152]**	
Observations	48	48	48	48	48	48	
R ²	0.78	0.77	0.78	0.75	0.73	0.67	

Notes: Robust standard errors in parenthesis, *significant at 10; **significant at 5; ***significant at 1 percent significance level.

Table 4.4: Cross-Sectional Regressions for the exports of 48 countries to Europe with price component as dependent variable over the period 1995-2005

	1995	1997	1999	2001	2003	2005	Wald Test P-Value
Income per Worker	0.2 [0.026]***	0.191 [0.029]***	0.178 [0.033]***	0.18 [0.034]***	0.2 [0.033]***	0.185 [0.040]***	0.70
Number of Workers	0.009 [0.019]	0.009 [0.021]	-0.017 [0.026]	-0.011 [0.026]	-0.017 [0.024]	-0.047 [0.029]	0.07
Remoteness	0.046 [0.023]*	0.055 [0.027]**	0.065 [0.033]*	0.071 [0.033]**	0.05 [0.029]*	0.011 [0.042]	0.41
EU Dummy	-0.068 [0.071]	-0.047 [0.081]	-0.019 [0.098]	-0.028 [0.098]	-0.078 [0.089]	-0.305 [0.111]***	0.04
Constant	-2.293 [0.305]***	-2.259 [0.331]***	-2.132 [0.390]***	-2.174 [0.401]***	-2.228 [0.392]***	-1.547 [0.548]***	
Observations	48	48	48	48	48	48	
R ²	0.64	0.59	0.52	0.5	0.56	0.46	

Notes: Robust standard errors in parenthesis, *significant at 10; **significant at 5; *** significant at 1 percent significance level.

Table 4.5: Cross-Sectional Regressions for the exports of 48 countries to Europe with quantity component as dependent variable over the period 1995-2005

	1995	1997	1999	2001	2003	2005	Wald Test P-Value
Income per Worker	0.291 [0.082]***	0.278 [0.089]***	0.193 [0.083]**	0.077 [0.080]	0.021 [0.096]	-0.011 [0.088]	0.00
Number of Workers	0.451 [0.045]***	0.478 [0.044]***	0.514 [0.036]***	0.458 [0.040]***	0.453 [0.049]***	0.499 [0.046]***	0.44
Remoteness	-0.345 [0.076]***	-0.432 [0.079]***	-0.469 [0.071]***	-0.521 [0.084]***	-0.503 [0.088]***	-0.449 [0.094]***	0.25 0.79
EU Dummy	0.316 [0.245]	0.157 [0.247]	0.164 [0.230]	-0.07 [0.265]	0.026 [0.288]	0.253 [0.260]	
Constant	-5.088 [0.830]***	-4.357 [0.938]***	-3.354 [0.914]***	-1.427 [0.771]*	-1.027 [0.982]	-1.446 [1.131]	
Observations	48	48	48	48	48	48	
R ²	0.73	0.74	0.8	0.76	0.73	0.74	

Notes: Robust standard errors in parenthesis, *significant at 10; **significant at 5; ***significant at 1 percent significance level.

Table 4.6: Proportion of Overall Share of Exports to Europe associated with relative income per worker (48 Countries)

Income per Worker	1995	1997	1999	2001	2003	2005
Overall Export Share	1	1	1	1	1	1
Extensive Margin	0.37	0.40	0.42	0.48	0.55	0.57
Intensive Margin	0.63	0.60	0.58	0.52	0.45	0.43
Price Component	0.26	0.25	0.28	0.36	0.41	0.46
Quantity Component	0.37	0.35	0.30	0.16	0.04	-0.03

Note: Table shows the proportion of variation in overall share associated with country income attributable to each trade margin and component.

Table 4.7: Proportion of Overall Share of Exports to Europe associated with the number of workers (48 Countries)

Number of Workers	1995	1997	1999	2001	2003	2005
Overall Export Share	1	1	1	1	1	1
Extensive Margin	0.31	0.29	0.27	0.28	0.29	0.29
Intensive Margin	0.69	0.71	0.73	0.72	0.71	0.71
Price Component	0.01	0.01	-0.02	-0.02	-0.03	-0.07
Quantity Component	0.68	0.70	0.75	0.74	0.74	0.78

Note: Table shows the proportion of variation in overall share associated with country workforce size attributable to each trade margin and component.

Table 4.8: Proportion of Overall Share of Exports to Europe associated with remoteness (48 Countries)

Remoteness	1995	1997	1999	2001	2003	2005
Overall Export Share	1	1	1	1	1	1
Extensive Margin	0.39	0.35	0.31	0.27	0.26	0.16
Intensive Margin	0.61	0.65	0.69	0.73	0.74	0.84
Price Component	-0.09	-0.09	-0.11	-0.12	-0.08	-0.02
Quantity Component	0.70	0.74	0.80	0.85	0.82	0.86

Note: Table shows the proportion of variation in overall share associated with country remoteness attributable to each trade margin and component.

Table 4.9: Proportion of Overall Share of Exports to Europe associated with relative income per worker (14 Countries)

Income per Worker	1995	1997	1999	2001	2003	2005
Overall Export Share	1	1	1	1	1	1
Extensive Margin	0.31	0.25	0.20	0.17	0.14	0.03
Intensive Margin	0.69	0.75	0.80	0.83	0.86	0.97
Price Component	0.17	0.32	0.35	0.49	0.49	0.64
Quantity Component	0.52	0.43	0.45	0.34	0.37	0.33

Note: Table shows the proportion of variation in overall share associated with country income attributable to each trade margin and component.

Table 4.10: Summary Statistics for market-category measure 1995 and 2005

	1995				2005			
	std. dev.	min.	max.	std. dev.	min.	max.	std. dev.	max.
Overall Export Share	0.05	0.00	0.28	0.04	0.00	0.26	0.04	0.26
Extensive Margin	0.24	0.05	0.95	0.22	0.15	0.97	0.22	0.97
Intensive Margin	0.05	0.01	0.29	0.04	0.01	0.26	0.04	0.26
Price Component	0.29	0.60	1.94	0.53	0.58	4.05	0.53	4.05
Quantity Component	0.04	0.00	0.24	0.04	0.00	0.23	0.04	0.23
Relative Income per Worker	26420	1070	84014	35291	2959	131770	35291	131770
Relative Employment	104.04	0.75	680.65	110.06	0.81	758.25	110.06	758.25

Note: This table displays summary statistics where the decomposition measures participation in both markets and product categories.

Table 4.11: Summary Statistics for category measure 1995 and 2005.

	1995				2005			
	std. dev.	min.	max.	std. dev.	min.	max.	std. dev.	max.
Overall Export Share	0.04	0.00	0.20	0.03	0.00	0.19		0.19
Extensive Margin	0.20	0.19	1.00	0.16	0.30	1.00		1.00
Intensive Margin	0.04	0.00	0.20	0.03	0.00	0.19		0.19
Price Component	0.29	0.62	1.95	0.55	0.59	4.08		4.08
Quantity Component	0.03	0.00	0.17	0.03	0.00	0.17		0.17
Relative Income per Worker	34970	1070	84014	35291	2959	131770		
Relative Employment	104.04	0.75	680.65	110.06	0.81	758.25		

Note: This table displays summary statistics where the decomposition measures participation in product categories but, unlike the previous table, not participation in market categories.

Table 4.12: Cross-Sectional Regressions for the exports of 48 countries to 48 countries with overall export share as dependent variable over the period 2000-2004

	2000	2001	2002	2003	2004	Wald Test P-Value
Income per Worker	0.689 [0.107]***	0.709 [0.104]***	0.742 [0.106]***	0.722 [0.110]***	0.689 [0.091]***	0.99
Number of Workers	0.685 [0.079]***	0.69 [0.077]***	0.693 [0.080]***	0.694 [0.084]***	0.694 [0.076]***	0.92
Remoteness	-0.248 [0.127]*	-0.268 [0.118]**	-0.235 [0.112]**	-0.283 [0.114]**	-0.256 [0.124]**	0.98
EU Dummy	-0.08 [0.285]	-0.079 [0.280]	-0.086 [0.283]	-0.122 [0.286]	-0.004 [0.262]	0.83
Constant	-10.541 [1.553]***	-10.593 [1.553]***	-11.246 [1.603]***	-10.754 [1.685]***	-10.777 [1.508]***	
Observations	48	48	48	48	48	
R ²	0.58	0.58	0.6	0.58	0.58	

Notes: Robust standard errors in parenthesis, *significant at 10; **significant at 5; ***significant at 1 percent significance level.

Table 4.13: Cross-Sectional Regressions for the exports of 48 countries to 48 countries with extensive margin as dependent variable over the period 2000-2004

	2000	2001	2002	2003	2004	Wald Test P-Value
Income per Worker	0.164 [0.034]***	0.164 [0.036]***	0.154 [0.039]***	0.154 [0.040]***	0.127 [0.035]***	0.42
Number of Workers	0.107 [0.023]***	0.103 [0.023]***	0.102 [0.024]***	0.098 [0.025]***	0.098 [0.021]***	0.80
Remoteness	-0.055 [0.050]	-0.051 [0.049]	-0.043 [0.050]	-0.061 [0.047]	0.027 [0.068]	0.35
EU Dummy	0.075 [0.074]	0.081 [0.074]	0.098 [0.082]	0.058 [0.078]	0.23 [0.116]*	0.23
Constant	-1.856 [0.529]***	-1.874 [0.567]***	-1.854 [0.586]***	-1.698 [0.598]***	-2.218 [0.699]***	
Observations	48	48	48	48	48	
R ²	0.42	0.38	0.35	0.34	0.35	

Notes: Robust standard errors in parenthesis, *significant at 10; **significant at 5; ***significant at 1 percent significance level.

Table 4.14: Cross-Sectional Regressions for the exports of 48 countries to 48 countries with intensive margin as dependent variable over the period 2000-2004

	2000	2001	2002	2003	2004	Wald Test P-Value
Income per Worker	0.524 [0.100]***	0.545 [0.095]***	0.588 [0.092]***	0.568 [0.092]***	0.562 [0.076]***	0.73
Number of Workers	0.578 [0.071]***	0.587 [0.068]***	0.591 [0.068]***	0.596 [0.070]***	0.597 [0.064]***	0.83
Remoteness	-0.194 [0.125]	-0.217 [0.117]*	-0.192 [0.108]*	-0.222 [0.108]**	-0.282 [0.140]*	0.66
EU Dummy	-0.155 [0.253]	-0.159 [0.245]	-0.184 [0.242]	-0.179 [0.243]	-0.234 [0.251]	0.80
Constant	-8.685 [1.429]***	-8.719 [1.401]***	-9.393 [1.387]***	-9.056 [1.431]***	-8.559 [1.514]***	
Observations	48	48	48	48	48	
R ²	0.54	0.55	0.59	0.58	0.58	

Notes: Robust standard errors in parenthesis, *significant at 10; **significant at 5; ***significant at 1 percent significance level.

Table 4.15: Cross-Sectional Regressions for the exports of 48 countries to 48 countries with price component as dependent variable over the period 2000-2004

	2000	2001	2002	2003	2004	Wald Test P-Value
Income per Worker	0.093 [0.052]*	0.084 [0.050]	0.061 [0.056]	0.134 [0.036]***	0.147 [0.032]***	0.69
Number of Workers	-0.01 [0.042]	-0.007 [0.039]	-0.028 [0.043]	-0.025 [0.027]	-0.018 [0.024]	0.83
Remoteness	0.023 [0.086]	0.016 [0.080]	0.066 [0.086]	0.027 [0.054]	-0.016 [0.060]	0.51
EU Dummy	0.186 [0.139]	0.172 [0.132]	0.215 [0.143]	0.103 [0.092]	0.001 [0.089]	0.35
Constant	-1.007 [0.740]	-0.848 [0.709]	-0.907 [0.802]	-1.417 [0.514]***	-1.182 [0.527]**	
Observations	48	48	48	48	48	
R ²	0.22	0.21	0.17	0.48	0.48	

Notes: Robust standard errors in parenthesis, *significant at 10; **significant at 5; ***significant at 1 percent significance level.

Table 4.16: Cross-Sectional Regressions for the exports of 48 countries to 48 countries with quantity component as dependent variable over the period 2000-2004

	2000	2001	2002	2003	2004	Wald Test P-Value
Income per Worker	0.431 [0.141]***	0.461 [0.142]***	0.527 [0.150]***	0.434 [0.116]***	0.415 [0.095]***	0.98
Number of Workers	0.588 [0.074]***	0.595 [0.073]***	0.619 [0.078]***	0.621 [0.076]***	0.615 [0.071]***	0.74
Remoteness	-0.217 [0.168]	-0.234 [0.159]	-0.258 [0.163]	-0.25 [0.132]*	-0.266 [0.168]	0.89
EU Dummy	-0.341 [0.280]	-0.331 [0.280]	-0.399 [0.289]	-0.282 [0.263]	-0.235 [0.285]	0.62
Constant	-7.678 [2.031]***	-7.871 [2.021]***	-8.485 [2.196]***	-7.639 [1.670]***	-7.377 [1.708]***	
Observations	48	48	48	48	48	
R ²	0.46	0.46	0.5	0.53	0.54	

Notes: Robust standard errors in parenthesis, *significant at 10; **significant at 5;
***significant at 1 percent significance level.

Table 4.17: Proportion of Overall Share of Exports to 48 countries associated with relative income per worker (48 Countries, BACI data)

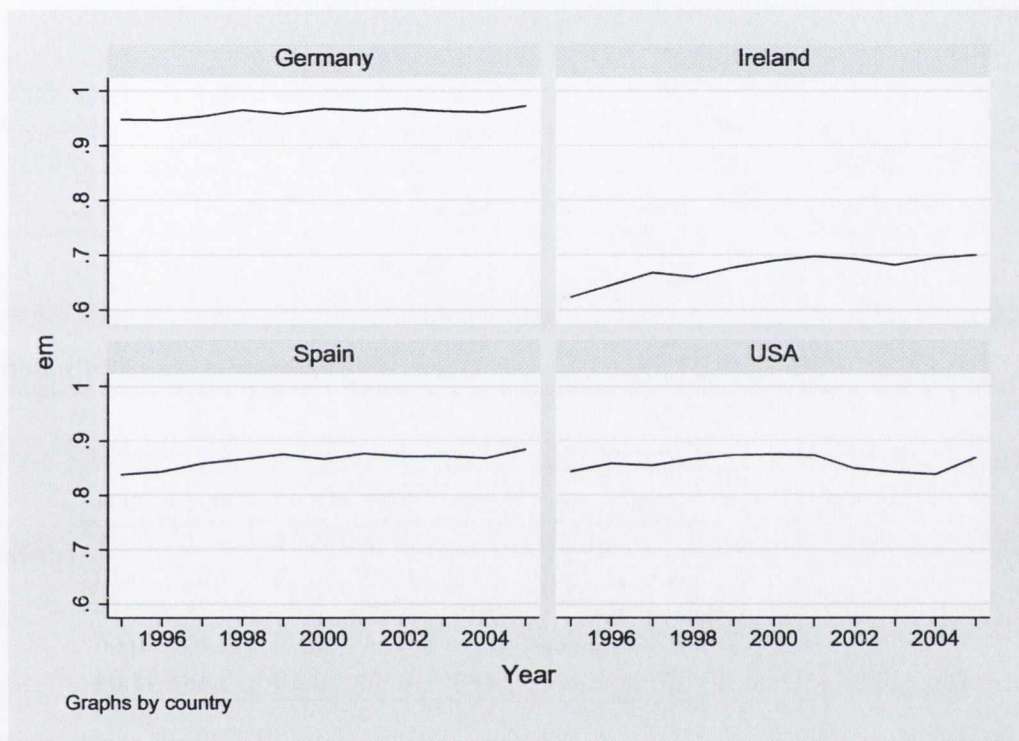
Income per Worker	2000	2001	2002	2003	2004
Overall Export Share	1	1	1	1	1
Extensive Margin	0.24	0.23	0.21	0.21	0.18
Intensive Margin	0.76	0.77	0.79	0.79	0.82
Price Component	0.13	0.12	0.08	0.19	0.21
Quantity Component	0.63	0.65	0.71	0.60	0.60

Note: Table shows the proportion of variation in overall share associated with country income attributable to each trade margin and component.

Table 4.18: Proportion of Overall Share of Exports to 48 countries associated with the number of workers (48 Countries, BACI data)

Number of Workers	2000	2001	2002	2003	2004
Overall Export Share	1	1	1	1	1
Extensive Margin	0.16	0.15	0.15	0.14	0.14
Intensive Margin	0.84	0.85	0.85	0.86	0.86
Price Component	-0.01	-0.01	-0.04	-0.03	-0.03
Quantity Component	0.85	0.86	0.89	0.89	0.89

Note: Table shows the proportion of variation in overall share associated with country workforce size attributable to each trade margin and component.



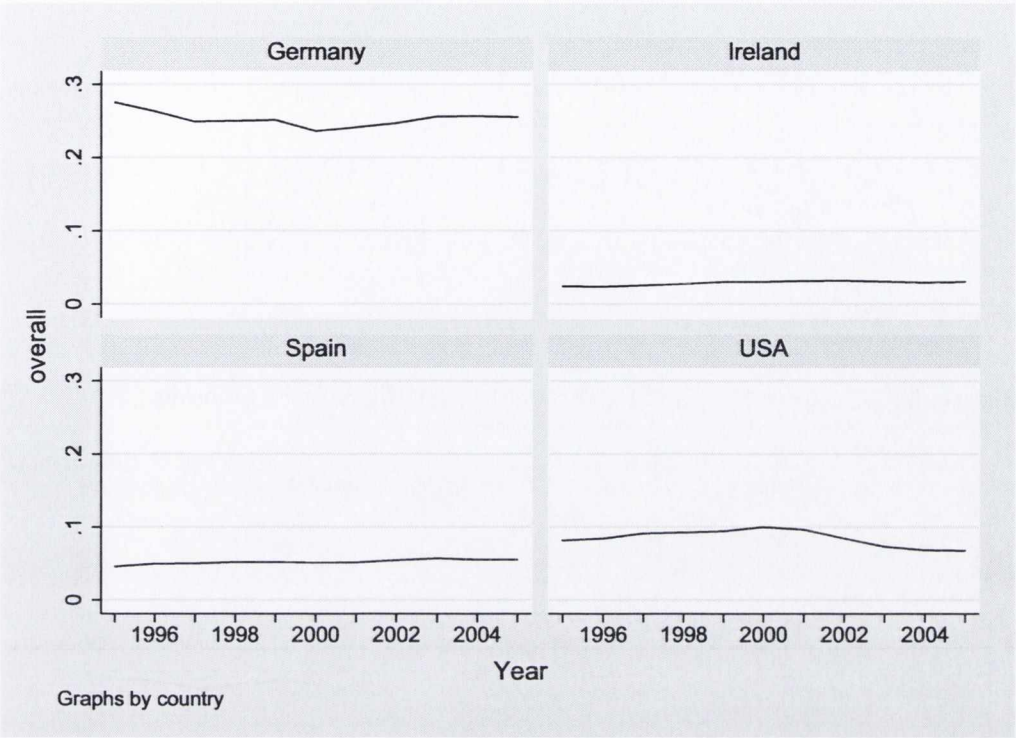
STATA

Table 4.19: Proportion of Overall Share of Exports to 48 countries associated with remoteness (48 Countries, BACI data)

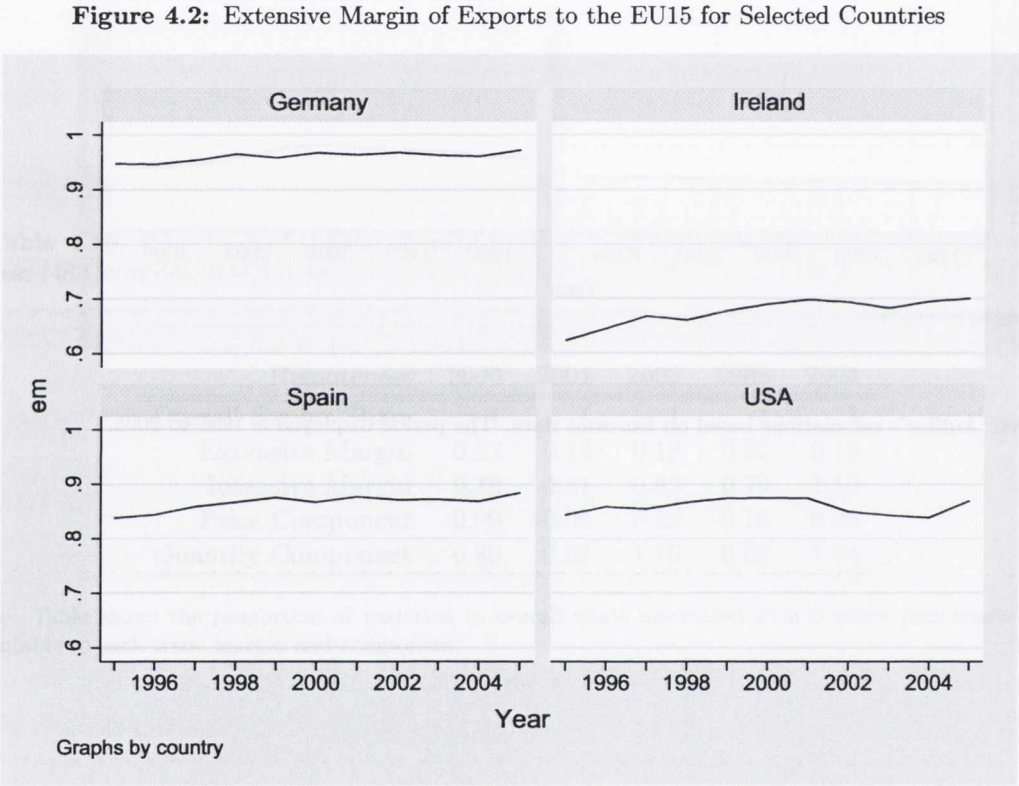
Remoteness	2000	2001	2002	2003	2004
Overall Export Share	1	1	1	1	1
Extensive Margin	0.22	0.19	0.18	0.22	-0.10
Intensive Margin	0.78	0.81	0.82	0.78	1.10
Price Component	-0.09	-0.06	-0.28	-0.10	0.06
Quantity Component	0.89	0.87	1.10	0.88	1.04

Note: Table shows the proportion of variation in overall share associated with country remoteness attributable to each trade margin and component.

Figure 4.1: Overall Export Share of Selected Countries to the EU15

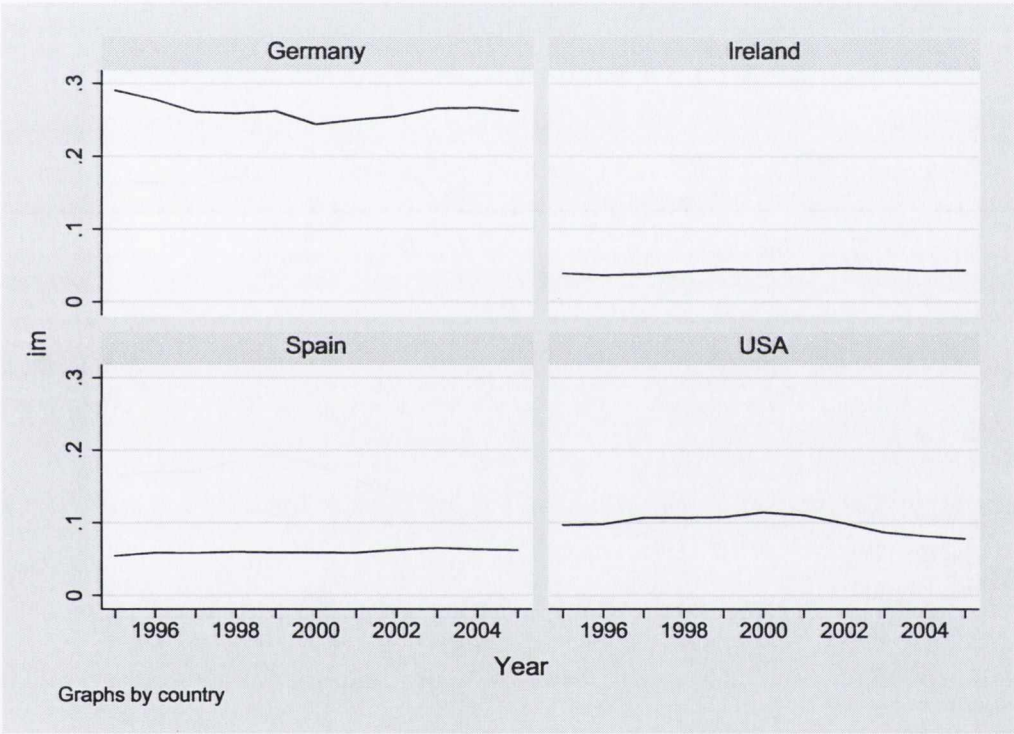


Source: Author's calculations based on Eurostat data. The period displayed is 1995 to 2005.



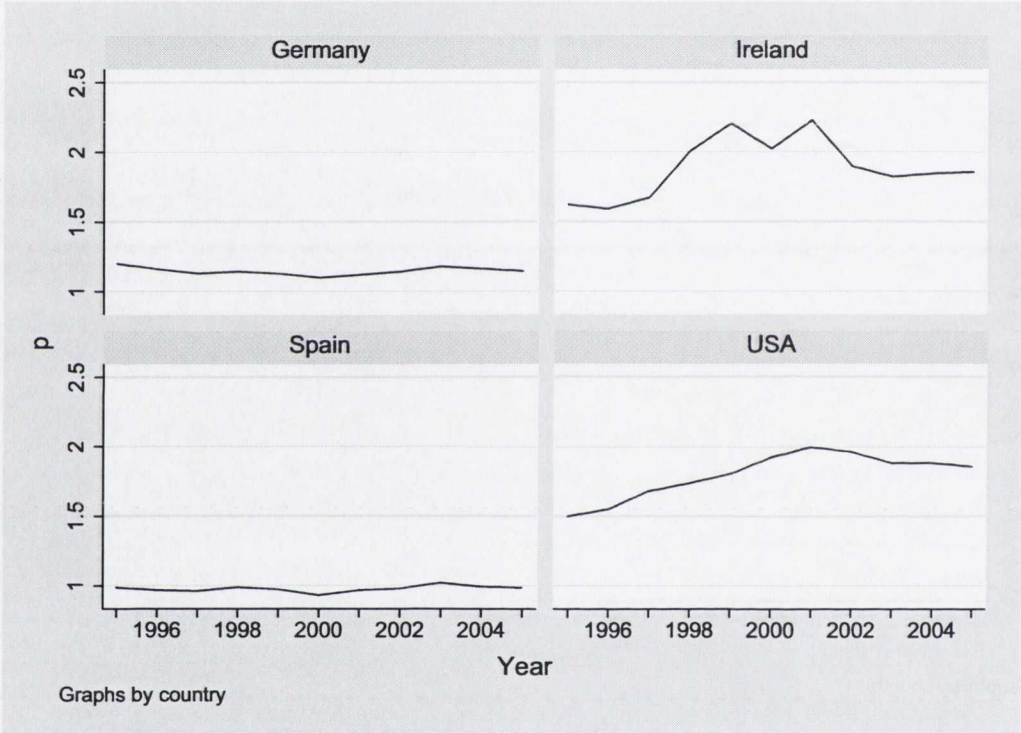
Source: Author's calculations based on Eurostat data. The period displayed is 1995 to 2005.

Figure 4.3: Intensive Margin of Exports to the EU15 for Selected Countries



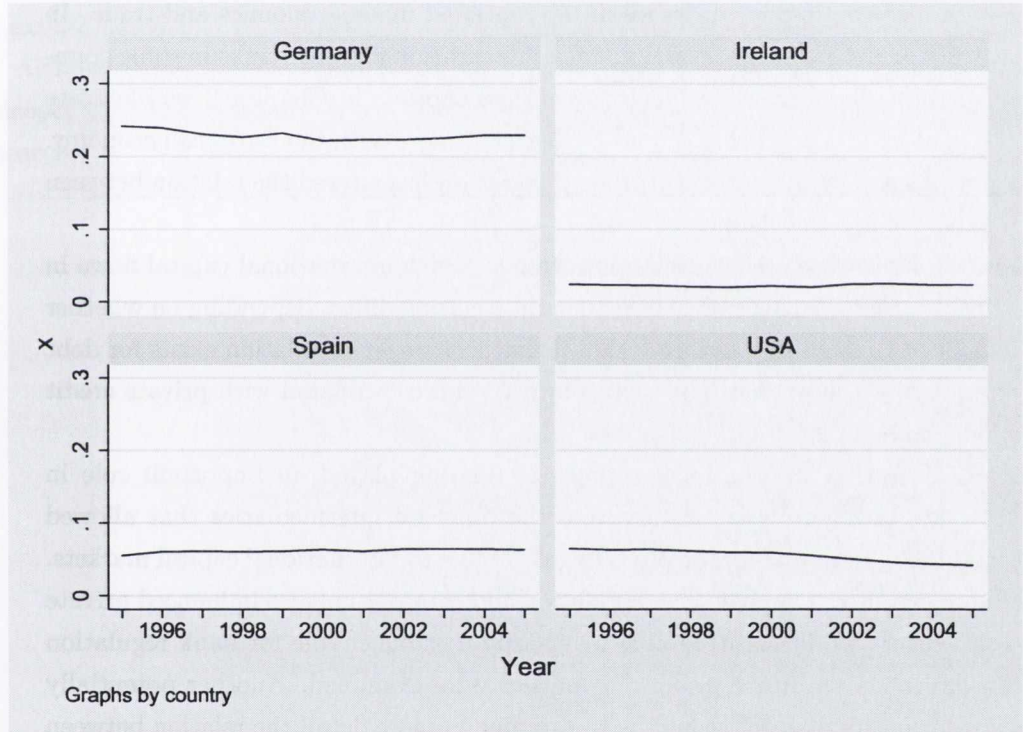
Source: Author's calculations based on Eurostat data. The period displayed is 1995 to 2005.

Figure 4.4: Price Component of the Intensive Margin of Exports to the EU15 for Selected Countries



Source: Author's calculations based on Eurostat data. The period displayed is 1995 to 2005.

Figure 4.5: Quantity Component of the Intensive Margin of Exports to the EU for Selected Countries



Source: Author's calculations based on Eurostat data. The period displayed is 1995 to 2005.

Chapter 5

Conclusions

This thesis examines two important issues in international macroeconomics and trade. In Chapter 2 we highlight how international financial integration allowed banks in some countries to fund private credit growth using international capital. In Chapter 3 we illustrate how the pattern of Irish exports changed as it integrated more with the European economy. In Chapter 4 we show how the process of trade integration has altered the relation between a country's export share and its income level.

Chapter 2 shows private credit growth is correlated with international capital flows in the period 1999 to 2007. We have identified that this relation differs depending on whether we examine debt or equity flows and have shown that a stronger correlation exists for debt flows. Furthermore, we show that bank debt flows are more correlated with private credit than other debt flows.

Thus, it is clear that international sources of funding played an important role in facilitating private credit growth. Banks were the financial intermediaries that allowed households and the majority of corporations to gain access to international capital markets.

Furthermore, we also show that bank regulation and competition also influenced private credit growth. Future work might be able to identify a stronger role for bank regulation variables if a larger, more diverse group of countries were examined. Another potentially fruitful avenue for future research would be to examine in more detail the relation between financial reform and bank regulation indicators and international capital flows.

Chapter 3 applies the Hummels and Klenow (2005) method to a longitudinal export data set for Ireland. Ireland's share of European exports are decomposed into the extensive and intensive trade margins. The results show that, over the period 1984 to 2000, Ireland experienced a rapid growth in export share and that there was an associated growth in Ireland's relative income. The component of overall export share most closely correlated with an increase in Ireland's relative income per worker was relative export quantities. Although the extensive margin accounted for much of the observed increase in Ireland's trade share, much of this increase occurred prior to Ireland experiencing income growth.

The pattern exhibited by the empirical analysis suggests that Ireland's export growth is more consistent with export-led growth based on export platform FDI rather than the models of the "new new trade" literature. Although Ireland is an extreme example of the

results of such a export-led growth policy, this type of export growth has become more common with the increase in outsourcing and FDI investment flows. As such, the case of Ireland highlights certain limitations of many cross-sectional studies based on “new new trade” models.

Chapter 4 examines the relation between a country’s trade share and its income level. Using the Hummels and Klenow (2005) decomposition method, we provide evidence that this relation changed significantly between 1995 and 2005. A country’s relative income has a smaller effect on trade share vis-a-vis the EU 15 than was previously the case, because relatively low-income export increasingly large quantities of goods. Higher export variety and prices remain a characteristic of wealthier countries exports.

We relate these results to the existing “new new trade” literature and find that Chaney (2008) is particularly helpful when considering our findings. Future research could focus on extending the

Although this paper has addressed a number of important aspects of globalisation, a deeper understanding of international trade and financial integration will require more research.

Bibliography

- Abiad, A., Detragiache, E. and Tressel, T. (2008). A New Database of Financial Reforms, *IMF Working Paper* **266**.
- Acemoglu, D. and Ventura, J. (2002). The World Income Distribution, *Quarterly Journal of Economics* **117**(2)(No.1): 659–694.
- Aisen, A. and Franken, M. (10). Bank Credit during the 2008 Financial Crisis: A Cross-Country Comparison, *IMF Working Paper* No. **10/47**.
- Alessandria, G. and Kaboski, J. (2007). Pricing-To-Market and the Failure of Absolute PPP, *Federal Reserve Bank of Philadelphia Working Paper* (07-29).
- Altunbas, Y., Gambacorta, L. and Marques, D. (2007). Securitisation and the bank lending channel, *ECB Working Paper Series* **838**.
- Anderson, J. E. and van Wincoop, E. (2004). Trade costs, *Journal of Economic Literature* **42**(3): 691–751.
- Armington, P. (1969). A Theory of Demand for Products Distinguished by Place of Production, *Staff Papers - International Monetary Fund* **16**(No.1): pp. 159–178.
- Asteriou, D. (2006). *Applied Econometrics; A Modern Approach using Eviews and Microfit*, Palgrave MacMillan, New York.
- Bahmani-Oskooee, M. and Rehman, H. (2005). Stability of the money demand function in asian developing countries, *Applied Economics* **37**(7): 773–792.
- Bakker, B. B. and Gulde, A.-M. (2010). The Credit Boom in the EU New Member States: Bad Luck or Bad Policies?, *IMF Working Paper* **10/130**.
- Baldwin, R. and Di Nino, V. (2006). Euros and Zeros: The common currency effect on trade in new goods, *Graduate Institute of International Studies*.
- Barnes, S. (2010). Resolving and avoiding unsustainable imbalances in the euro area, *OECD Economics Department Working Papers* **827**.
- Barry, F. (2004). Export platform fdi: the irish experience, *European Investment Bank Papers* **9**.

- Barth, J. R., Caprio, G. and Levine, R. (2001). Bank Regulation and Supervision: What Works Best?, *World Bank Policy Research Working Paper Series* **9323**.
- Barth, J. R., Caprio, G. and Levine, R. (2006). *Rethinking Bank Regulation: Till Angels Govern*, Cambridge University Press.
- Barth, J. R., Caprio, G. and Levine, R. (2008). Bank regulations are changing: for better or worse?, *World Bank Policy Research Working Paper Series* **4646**.
- Battersby, B. and Ewing, R. (2005). International Trade Performance: The Gravity of Australia's Remoteness, *Australian Treasury Working Paper* (2005-03).
- Baum, C. F., Schaeffer, M. E. and Stillman, S. (2002). Ivreg2: Stata module for extended instrumental variables/2sls and gmm estimation, *Statistical Software Components, Boston College Economics* **S425401**.
- Baum, C. F., Schaffer, M. E. and Stillman, S. (2007). Enhanced routines for Instrumental variables/GMM estimation and testing, *Boston College Working Paper* **667**.
- Beck, T., Demirguc-Kunt, A. and Levine, R. (2006). Bank concentration, competition, and crisis: First results, *Journal of Banking and Finance* **30**: 1581–1603.
- Beck, T., Demirguc-Kunt, A. and Levine, R. (2009). Financial institutions and markets across countries and over time: data and analysis, *World Bank Policy Research Working Paper Series* **4943**.
- Bernanke, B. (2005). The global saving glut and the u.s. current account deficit, *Federal Reserve Board Speech* **March 2005**.
- Bernanke, B. and Blinder, A. (1988). Credit, money and aggregate demand, *American Economic Review* **78(2)**: 435–439.
- Bernanke, B. and Lown, C. (1991). The credit crunch, *Brookings Papers on Economic Activity* **22(1991-2)**: 205–248.
- Bernard, A., Jensen, J. and Schott, P. (2005). Survival of the Best Fit: Exposure to Low-Wage Countries and the (Uneven) Growth of U.S. Manufacturing Plants, *Center for Economic Studies* (Working Papers 05-19).
- Bernard, A., Jensen, J. and Schott, P. (2007). Firms in International Trade, *NBER Working Paper* (13045).
- BIS (2009). Annual Report 2009, *Bank for International Settlements*.
- Broda, C. and Weinstein, D. (2006). Globalisation and the Gains from Variety, *Quarterly Journal of Economics* **121**(No.2): pp. 541–585.
- Caballero, R. (2006). On the Macroeconomics of Asset Shortages, *National Bureau of Economic Research Working Papers* **12753**.

- Caballero, R. (2010). The "other" imbalance and the financial crisis, *VOX* **14 January 2010**.
- Cetorelli, N. and Goldberg, L. S. (2008). Banking Globalisation, Monetary Transmission, and the Lending Channel, *NBER Working Paper* **14101**.
- Cetorelli, N. and Goldberg, L. S. (2010). Global Banks and International Shock Transmission: Evidence from the Crisis, *Federal Reserve Bank of New York Staff Reports* **446**.
- Chaney, T. (2008). Distorted Gravity: The Intensive and Extensive Margins of International Trade, *American Economic Review* **98**(04): pp. 1707–1721.
- Chen, N. and Novy, D. (2009). International trade integration: A disaggregated approach, *CEPR Discussion Paper* **0908**.
- Chinn, M. D. and Prasad, E. S. (2003). Medium-term determinants of current accounts in industrial and developing countries: an empirical exploration, *Journal of International Economics* **59**: 47–76.
- Choi, Y., Hummels, D. and Xiang, C. (2006). Explaining import variety and quality: The role of income distribution, *NBER Working Paper* (12531).
- Cihak, M. and Schaeck, K. (2010). How well do aggregate prudential ratios identify banking system problems, *Journal of Financial Stability* **Volume 6, Issue 3**: 130–144.
- Corcoran, A. (2008). International financial integration and consumption risk sharing, *Institute for International Integration Studies* **241**.
- de Bandt, O., Bruneau, C. and El Amri, W. (2006). Credit demand across euro area countries: Evidence from panel data, *Banque De France, Notes d'études et de recherche* **158**.
- Deveraux, M. B. (2007). Financial globalization and emerging market portfolios, *Monetary and Economic Studies* **25**: 101–130.
- Dixit, A. and Stiglitz, J. (1975). Monopolistic competition and optimum product diversity, *Warwick Economic Research Papers* (64).
- Djankov, S., McLiesh, C. and Shleifer, A. (2007). Private Credit in 129 Countries, *Journal of Financial Economics* **84**(2): 299–329.
- EBRD (2010). Transition Report, *European Bank for Reconstruction and Development* pp. 60–75.
- ECB (2009). EU Banks' Funding Structures and Policies, *European Central Bank* **May**.
- ECB (2010). Euro Area Credit Institutions Statistics, *ECB Explanatory Notes* **March**.

- Ekholm, K., Forslid, R. and Markusen, J. (2007). Export-platform foreign direct investment q, *Journal of the European Economic Association* **5**(4): 776–795.
- Elhanan Helpman, M. M. and Rubinstein, Y. (2008). Estimating trade flows: Trading partners and trading volumes, *Quarterly Journal of Economics* **123**(2).
- Engel, C. and Rogers, J. H. (2006). The u.s. current account deficit and the expected share of world output, *Journal of Monetary Economics* **53**: 1063–1093.
- European Commission (2010). Surveillance of Intra-Euro-Area Competitiveness and Imbalances, *European Economy* **1**.
- Fair, R. C. and Dominguez, K. M. (1991). Effects of the Changing U.S. Age Distribution on Macroeconomic Equations, *American Economic Review* **81**(5): 1276–94.
- Faruq, H. (2006). New Evidence on Product Quality and Trade, *Center for Applied Economics and Policy Research* (Working Papers 2006-19).
- Feenstra, R. (1994). New product varieties and the measurement of international prices, *American Economic Review* **84**(01).
- Feenstra, R. (2004). *Advanced International Trade: Theory and Evidence*, Princeton University Press, New Jersey.
- Feenstra, R., Heston, A., Timmer, M. and Haiyan, D. (2004). Estimating real production and expenditures across nations: A proposal for improving and penn world tables, *NBER Working Paper* (10866).
- Feenstra, R. and Kee, H. (2004). Export variety and country productivity, *NBER Working Paper* (10830).
- Feenstra, R. and Kee, H. L. (2008). Export variety and country productivity: Estimating the monopolistic competition model with endogenous productivity, *Journal of International Economics* **74**: 500–519.
- Feenstra, R., Lipsey, R., Deng, H., Ma, A. and Mo, H. (2005). World trade flows: 1962–2000, *NBER Working Paper* (11040).
- Felletigh, A. and Monti, P. (2008). How to Interpret the CPIS Data on the Distribution of Foreign Portfolio Assets in the Presence of Sizeable Cross-Border Positions in Mutual Funds: Evidence for Italy and the main euro area countries, *Bank of Italy, Occasional papers*.
- Fitzgerald, D. and Haller, S. (2009). Pricing-to-market: Evidence from producer prices, *Working Paper*.
- Flam, H. and Helpman, E. (1987). Vertical product differentiation and north-south trade, *American Economic Review* **77**(5): 810–22.

- Frensch, R. (2008). Trade liberalisation, adoption costs, and import margins in ceec and oecd trade, *Osteuropa-Institut, Working Paper* (269).
- Friedman, M. (1957). Evidence from income data on the relative importance of permanent and transitory components of income, *National Bureau of Economic Research A Theory of the Consumption Function*: 183–199.
- Giannone, D., Lenza, M. and Reichlin, L. (2010). Market Freedom and the Global Recession, *ECARES working paper* 020.
- Giavazzi, F. and Spaventa, L. (2010). Why Current account matters in a monetary union: Lessons from the financial crisis in the Euro area, *The Euro Area and the Financial Crisis*.
- Gleeson, A.-M. and Ruane, F. (2006). Export dynamics in small open economies: Indigenous irish manufacturing exports, 1985–2003, *Institute for International Integration Studies Discussion Paper Series* 140.
- Greene, W. H. (2002). *Econometric Analysis*, Prentice Hall, New Jersey.
- Gujarati, D. (2003). *Basic Econometrics*, McGraw and Hill, New York.
- Haddad, M., Lim, J., Munro, L. and Christian (2011). *Managing Openness: Trade and Outward-Oriented Growth after the Crisis* Saborowski and Ben Shepard, World Bank Publications, chapter Volatility, Export Diversification, and Policy.
- Haddad, M. and Shepard, B. (eds) (2011). *Managing Openness: trade and outward-oriented growth after the crisis*, World Bank Publications.
- Hallak, J. (2003). The Effect of Cross-Country Differences in Product Quality on the Direction of International Trade, *University of Michigan Research Seminar in International Economics Discussion Paper*(493).
- Heston, A., Summers, R. and Atten, B. (2006). Penn world tables 6.2, *CIPUP at the University of Pennsylvania*.
- Higgins, M. (1998). Demography, national savings and international capital flows, *Federal Reserve Bank of New York Staff Reports* 34.
- Hofmann, B. (2001). The Determinants of Private Sector Credit in Industrialised Countries: do property prices matter?, *BIS Working Papers* 108.
- Hoggarth, G., Mahadevaand, L. and Martin, J. (2010). Understanding international bank capital flows during the recent financial crisis, *Bank of England Financial Stability Paper* No. 08.
- Honohan, P. (1992). The Irish Economy in the 1990s: Resolving some paradoxes, *Read to the Trilateral Commission, Dublin Castle*.

- Honohan, P. and Walsh, B. (2002). Catching up with the leaders: The Irish hare, *Brookings Papers on Economic Activity* .
- Hume, M. and Sentance, A. (2009). The Global Credit Boom: challenges for macroeconomics and policy, *Bank of England Discussion Paper* **27**.
- Hummels, D. and Klenow, P. (2002). The variety and quality of a nation's trade, *NBER Working Paper* **8712**.
- Hummels, D. and Klenow, P. (2005). The Variety and Quality of a Nation's Exports, *American Economic Review* **112**(5).
- Hummels, D. and Skiba, A. (2004). Shipping the Good Apples Out? An Empirical Confirmation of the Alchian-Allen Conjecture, *Journal of Political Economy* **112**(6).
- IMF (2010). Balance of payments manual, *IMF* .
- Isquierdo, M. and de los Llanos Matea, M. (2001). An Approximation to Biases in the Measurement of Spanish Macroeconomic Variables Derived from Product Quality Changes, *Bance de Espana, Servicio de Estudios Economicos* (71).
- Jevcak, A., Setzer, R. and Suardi, M. (2010). Determinants of Capital Flows to the New EU Member States Before and During the Financial Crisis, *European Commission, DG EcFin, Economic Papers* **425**.
- Jorda, O., Schularick, M. and Taylor, A. (2010). Financial Crisis, Credit Booms, and External Imbalances: 140 Years of Lessons, *NBER Working Paper* **16567**.
- Kang, K. (2004). The path of the extensive margin (export variety), theory and evidence., *Working Paper, University of California, Davis* .
- Kaplinsky, R. and Santos-Paulino, A. (2006). A disaggregated analysis of EU imports: the implications for the study of patterns of trade and technology, *Cambridge Working Papers in Economics* **30**.
- Keating, W. (1995). Measuring growth, *Proceedings of Conference on Measuring Economic Growth, Dublin, Central Statistics Office and Irish Economic Association* **November**.
- Kehoe, T. J. and Ruhl, K. J. (2009). How important is the new goods margin in international trade?, *Federal Reserve Bank of Minneapolis Research Department Report* **324**.
- Kelly, M. (2010). The Irish Credit Bubble, *UCD Geary Institute Discussion Paper Series* .
- King, R. G. and Levine, R. (1993). Finance and growth: Schumpeter might be right, *The Quarterly Journal of Economics* **Volume 108**: 717-737.
- Krugman, P. (1979). Increasing returns, monopolistic competition, and international trade, *Journal of International Economics* **9**(04).

- Krugman, P. (1980). Scale Economies, Product Differentiation, and the Pattern of Trade, *American Economic Review* **70**(05).
- Lanau, S. (2009). Domestic financial regulation and external borrowing, *Bank of England Draft Paper*.
- Lane, P. R. (1998). Profits and wages in Ireland, 1987-1996, *Journal of the Statistical and Social Inquiry Society of Ireland, Barington Lecture*.
- Lane, P. R. and Milesi-Ferretti, G. M. (2002). Long-Term Capital Movements, *NBER Macroeconomics Annual 2001* **16**: 73-136.
- Lane, P. R. and Milesi-Ferretti, G. M. (2007a). Europe and Global Imbalances, *IMF Working Papers* **07/144**.
- Lane, P. R. and Milesi-Ferretti, G. M. (2007b). The External Wealth of Nations Mark II: Revised and Extended Estimates of Foreign Assets and Liabilities, 1970-2004, *Journal of International Economics* **73**(2): 223-250.
- Lane, P. R. and Milesi-Ferretti, G. M. (2008). The Drivers of Financial Globalization, *American Economic Review* **98**: 327-332.
- Lane, P. R. and Milesi-Ferretti, G. M. (2010a). Cross-Border Investment in Small International Financial Centers, *IMF Working Paper* **10/38**.
- Lane, P. R. and Milesi-Ferretti, G. M. (2010b). The Cross-Country Incidence of the Global Crisis, *IIIS Discussion Paper No. 333*.
- Lawless, M. and Whelan, K. (2008). Where do firms export, how much, and why?, *University College Dublin Working Paper* (200821).
- Levine, R. (1996). *International Financial Markets: Harmonization versus Competition*, AEI Press, chapter Foreign banks, financial development and economic growth.
- Lionel Fontagne, G. G. and Zignago, S. (2007). Specialisation across varieties within products and north-south competition, *CEPII Working Papers* **06/05**(2007 - 06).
- M. Jansen, C. L. and Piermartini, R. (2009). Exposure to external country specific shocks and income volatility, *CEPR Discussion Paper* (7123).
- Melitz, M. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity, *Econometrica* **71**(6): 1695-125.
- Milesi-Ferretti, G. M. and Tille, C. (2010). The Great Retrenchment: International Capital Flows During the Global Financial Crisis, *Graduate Institute of International and Development Studies, Geneva, Working Paper Series* **18**.
- Neary, J. P. (2004). Rationalizing the Penn World Table: True multilateral indices for international comparisons of real income, *American Economic Review* **94**(5): 1411-1428.

- Nichols, A. and Schaeffer, M. E. (2007). Clustered standard errors in stata, *United Kingdom Stata Users' Group Meetings* **07**.
- Novy, D. (2008). Gravity redux: Measuring international trade costs with panel data, *Warwick Economic Research Papers Series* (861).
- Obstfeld, M. and Rogoff, K. (1996). *Foundations of International Macroeconomics*, MIT Press.
- O'Rourke, K. H. and Williamson, J. G. (1999). When did globalisation begin?, *European Review of Economic History* **60(1)**: 23–50.
- Pels, B. (2010). *International Financial Integration: Empirical analyses*, PhD thesis, University of Dublin, Department of Economics, Trinity College Dublin.
- Pesaran, P., Shin, Y. and Smith, R. (1999). Bounds testing approaches to the analysis of long-run relationships, *Cambridge Journal of Economics* (9907).
- Pula, G. and Santabarbara, D. (2011). Estimating cross country differences in product quality using eurostat's comext trade database, *ECB Working Paper Series* **1310**.
- Raddatz, C. (2010). When Rivers Run Dry: Liquidity and the Use of Wholesale Funds in the Transmission of the U.S. Subprime Crisis, *World Bank Policy Research Working Paper Series* **5203**.
- Rikhil Bhavnani, David Coe, A. S. and Tamirisa, N. (2002). The missing globalization puzzle, *IMF Working Paper* **171(02/171)**.
- Rossiter, R. D. (2000). Fisher ideal indexes in the national income and product accounts, *Journal of Economic Education* **31, 4**: 363–373.
- Ruane, F. and Ugur, A. (2005). Export platform fdi and dualistic development, *Institute for International Integration Studies Discussion Paper Series* **029**.
- Schaeffer, M. E. (2005). Xtivreg2: Stata module to perform extended iv/2sls, gmm and ac/hac, liml and k-class regression for panel data models, *Statistical Software Components, Boston College Economics* **S4994401**.
- Schmitz, M. (2009). Financial Reforms and Capital Flows to Emerging Europe, *The Institute for International Integration Studies Discussion Paper Series* **278**.
- Schularick, M. and Taylor, A. M. (2008). Credit Booms Gone Bust: Monetary Policy, Leverage Cycles and Financial Crises, 1870–2008, *NBER Working Paper* **15512**.
- Tressel, T. and Detragiache, E. (2008). Do Financial Sector Reforms Lead to Financial Development? Evidence from a New Dataset, *IMF Working Paper* **265**.
- Vartia, Y. (1976). Ideal log-change index numbers, *Scandinavian Journal of Statistics* pp. 121–126.

- Vartia, Y. and Vartia, P. (1984). Descriptive index number theory and the bank of finland currency index, *Scandinavian Journal of Economics* **86(3)**: 352-364.
- Verbeek, M. (2004). *A guide to Modern Econometrics*, John Wiley and Sons.
- Walsh, B. (2000). The role of tax policy in ireland's economic renaissance, *Canadian Tax Journal* **48(3)**.
- Walsh, B. (2003). Taxation and foreign direct investment in ireland, *Tax Reform in Canada: our path to greater prosperity*.
- Wooldridge, J. M. (2002). *Econometric Analysis of Cross Section and Panel Data*, Massachusetts Institute of Technology.