Vertical Specialisation and New Regionalism

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SUMMARY

The increased spread in the location of value added coupled with the growing impetus for new forms of bilateral integration are re-shaping international economic activity. The world is becoming more regional and more fragmented but little empirical work has been dedicated to examining the nature of the links between these processes. This thesis aims to fill this gap in the literature.

The primary aim of the first essay of this thesis is to extend current indicators of international production so that the bilateral degree of vertical specialisation can be captured. This has been one of the major hurdles in examining the links between vertical specialisation and Free Trade Agreements (FTAs). The comparative static analysis of this first essay reveals that there appears to be a high incidence of regional value chain activity and this motivates the aims of the second essay. It attempts to isolate the impact of an FTA on these flows through a theoretically derived gravity model of input trade. The results suggest that an FTA increases the use of intermediate inputs that are part of a bilateral value chain by 65%. Moreover, the results identify the presence of 'magnification' which implies that this type of trade is also more responsive to changes in trade costs and income variables. The third essay then looks at how the changing nature of trade affects the formation of new FTAs. It suggests that the propagation of international production alters the political economy dynamics of countries towards favouring further liberalisation. It also identifies regulatory quality and a growing FTA 'contagion' as determinants of new FTAs.

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An unusual side effect of the focus of this thesis is that it has begun to overrule my modus operandi when facing new challenges. The thesis is a daunting process, but when fragmented into small ‘tasks’ it becomes much more manageable and much less scary. Time will tell whether I am grateful for this lesson or if I need to see a special counsellor about this.

I dedicate this thesis to my parents, my brother and Huguito. No superlatives can express how much they mean to me.

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LIST OF ABBREVIATIONS AND ACRONYMS

2SLS	Two Stage Least Squares
ANZCERTA	Australia New Zealand Closer Economic Agreement
ATE	Average Treatment Effect
ATET	Average Treatment Effect on the Treated
BEC	Broad Economic Categories
BIT	Bilateral Investment Treaty
BVS	Bilateral Vertical Specialisation
CEPII	Centre d'Etudes Prospectives et d'Informations Internationales
CES	Constant Elasticity of Substitution
EFTA	European Free Trade Association
EU	European Union
FD	First Differences
FDI	Foreign Direct Investment
FE	Fixed Effects
FK	Finger-Kreinin
FTA	Free Trade Area
GDP	Gross Domestic Product
GTAP	Global Trade Analysis Project
H-O	Heckscher-Ohlin
IMF	International Monetary Fund
IO	Input Output
IV	Instrumental Variable
LDC	Least Developed Countries
MERCOSUR	Mercado Comun del Sur
MFN	Most Favoured Nation
MNE	Multinational Enterprise
NAFTA	North American Free Trade Area
NEG	New Economic Geography
NMS	New Member States
NTM	Non Tariff Measure
OECD	Organization for Economic Cooperation and Development
OLS	Ordinary Least Squares
PPML	Poisson Pseudo-Maximum Likelihood
PPP	Purchasing Power of Parity
RCA	Revealed Comparative Advantage
RE	Random Effects
RoO	Rules of Origin
SVS	Sectoral Vertical Specialisation
VAT	Value Added Tax
VIIT	Vertical Intra-Industry Trade
VS	Vertical Specialisation
WDI	World Development Indicators
WITS	World Integrated Trade Solution
WTO	World Trade Organisation

INTRODUCTION

Two important processes have characterised global economic activity during the last decades. The first is a new *unbundling* (Baldwin, 2006a and 2011) that has seen the unpacking of factories across international borders and has resulted in a greater spread in the location of value added. The second is a regionalisation of world trade evidenced by the growing number of countries participating in Free Trade Agreements (FTAs). Although these processes are concurrent and appear to be linked, as the rise in 'Factory Asia' (Baldwin, 2006b) coupled with the growing demand for deeper trade agreements in the region suggests; there has, hitherto, been little empirical work dedicated to examining the nature of these links. The purpose of this thesis is to fill this gap in the literature.

Vertical specialisation (VS) – or the international fragmentation of production[1], is driving a new wave of globalisation[2]. Production is increasingly being split into finer processes across international borders and this is leading to a greater spread in value added where comparative advantages are being exploited along more segments of the value chain. According to Feenstra and Hanson (1996); Feenstra (1998); Yeats (2001); Hummels et al. (2001); Yi (2003); WTO (2008); and OECD (2010) these new modes of production are rising rapidly and occupying a growing share of international trade. Yet each of these papers uses different measures to capture the incidence of this phenomenon and this reflects one of the main challenges in its empirical analysis: it is hard to quantify[3].

One measure that has gained prominence is the indicator of vertical specialisation proposed by Hummels et al. (2001); it identifies the *import content of exports*. This more narrow proxy for value chain activity captures a production sequence where intermediate imports are used to produce output destined to other countries. However, this indicator does not disentangle the origin of imports or the destination

[1] The term 'offshoring' is commonly used to refer to this phenomenon (WTO, 2008).
[2] Blinder (2006) calls this the new industrial revolution.
[3] The World Trade Report (2008) identifies the salience of this phenomenon and a recent venture between the OECD and the WTO seeks to address unsolved issues relating to measures of this phenomenon which make this thesis quite timely (OECD-WTO, 2011).

of the corresponding export flow which implies that, in this form, it is not well suited to analysing the links between the spread of production and the rise in regionalism. This has been a major hurdle in the empirical analysis of these concurrent processes.

This motivates one of the primary aims of the first essay of this thesis which is to construct a bilateralised indicator of vertical specialisation. This is approached through an extension of Hummels et al.'s (2001) indicators via the combination of technical coefficients, derived from input-output tables, and trade data[4]. The resulting database then enables the use of more sophisticated empirical methods of analysis through which one can investigate the causal links between vertical specialisation and new regionalism which is the focus of the two remaining essays of this thesis.

One of the other aims of this first essay is to identify the nature of patterns of specialisation. It has often been argued that countries move up the value added ladder as they engage in further specialisation along a value chain, but evidence of this has been rather elusive. The case study of Bergin et al. (2008) suggest that since the establishment of the *maquiladoras* during the 60's, Mexico moved beyond assembly provisions towards more sophisticated modes of production which are characterised by higher value adding activities. In an effort to capture such specialisation patterns, this essay decomposes vertical specialisation into backward and forward linkages. The former identifies the foreign value added of exports whereas the latter captures the value of domestic intermediates that are used for further processing by other countries. This decomposition is useful because countries specialising at different stages of the value chain are expected to exhibit different intensities in these linkages. For example, countries that engage in assembly activities are likely to display a growing backward linkage, or a rising import content of exports, as they import more and more components for processing. However, as specialisation unfolds, these countries may begin to specialise in higher value adding activities leading to reductions in their backward linkages and consequent increases in their forward linkages. But capturing this through indicators of vertical specialisation is challenging because their calculation is limited by the relatively small temporal coverage of input-output tables. Hence to identify long-run patterns of specialisation

[4] The very recent work of Johnson and Noguera (2011) uses a similar approach.

this essay looks at how different country linkages behave at varying levels of per capita GDP. It finds evidence of a non-monotonic relationship between levels of development and these linkages lending support to the notion that countries do appear to move up the value chain.

Another aim of this first essay is to identify the channels through which FTAs may affect vertical specialisation. Although the traditional shallow integration effects of FTAs are thought to be well understood, grasping the consequence of removing tariffs, on a preferential basis, in the presence of vertically specialised modes of production is quite complicated. The increased dimensionality of international value chain transactions, which involve both an importing and an exporting component, introduces the possibility for trade creation and diversion occurring at either or both the input and output elements of production. Hence although FTAs are expected to increase bilateral trade, the global welfare implications of these, in the presence of vertically specialised modes of production can be hard to grasp.

One of the predictions made by Yi's (2003) theoretical model of vertical specialisation is that the removal of tariff barriers to trade should lead to 'magnified' increases in the trade flows that are occupied in vertically specialised production. Because these modes of production involve back and forth movements of products along a single border the removal of a tariff barrier to trade can lead to an important reduction in the costs of production. This leads to 'magnification effects' which imply that this type of trade should be more responsive to changes in trade costs and economic size than traditional trade flows. Yi argues that these effects may help explain why world trade has grown at a faster pace than world GDP.

The second essay of this thesis looks at the impact of FTAs on vertically specialised trade and attempts to see whether Yi's predictions can be substantiated empirically. To this end, the determinants of this type of trade are identified via the derivation of a country's demand for intermediate imports. This is then used to develop a gravity model of input trade through which the impact of an FTA on these flows can be captured. The estimation procedure draws on the recent literature that highlights the challenges faced in estimating gravity models with an endogenous FTA variable. Baier and Bergstrand (2007) suggest that biases in the coefficient estimates of a gravity mode arise from unobserved heterogeneity which is caused by the presence of unobserved characteristics that simultaneously affect both the degree of trade between countries and the incentives for these to engage in an FTA. They propose the use of bilateral pair-wise fixed effects as control mechanisms but these have the undesirable consequence of restricting the variance of the FTA variable. This implies that this variable captures the impact of *switching* into an FTA which is problematic when the sample used in the estimation includes many agreements that were established before the beginning of the sample period.

The use of less restrictive country-year fixed effects that do not place such constraints on the variance of the FTA variable is proposed as an alternative estimation technique. But their use has to be supported with evidence that these controls appropriately deal with the problems caused by unobserved heterogeneity. If this is the case, then current trade flows should not be affected by the presence of a future FTA, and this can be tested empirically. The results from this test suggest that this condition holds when using these fixed effects and hence that this is an appropriate empirical strategy to capture unbiased estimates of FTA effects. However, in the process this test also raises an interesting question. Could the changing nature of trade be leading to a greater demand for new agreements?

The third essay of this thesis tackles this question. Baldwin (2011) suggests that a new wave of *21st century regionalism* is unfolding. It involves more countries negotiating on 'deeper' issues (see also WTO, 2011; and Orefice and Rocha, 2011). His arguments lend themselves to the idea that the increased spread of production is generating new incentives to form new agreements. The third essay of this thesis attempts to investigate this empirically. It identifies changes in the characteristics of countries involved in the various waves of regionalism where the latest wave appears to involve countries that are more distant and more dissimilar in their factor endowments than in the past. It is then suggested that this could be a manifestation of changing conditions in the game of regionalism.

The analysis draws on the political economy literature of FTA formation (Grossman and Helpman, 1995; and Ornelas, 2005a,b,c) to suggest that the changing nature of trade, or the spread in vertically specialised modes of production, leads to changes in the internal political economy dynamics within countries. As production becomes internationalised, lobbies within countries should increasingly favour liberalisation in an attempt to access cheaper intermediates inputs and to obtain market access for their exports. This internationalisation of production can be captured through measures of vertical specialisation introduced into a 'traditional' empirical model of FTA formation (see Baier and Bergstrand, 2004). They are expected to be significant determinant of new FTAs. But in testing this proposition particular care needs to be taken in the empirical strategy. The use of measures of trade in an FTA formation model introduces the possibility of biases arising from unobserved heterogeneity (as was seen in the second essay of this thesis) and simultaneity. This essay applies cross-sectional and panel data techniques to control for these biases.

Two other propositions are also tested in this essay. The first is derived from Baldwin's (1993) domino theory of regionalism which suggests that new FTAs might arise as a response to the spread of neighbouring FTAs. This claim has recently been justified through the empirical findings of Baldwin and Jaimovich (2010). This third essay incorporates a new form of FTA 'contagion' that is distinct from that used in Baldwin and Jaimovich (2010) in that it captures contagion forces arising from the spread of production. It then tests whether these measures affect the likelihood of an FTA being formed. The other proposition arises from the recent literature on offshoring and FTAs (Antras and Staiger, 2011; and Ornelas and Turner, 2008). These papers suggest that value chain activity might require the presence of appropriate regulatory provisions so as to avoid inefficient 'hold-ups'. This suggests that the desirability of engaging in a new trade agreement could be tied to the prevailing regulatory environment between countries. This proposition is tested through the introduction of measures of governance in an FTA formation model. It contributes to the growing literature on the links between intermediate goods trade, regulatory provisions and FTAs (see Orefice and Rocha, 2011).

The thesis concludes by detailing the results obtained and highlighting the methodological contributions made in the process. It also identifies some avenues for future research and some of the key implications of the results.

ESSAY ONE

THE NATURE AND SPREAD OF BILATERAL VERTICAL SPECIALISATION

Abstract

The concurrent international fragmentation of production structures with the regionalisation of world trade suggests the possibility of a link between these processes. This essay develops a new approach to capture the bilateral element of vertical specialisation so that its nature and evolution can be investigated. Vertical specialisation is decomposed into backward and forward linkages. On aggregate, the nature of these linkages varies significantly according to the position of a country in the value chain. Preliminary evidence of countries 'moving up the value added ladder' is presented and a statistically significant correlation between this type of activity and positive changes in productivity growth is identified. Where regionalism is concerned there appears to be marked differences between European, North American and Asian patterns of specialisation. The former two tend to be more inward oriented, whereas the last remains highly dependent on European and North American demand.

1.1. INTRODUCTION

The unprecedented reduction in barriers to trade (bilateral and multilateral) combined with reduced communication and transportation costs (*Death of Distance* – Cairncross, 1997) has presented firms with new opportunities to fragment processes of production across international borders. This has spurred a new wave of globalisation which is re-shaping the way we think about trade and the borders of production both at the country and firm level (Baldwin 2006a). Concurrently, there has been a deepening and widening of preferential trade agreements which suggests that these processes could be linked. The recent emergence of 'Factory Asia' (Baldwin 2006b) and the subsequent growth in the demand for new preferential agreements in the region supports this idea as do the specialisation patterns between the US and Mexico since the establishment of the North American Free Trade Area (NAFTA)[5].

Yet there appears to be a gap in the empirical literature. Very little work has been undertaken in capturing either the impact of trade agreements on this type of trade or the role that the changing nature of trade plays in the formation of new trade agreements. This is due neither to a lack of interest nor of available tools in analysing these issues, but rather because of difficulties in quantifying this phenomenon. The seminal work of Hummels et al. (2001) highlighted the importance of the growth in this type of trade through an indicator that used Input-Output tables to track the *import content of exports*, or the degree of *vertical specialisation* (VS)[6]. However this indicator does not disentangle the origin of imports or the destination of the corresponding export flow which implies that it is not well suited to the task of identifying the spread of vertical specialisation across preferential partners.

This essay aims to provide a first step in filling this gap by extending these indicators geographically so that the degree of *bilateral vertical specialisation* can be identified. This is done by combining information from the technical coefficients of production, obtained from Input-Output tables, with trade data. The resulting

[5] See Hanson and Robertson (2003).
[6] The indicator captures a particular sequence of production that involves a country importing intermediate products that are then used to produce exports.

indicator is then used to measure the extent and spread of 'international production' across countries. It identifies a production sequence where domestic resources are combined with imported intermediates to produce exports and hence can be thought of as a proxy measure of bilateral value chain activity. Whereas the traditional indicators of VS would allow one to capture the foreign value added of Mexican exports, this new measure identifies the origin of this value added so that one can track the US content of Mexican exports to any destination.

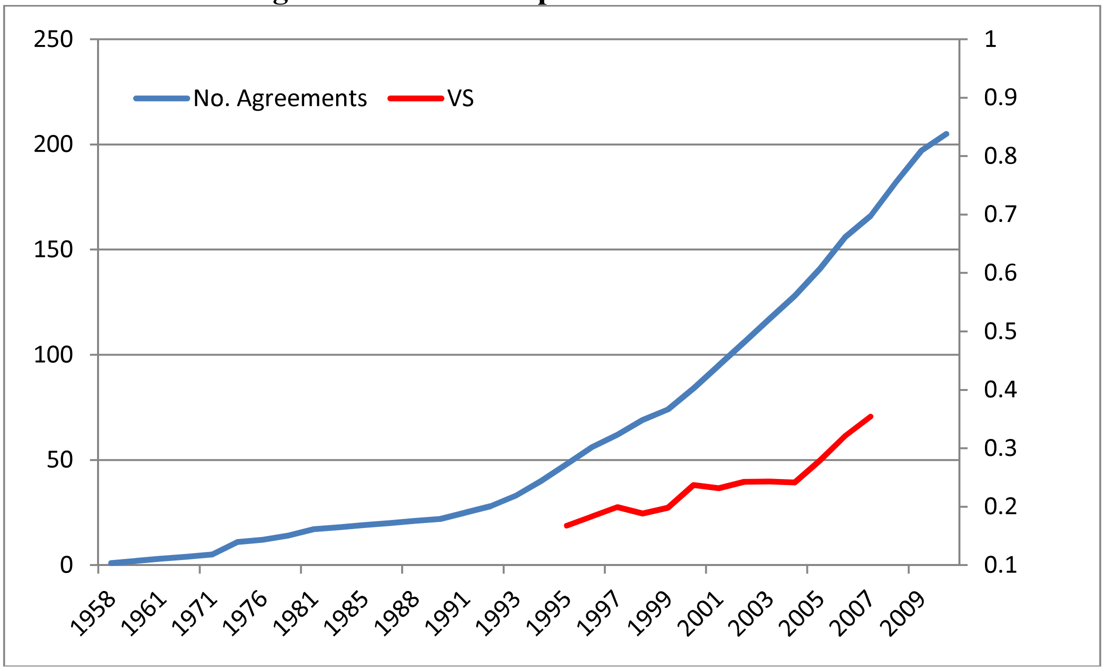
The primary purposes of this essay are:

1. To discuss the theoretical underpinnings of vertical specialisation and provide a workable definition which captures the extent, spread and evolution of this phenomenon; and
2. To shed light on the role that trade agreements might play in promoting the fragmentation of production structures.

The secondary aim is to prepare the ground for more sophisticated empirical analysis on the link between vertical specialisation and free trade agreements (FTAs).

The surge and importance of international production has been well documented in; Feenstra (1998); Yeats (2001); Hummels et al (2001); Yi (2003); and OECD (2010). It is concurrent with an unprecedented growth in the number of FTAs concluded as Figure 1.1 shows. However the links between these processes remain hard to pin down.

Figure 1.1: Vertical Specialisation and FTAs



Source: Data on FTAs from WTO FTA database. VS calculated for aggregate sample of 39 OECD countries using Hummels et al.'s (2001) indicator the method used is explained in greater detail in subsequent sections.

This essay provides a short review of the theoretical approaches that have been used to describe vertical specialisation. It argues that 'new paradigms', explaining the drivers of this phenomenon, are perhaps not needed. Vertical specialisation certainly increases the quantity of products traded across borders, but the existing body of trade theory should be capable of grasping its implications. What is particularly new about this phenomenon is that trade is becoming complementary rather than competing (see Samuelson, 2001; and Bas and Strauss-Kahn, 2011), this may then have unusual consequences in how it interacts with trade policy[7].

Analysing the impact of FTAs on this type of trade, in the context of the traditional trade creation and diversion framework proposed by Viner (1950) may become more complex owing to the presence of both importing and exporting elements in value chain interactions. Trade creation or diversion can occur at either end of the value chain and, with complementary trade, trade creation at one end may lead to further trade creation at the other. This introduces the possibility of there being complex feedback mechanisms. Moreover, if *magnification effects* (Yi 2003) arise,

[7] Trade is complementary, as opposed to competing, when the competitiveness of a foreign producer benefits domestic production rather than reducing its market share. It arises when products can be used as inputs in the productive process (as shown in Samuelson, 2001).

through the impact of the removal of tariffs on trade flows in the presence of multiple border crossings, then these forces may be further amplified.

This essay also attempts to highlight the role of deep integration in shaping the spread of international production. It argues that the increasing complexity of production is likely to demand greater private and public coordinating mechanisms. This implies that standardisation and the enforcement of the rule of law, or contractual obligations, might become increasingly important in determining patterns of value chain activity.

The indicator of vertical specialisation is herein divided into two main components; backward and forward international production linkages. These capture different facets of value chain activity. The backward linkage identifies the use of intermediate imports in the production of exports whereas the forward linkage captures the use, by other countries, of a reporting country's intermediate goods to produce exports. Hence Mexico's backward linkage with the US is the value of intermediate imports from the US in Mexico's total exports whilst its forward linkage is the share of Mexican intermediate goods that the US uses to produce exports as a proportion of Mexico's total exports.

This separation is convenient because it facilitates tracking a country's position in an international value chain (i.e. as assembler or as supplier of intermediates). This essay suggests that a non-monotonic relationship arises between levels of development and the position of countries in a value chain. At low levels of development, countries appear to enter global value chains in assembly activities which are characterised by low domestic value adding activities. This implies that their exports tend to have a high, and rising, foreign value added component. However, as specialisation unfolds and countries become more integrated in value chain activity, the share of domestic value added to foreign value added increases and hence the vertical specialisation indicator that captures backwards linkages falls. This gives rise to a specialisation pattern that exhibits an inverted-U relationship (between development and backward linkages). On the supply side, as countries engage in the assembly of final goods their share of intermediate exports to total exports initially falls, but as they specialise in higher value adding activities this share begins to rise driving a U shaped relationship between levels of development and forward linkages[8].

Such specialisation patterns lend support to the notion that countries 'move up the value added ladder' which is important because it presents a path through which developing countries can benefit from integrating into global value chains. Furthermore, this essay identifies a positive correlation between value chain activity (both backward and forward linkages) and productivity growth suggesting a possible link between these processes. This may reinforce the importance of engaging in such activities not least for development purposes.

In terms of the spread of bilateral vertical specialisation, the observations of this essay confirm many perceived wisdoms. There is a lot of vertical specialisation taking place within traditional regional blocks (EU, NAFTA and East Asia). However the rise of China as a source of intermediate products also suggests that one needs to look carefully at the determinants of this type of trade to disentangle the role that trade policy might play in this process. Regional partners are close in proximity and exhibit similar per capita GDPs (Baier and Bergstrand, 2004). These factors should also be conducive to higher degrees of vertical specialisation and hence need to be controlled for so that the trade policy element can be isolated.

This essay is divided into 8 sections. Section 1.2 provides a review of the literature on vertical specialisation. Section 1.3 then focuses on a discussion on how FTAs may impact degrees of vertical specialisation. In the fourth section, the challenges in measuring this type of trade are presented. Section 1.5 then provides a new method that can be used to capture vertical specialisation across bilateral partners and divides international production into forward and backward linkages. The sixth section presents some preliminary observations on the nature of these linkages. Section 1.7 highlights the spread of bilateral vertical specialisation across different geographical regions. The final section concludes and sets the agenda for future research in this field.

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[8] These patterns are also in line with the evolution of *Maquiladora* specialisation where the giant assembly lines of the 60's have given way to new generation plants engaged in higher value adding activities and have led to a tripling of value added between 1994 and 2005 as suggested in Bergin et al.(2008).

1.2. VERTICAL SPECIALISATION IN THEORY

Many names have been given to the disintegration of production structures across national boundaries, such as; 'slicing up the value-added chain' (Krugman 1996); 'offshoring'; 'outsourcing'; 'fragmentation' (Jones and Kierkowski 1990 and 2001, Deardorff 2001); 'delocalisation of production' (Leamer 1996); and 'vertical specialisation' (Balassa 1967 and Hummels et al. 1998, 2001). Each captures a different facet of the grander, and recently evolving, second *unbundling* (Baldwin 2006a). This international unpacking of production processes has led to an increase in the spread of the location of value added so that this is now performed in different countries and at different stages of the value chain. Henceforth, the term vertical specialisation will be used to refer to this phenomenon.

1.2.1. THEORETICAL MODELS

Models providing theoretical underpinnings to this type of trade are also numerous. They fall along the traditional trade theory divides. The *Ricardian* models see this process as being motivated by comparative advantages that arise from differences in technologies across countries (Sanyal and Jones 1982, Feenstra and Hanson 1996, Deardorff 2001, Yi 2003). The H-O frameworks are then driven by comparative advantages which arise from differences in factor endowments (Jones and Kierzkowski 2001, Deardorff 2001, Arndt 2002, Baldwin and Robert-Nicoud 2010). The new trade theory models see imperfect competition, product differentiation and 'international economies of scale' as the drivers of such trade (Ethier 1982, Burda and Dluhosch 2002, Lüthje 2001 and 2003, Grossman and Rossi-Hansberg 2008 and Baldwin and Robert-Nicoud 2010)[9]. A well rounded understanding of vertical specialisation passes through a discussion of the insights of each theoretical approach.

Yi's (2003) Ricardian model is particularly perceptive. It suggests that, in the presence of vertically specialised modes of production, the removal of border measures can 'magnify' bilateral trade flows and technological differences across

[9] These economic approaches have used partial equilibrium, general equilibrium and econometric estimation.

countries. This results in a greater responsiveness of trade flows to tariff reductions[10]. Egger and Pfaffermayr (2005) lend support to the presence of such magnification effects in their empirical study of Austrian intra-firm trade. They show that falling trading costs encourage multinationals to fragment production and identify a magnification effect associated with two-way trade in components. Similarly, Chinn (2005), who looks at import and export flows in the US, argues that the presence of vertically specialised trade, combined with decreasing tariff rates, yields more plausible estimates for income elasticities. This, a priori, implies that the removal of barriers to trade on a preferential basis may generate distinct magnification effects that reinforce the propagation of vertically specialised trade across preferential areas.

The factor endowment approach to vertical specialisation presented in Deardorff (1998) sees differences in factor intensities motivating specialisation across countries. The US exports goods which are intensive in the use of skilled-labour to Mexico where these are assembled using unskilled labour into finished products destined for the US (e.g. *Maquiladoras* trade). Here firms take advantage of the lower costs of labour to decrease overall costs of production. Similarly, but in the context of FTAs, Arndt (2002) argues that entering into an agreement with a country with differing factor intensities, and allowing for vertical specialisation in tasks, results in a more efficient allocation of processes of production.The welfare effects of engaging in this type of trade are equivalent to technical progress in both the labour-intensive and the capital-intensive tasks. When countries are allowed to vary in size, terms of trade gains may also arise so that: “the combined effect of investment liberalisation and cross-border production sharing is to raise wages in both countries and to increase area-wide output” (Arndt, 2002:p8).

New trade theory approaches owe much to the seminal work of Krugman (1979 and 1981) and Ethier (1982). The latter models a world where all trade takes place in intermediate products. Firms combine inputs through a CES production function and derive ‘international economies of scale’ from the use of new varieties that become available through trade. A contrasting approach to this ‘love of input variety’ setting

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[10] Yi (2003) argued that the responsiveness of trade flows to the most recent reductions in tariffs could not be explained by traditional trade models unless a counterfactually large elasticity was used. He then suggests that magnification effect arising from the removal of barriers provide a good explanation for the large growth in world trade.

is the ‘ideal input variety’ approach that follows Lancaster’s (1979) insights in Lüthje’s (2001 and 2003) theoretical models. These general equilibrium models of intra-industry trade in intermediate products put forward the idea that for every final good, an ideal intermediate good that perfectly fits its production requirements exists. If this ideal variety is not available, firms buying intermediate goods will need to devote resources to moulding (transforming) the available intermediate good before they can assemble a finished product. Because this transformation requires the use of labour and capital, it affects the production of final goods. An increased variety of intermediate goods raises the probability of finding an ideal variety, but the combination of non-ideal intermediate goods does not increase production as is the case in Ethier type models.

Supply side models of vertical specialisation are motivated by the observation that trade in producer goods has advanced at a significantly faster pace than trade in consumer goods. Burda and Dluhosch (2002) argue that fragmentation is driven by cost-competition and the international division of labour through a monopolistically competitive framework with economies of scale. An index, *z,* captures the degree of fragmentation across stages of value added within a value chain. Increasing this degree of fragmentation reduces production costs but also incurs a fixed cost that arises from the coordination, or management, of shared production processes. The model then identifies market size as the guiding force in this process. A growing market leads to increased pressures to cut costs of production and results in competition taking place across methods of production. This suggests that, to the extent that FTAs increase the size of the market, they may have important pro-competitive effects through cost savings opportunities. Furthermore “an enlarged market associated with trade drives an endogenous evolution of technology, which in turn affects the international division of labour” (Burda and Dluhosch 2002:432)[11].

[11] The more credible the commitment to an FTA the more securely a firm may afford to outsource. Eichengreen (2006) suggested that, before 1945, European firms could simply not guarantee security of supply if they sought to base production on imported parts. However the deep provisions associated with the EU’s process of integration may then have reinforced the division of labour across Europe by guaranteeing the contestability of markets.

1.2.2. A CHANGE IN PARADIGM OR BUSINESS AS USUAL?

Despite vertical specialisation being touted as a new phenomenon, it may just be a global up-scaling of Adam Smith's (1776) *pin factory* where international competition happens not in the final pin market but rather in the *tasks* that lead to the production of the pin. The international division of tasks across processes of production is desirable because it can give rise to productivity increases that generate important welfare gains that can ultimately drive economic growth. It introduces scope for additional gains arising from; 'learning by doing' effects; technology transfers; or increased international competition at the finer process level. Gains can also be amplified through 'natural selection forces' that follow global comparative advantages and these are likely to drive a re-shaping of global economic activity.

What is particularly new about this phenomenon is that it may affect a wider array of goods, services and people in a way that traditional trade theory could be ill-equipped to predict (Blinder 2006). Baldwin (2006a:p6), in an effort to summarise the *second unbundling* paradigm in which vertical specialisation falls, argues that whilst "the first unbundling allowed the spatial separation of factories and consumers [...] the second unbundling spatially unpacked the factories and offices themselves". Hence the first unbundling facilitated the consumption of products originating from distant locations whereas the second unpacked the different tasks that lead to the manufacture of these products.

Such a view of the world has led to the creation of a new theoretical approach to vertical specialisation that focuses on *trade in tasks* rather than products (Blinder, 2006 and 2009; Grossman and Rossi-Hansberg, 2006 and 2008; Baldwin, 2006 and 2010; and Baldwin and Robert-Nicoud 2010). Although this may appear as a new idea, it seems that Adam Smith had already understood the importance of tasks in the production process:

> *"The woollen coat, for example, which covers the day-labourer, as coarse and rough as it may appear, is the produce of the joint labour of a great multitude of workmen. The shepherd, the sorter of the wool, the wool-comber or carder, the dyer, the scribbler, the spinner, the weaver, the*

> *fuller, the dresser, with many others, must all join their different arts in order to complete even this homely production."(Adam Smith 1776:p.8).*

Grossman and Hansberg (2006 and 2008), later backed by Baldwin (2006), were first to advocate this new theory of task trade. In their model, declining costs of task trade result in productivity boosts "for the factor whose tasks become easier to move offshore". In parallel Blinder (2006) suggested that under the *new industrial revolution*, the distinction between tradable and non-tradable goods and services becomes blurred as do trade theory predictions based on the traditional factor endowment dichotomy of skilled and unskilled labour. As an economy becomes more service oriented, the dichotomy for the new paradigm should focus on personal versus impersonal services where the latter are more easily offshoreable than the former (Blinder, 2006)[12]. This poses new problems for economists given the heterogeneous mix of skilled and unskilled labour embodied in tasks and makes the distributional implications harder to predict. Baldwin and Robert-Nicoud (2010) then argued that the new paradigm could be incorporated into mainstream trade theory by considering offshoring as a productivity gain achieved through technological change ("factor specific technical progress" Baldwin and Robert-Nicoud 2010 p.5). This would suggest that current trade theory may not be as ill equipped to deal with this process as initially thought[13].

This new literature seems to have gone full circle leaving us where we started. At one level there is little need for a paradigm shift because trade in intermediate goods, or trade in tasks, is like any other form of trade, although the ability to outsource parts of a production process does potentially enlarge the scale of the tradable sector. These new modes of production are also likely to greatly increase the complexity of international transactions (Baldwin, 2011). But there is a point that is rarely remarked on. Vertical specialisation involves trade in *complementary* goods. Most of the traditional micro theory of trade works because goods are more or less close substitutes but when we have trade in intermediates we are in a world of

[12] Levy and Murnane (2003) propose distinctions along the lines of routine and non-routine tasks. Where these distinctions are not without consequence for important Balassa-Samuelson type effects (i.e. wage (productivity) differentials across types of goods; traded/non-traded, personal/impersonal and routine/non-routine).

[13] It is possible to argue that the insights of the theoretical models remain relevant but that the unit of analysis is changing.

complementarity where price effects can have unusual consequences. If the price of Chinese intermediates falls, this could make producers of final goods more rather than less competitive, until the point where a flip occurs and final production relocates. On the other hand what is good for final producers may be bad for intermediate producers, recalling tensions between spinners and weavers in Smith's time.

A short and sharp paper by Samuelson (2001) highlights the positive implications of complementary trade arising from a rudimentary Ricardian model[14]. He shows that the traditional gains from trade can be greatly enhanced through specialisation when countries can use each others' produce as inputs. His numerically simple example sees specialisation in one country leading to enhanced production possibilities in the other and hence that one country's specialisation may induce another's. Therefore, if products can be used in conjunction with other products to produce output, specialisation leads to a sizeable expansion in the production possibility frontier[15]. This then delivers increased welfare gains, compared to a scenario where trade only occurs in final products, for countries involved in such specialisation. Empirical evidence of complementary trade can be found in the work of Coulibaly (2008) and Bas and Strauss-Kahn (2011). The former identifies a cross-country link between imports of intermediate products and exports[16] whereas the latter provide evidence of similar links for a more focused study of French firms[17].

1.3. TRADE AGREEMENTS AND VERTICAL SPECIALISATION

The presence of complementary trade may have important implications for trade policy. It means that tariff barriers to trade, and indeed non-tariff barriers to trade, may increasingly act as production taxes rather than as intended protectionist measures. As more and more products become intermediate inputs into a productive

[14] It is Ricardian even in the products that Samuelson uses to explain complementary trade (wine and cloth).
[15] Somewhat analogous to a technological efficiency enhancing change much like that of Baldwin and Robert-Nicoud (2010).
[16] It provides evidence of Granger causality with threshold effects.
[17] The study suggests that gains can arise through the extensive margin of exports and also that the origin of intermediate products seems to matter where more specialised inputs, originating from richer countries, may impact export flows to a greater degree.

process, through the growth in vertically specialised modes of production, old tariff systems that have not adapted to new conditions may penalise production. This is well understood through the effective rate of protection logic which suggests that tariffs on intermediate products can act as taxes on production[18]. Hence, as countries become more vertically specialised, tensions between the gains and losses from trade for consumers and producers may fall so that support for protectionism may also weaken. New channels through which trade policy can shape the spread of production may then arise. However, the welfare implications of preferential liberalisation may become harder to grasp.

1.3.1. Shallow Integration Effects

Trade creation may be defined as a switch in the supply of products from less efficient domestic sources to more efficient foreign ones as a result of liberalisation[19]. Because the process of international fragmentation involves a similar replacement of domestic inputs by foreign ones, then international outsourcing is likely to be trade creating and hence deliver similar positive welfare gains. However, if processes of production are already fragmented internationally, and sources of inputs switch across different foreign suppliers as a result of preferential liberalisation, then trade diversion is likely to arise. Understanding the welfare implications of such a switch may be harder.

The traditional trade creation and trade diversion dichotomy is expected to be less clear cut in the presence of vertically specialised trade (WTO 2011). Because such international modes of production involve both an import and an export element then there is a possibility of there being trade creation and diversion at either end of a value chain (input or output). Moreover, if there are complementarities in trade, then trade creation on the input side may lead to trade creation on the export side which may lead to complex feedback mechanisms[20].

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[18] See Kasahara and Lapham (2006) for a theoretical appraisal of this.

[19] Note that trade creation can also arise when countries import more intermediate products from the most efficient producers of these.

[20] For example, if Mexican firms are able to become more competitive by importing cheaper intermediates from the US as a result of NAFTA (through a reduction in input costs), then this competitive boost may give rise to a greater demand for Mexican products in other countries. If these products consequently become a cheaper source of intermediates for the US too, then this may spur further trade creation.

In parallel, trade diversion on the input side may have unusual trade creating effects on the output side. Preferential liberalisation may lead to efficiency gains in the export industry if the prices of intermediates are reduced as a result, and this can arise even when this is the result of trade diversion. Consider 3 countries A, B and C. Country A imposes an MFN tariff on all imports and currently sources all of its intermediates from country C to produce exports to all destinations. This suggests that C is the most efficient producer of these intermediates. Signing a trade agreement with country B, despite this country not being the most efficient producer of the inputs, then induces a source-switching trade diversion effect whereby Country A passes to import all its intermediates from B[21]. Because these intermediate imports are now cheaper than before, as a result of the preferential reduction in the tariff, country A may achieve a gain in efficiency in the production of its exports through a reduction in the cost of its inputs[22]. If this gain in efficiency is larger than the loss of tariff revenue, then the agreement could be welfare enhancing even though there has been no direct trade creation[23]. Furthermore, if this efficiency gain results in the reduction of the price of country A's exported product, this might, in turn, spur further fragmentation (trade creation or diversion).

But there may be an associated cost to this. Under vertically specialised trade, having access to cheaper, but not the cheapest, intermediate goods may generate an opportunity cost which can translate into a loss in global competitiveness in other export markets. Hence although firms gain from a cheaper price for the intermediate products, the price of these may still be higher than those set by the most competitive producer outside the FTA. This means that an identical vertically specialised exporting firm, in a nation that has embraced unilateral liberalisation, may have a

[21] Again it is implicit that country A does not produce any of these and hence there is no trade creation from this agreement.

[22] This presumes that there will be a reduction in the price of the intermediate product which would be consistent in a perfectly competitive world. The gain in efficiency arises because keeping the production function unchanged, country A can now produce more output with the same amount of inputs. Alternatively under other assumptions about the competitive setting (monopolistic or indeed oligopolistic) the firm in country A can also increase profits but this case is not considered at this stage.

[23] A preferential agreement can reduce the implicit export tax that arises from levying tariffs on intermediate products. Although this can result in trade diversion, the removal of the distortion created by the high MFN may result in the partner's price approaching the world price and hence gains can arise for domestic producers.

cost advantage in a third market over the exact same firm in a nation with an FTA[24]. The FTA may then have 'penalised' the competitiveness of the export industry in third markets.

This example illustrates the complexities that arise in capturing the welfare implications of trade agreements in the presence of vertically specialised trade. Moreover, it may also help provide an understanding of some empirical observations on how countries tackle their liberalisation strategies. Mexico, for instance, is heavily engaged in vertical specialisation with respect to the US[25]. It can be argued that this fragmentation has come to pass through the effects of closer integration associated to the creation of NAFTA. However, once Mexico secured its market access into the US, it has been seen to more fully embrace MFN liberalisation[26]. This could be in an effort to capture cheaper intermediates from China and therefore enhance its competitiveness in the US or indeed the world market. Because trade diversion can lead to opportunity costs that may result in a loss of competitiveness in export markets, engagement in value chain activity can change the liberalisation incentives, or the political economy forces that motivate these, in complex ways too[27]. Although the optimal policy that mitigates the aforementioned possible losses in competitiveness in export markets is one that pursues unilateral (multilateral) liberalisation, it may only be optimal when the tariff faced by the exporting industry is the same across destinations. This is to say that a cost disadvantage can be mitigated by a preference in a particular market.

Adding to the increased complexity that the traditional trade creation and diversion effects are expected to display in the presence of vertically specialised trade is the role of 'magnification' in this process (Yi 2003). The bilateral reduction in tariffs across preferential partners is likely to amplify the trade creating and diverting forces at play which may then promote a further spread of vertical specialisation across preferential partners. If economies of scale also play a role in this process, the expansion of markets, achieved through preferential liberalisation, could yield

[24] Assuming that neither of them have an FTA with this third country.
[25] Evidence of this is shown in subsequent sections.
[26] Mexico's weighted average MFN tariff declined from 11.4 in 1995 to 5.6 in 2010 whilst its weighted bound tariff remained largely unchanged at around 35% (data from Trains). Its unweighted MFN tariffs also declined but by a little less.
[27] This is the subject of the final essay of this thesis.

additional gains. It may increase the probability of finding 'ideal varieties' (Luthje 2001 and 2003) and encourage a further division of labour (Burda and Dluhosch 2002). The link between vertical specialisation and regionalism may be more far reaching if VS plays a role in productivity growth as suggested in Baldwin and Robert-Nicoud (2010) and Arndt (2002)[28].

However the propagation of value chain activity may also depend on the depth of integration achieved within a preferential area[29]. This is because such activity is likely to demand considerable coordinating efforts so as to ensure that a sub-standard quality of inputs, in a particular stage of production, does not hold the entire value chain production to ransom. Furthermore, upholding the rule of law so that contracts can be enforced between buyers and sellers should also become increasingly important. Value chain activity may operate best in more integrated markets where default uncertainties and transaction costs are low. The recent world trade report argues that "In order for cross-border production networks to operate smoothly, certain national policies need to be harmonized across jurisdictions. This generates a demand for deep forms of integration" (WTO, 2011:p.112).

1.3.2. Deep Integration and Vertical Specialisation

The role of deep integration in promoting vertical specialisation may be analogous to recreating the pre-conditions that motivated the division of labour in Adam Smith's pin factory. The establishment of a *common working space* where workers could interact in the process of producing a final good may have provided the necessary and sufficient conditions for specialisation[30]. This initial separation of production across processes within a factory was later followed by an unbundling where the division of labour unpacked the factories across domestic economic spaces. This process may then have been facilitated by the common sets of laws that govern interactions within a country. This then suggests that this new unbundling, or the

[28] In addition, the literature on heterogeneous firms developed by Melitz (2003) and extended by Helpman and Yeaple, 2004 and Antras and Helpman (2004) may provide further supportive evidence of such links.

[29] And, although not mentioned explicitly, on the degree to which FTAs can adjust Rules of Origin (RoO) to cater for such production processes. A particularly interesting avenue for future research is how the increased spread of international value added is affected by the presence of restrictive rules of origin or how 'cummulation' can be used to encourage regional modes of production.

[30] And also a manageable space in which to track the quality of each sequence of production.

division of labour across international borders, could be tied to the depth of the regulatory provisions that are created between countries[31]. Or to the set of policies that create 'thick' markets (Leijonhufvud 2007) across national borders[32].

Broadly speaking deep integration can play an important role in the propagation of international fragmentation through two key channels[33]. The first is via the provision of minimum standards that enable the identification of the quality of inputs and the second through mechanisms that enforce the rule of law that governs contractual obligations between buyers and sellers. Whilst deeper integration through the first channel can be achieved by means of private or public involvement, the second channel is likely to be the remit of public institutions and their efforts in creating an appropriate rules-based system of enforcement mechanism across international borders.

Standardisation can be achieved through public policy coordination or through the creation of mandatory private standards or quality controls for products circulating across a value chain[34]. It can act as a facilitator of trade, as well as a barrier to trade, and can be drawn up nationally, regionally and multilaterally[35]. In a world of imperfect and asymmetric information and considerable transaction costs, standards provide information on the quality of inputs[36]. If buyers face costs in assessing the quality of inputs and these are increasing in the degree of fragmentation, then standards can create important positive externalities that facilitate the flow of inputs and reduce the incidence of failures that could jeopardise the entire production of the value chain.

[31] The term unbundling is used somewhat differently here than in Baldwin (2006a).
[32] The creation of such markets is, in part, a transposition of Coase's Theorem to value chain interactions where recognising the existence of both positive and negative externalities affecting transaction costs suggests that contractual arrangements matter and may indeed be preferable to arms length dealings.
[33] This section draws heavily from a co-authored working paper of this essay in Lopez Gonzalez and Holmes (2011). It paraphrases some of the key aspects of the links between VS and deep integration that were highlighted by Peter Holmes in this working paper.
[34] The contrasting evidence of the paths of integration between East Asia and the EU are examples of how private and public policy can be substitutes in the formation of area wide standards. A discussion of which is more efficient is well beyond the scope of this essay.
[35] The term 'standard' is used loosely here and refers to the process of setting technical standards or certification procedures.
[36] In a world of perfect information and no transactions costs, standards should not be necessary.

The extensive literature on transactions costs (see Williamson, 1975) argues that overcoming these costs can be accomplished through the internalisation of economic activity. Hence a 'factory system' emerges where ownership is maintained within a parent firm and in close proximity so that quality controls, at each step of the production process, can be monitored. However, new developments in information technology systems and management structures may revitalise the subcontracting and outsourcing relationship by making quality controls easier to implement at lower costs. This may then lead to further outsourcing which can motivate 'niche' specialisation in finer segments of production and benefit from economies of scale and learning by doing gains. Such privately led standardisation seems to be characteristics of the East Asian experience where institutions appear to have initially taken a laissez-faire attitude to regional economic integration. However as specialisation unfolds, new mechanisms for the enforcement of contracts between upstream and downstream producers may become increasingly pressing, as a consequence, the demand for a greater involvement of public institutions should rise. This might explain the recent surge in new and deeper agreements in East Asia (WTO, 2011).

The new theoretical literature on offshoring in the presence of incomplete contracts (Antras and Staiger, 2011) highlights a similar link. It argues that an inefficient allocation of economic activity arises due to the presence of incomplete contracts. A 'hold-up' occurs when asymmetric information induces sunk searching costs between buyers and sellers and contractual obligations may be reneged on. This strand of literature (see also Ornelas and Turner, 2008) suggests that regulatory quality, across preferential areas, could be an important factor in the propagation of international value chains. This could help explain why new trade agreements appear to negotiate provisions beyond reductions in tariff schedules such as competitions policy, investment and intellectual property rights (see Baldwin, 2011).

1.3.3. Related Empirical Literature

Empirical investigations into the impact of FTAs on vertical specialisation are far and few between. This is because the empirical literature has struggled to disentangle vertical specialisation across bilateral partners. One notable attempt at capturing the spread of fragmentation within FTAs is that of Daudin et al (2008). They develop a method for identifying the origin of *value-added trade* and compute intra and extra regional value-added trade aggregates[37]. They track domestic value added through stages of processing in different countries and show that 56% of the EU's value-added trade comes from other EU partners. For the Americas and Asia the intra regional figures stand at 44% and 34% respectively. Whilst the study offers an innovative approach for disentangling the location of value added, it does not focus on vertical specialisation per se and hence does not look at either the determinants of this type of trade or the link between vertical specialisation and trade agreements. A recent paper by Johnson and Noguera (2011) also attempts to disentangle value added trade to track its spread across bilateral origins and destinations. To do so they compile a world input-output table which allows them to capture the indirect use of domestic value added embodied in exports produced by other countries. However, this paper does not look at the spread of production across preferential partners[38]. Rather, it is concerned with exposing how bilateral trade balances, such as that between the US and China, are very different when one considers indirect exports (or the US value added embodied in Chinese imports that is then embodied in Chinese exports to the US). Most saliently, they show that the current trade balance between the US and China is 30% lower that gross trade figures suggest because China imports high US value added products from Japan and Korea.

Nordas (2004) provides one of the first empirical studies on the determinants of *aggregate* vertical specialisation. This paper suggests that economically small countries with high per capita GDP and low tariffs tend to exhibit higher levels of vertical specialisation. It suggests that infrastructure variables such as telephone density and port efficiency may be key drivers of vertical specialisation. These variables act as proxies for delivery times and rates of fault which have been identified as important in the value chain literature. This, in turn, suggests that the 'thickness' of the market could play a decisive role in vertical specialisation recalling Leijonhufvud's (2007) claims. However Nordas' investigation is also not extended to

[37] Value added trade is measured as the amount by which a good has increased in value while passing through a specific process in a country.
[38] Some of the key differences between the strategies used in these papers to track value added trade and those proposed in this essay are discussed in subsequent sections.

the role of FTAs in the propagation of VS as the indicator used does not disentangle bilateral flows of vertically specialised trade.

Hence there appears to be a gap in the empirical literature treating the role of trade agreements on vertical specialisation. These processes are likely to be interrelated in complex ways where causation may run from increased integration of bilateral value chains to trade agreements or from trade agreements to increased bilateral vertical specialisation. An appropriate econometric setting will be needed to disentangle these issues where the work of Baier and Bergstrand (2007), on the impact of FTAs on final goods trade, and that of Baier and Bergstrand (2004) on the determinants of FTAs is likely to be key due to the possible endogeneity of these processes. But before turning to more sophisticated econometric analysis, as is done in subsequent essays of this thesis, the first hurdle, and a key objective of this essay, is to identify ways of capturing vertical specialisation across bilateral partners.

1.4. CAPTURING VERTICAL SPECIALISATION

In practice, vertical specialisation has proven to be a difficult phenomenon to measure. This is because, without prior knowledge of production processes, the *identification* of what constitutes an intermediate product is not straightforward. Adding to this, the 'double counting' of trade, arising from the gross valuation of trade flows at each border crossing, may make the evaluation of its spread even trickier[39]. This section focuses on the challenges and implications of these issues. A more detailed discussion of other indicators that can be, or have been, used to capture this phenomenon is left for the appendix A1.1.

1.4.1. IDENTIFICATION AND VALUATION PROBLEMS IN TRADE BASED MEASURES

Many empirical studies have used trade based measures to capture vertical specialisation (see for example Feenstra 1998; Yeats 2001; Egger and Egger 2005; and Gasiorek et al., 2010). This is because trade data is widely available and affords

[39] See Daudin et al. (2008) and Johnson and Noguera (2011) for a wider discussion of the implications of double counted trade.

a very detailed geographical and temporal coverage of trading structures. Commonly, intermediate goods are identified through the United Nation's Broad Economic Categories (BEC) classification. It delineates, at a fairly disaggregate level (i.e. up to 6-digits), products according to supposed end-use from which it is possible to identify intermediate goods. However the identification of intermediate goods is not always straightforward and hence such classifications may be arbitrary (Hummels et al., 2001[40]). Products can often act as both intermediates and final goods implying that they may not be exclusive to one particular end-use. For example, milk can serve both as a final product, or alternatively as an intermediate input into the production of dairy produce such as yogurts. Similarly a tyre can be a final good in some uses, such as a replacement tyre, or an intermediate when it is used as an input into the production of a car. Hence classifications that list intermediate products, such as the BEC nomenclature, could be inaccurate in capturing the true extent of vertical specialisation since they do not differentiate across final use.

Valuation issues may also arise from the way that national trade statistics are computed. Traditionally these track the entire value of a product, and not the value added, at each border crossing. This implies that, in a world where fragmentation is rife and value added is being carried out in many different locations, 'double counting' of a good's value is likely to occur (see Johnson and Noguera, 2011). A simple example illustrates this. Consider a final product that is sequentially produced in the US and Mexico. The sequence of production is one where the US exports an intermediate good that then undergoes a series of transformations in Mexico and is then re-imported for final consumption[41].The value of the intermediate good originating in the US is of $2 and the value added in Mexico is of $1. The total value of net trade between the US and Mexico should then be $1 (the value added performed by Mexico on the intermediate product that the US exported to Mexico). However, trade statistics will inflate the actual value of trade by capturing the $2 value of exit of the product from the US to Mexico and then the re-import of the product at $3 dollars (The US' intermediate product, $2, plus Mexico's value added

[40] "Data on intermediate goods trade could be examined, but this would require relying on rather arbitrary classifications of goods into intermediate and final" (Hummels et al., 2001:p76).
[41] This type of production sequence is representative of maquiladora trade.

of $1). The gross value of trade between these two countries, as captured by the trade statistics, is then $5.

This valuation problem has recently received growing attention, most notably at the WTO by Pascal Lamy (2010) who is now pushing for a change in the way national trade statistics are computed towards a 'value added' method[42]. However the direct implications of undertaking empirical analysis on the basis of gross instead of net flows, as has been the tradition, is uncertain. To a large extent, gross trade flows can be deceptive in the attribution of comparative advantages as suggested in Koopman and Wei (2012). A country may be seen as having a comparative advantage in high tech products when in fact its advantage is only in the final assembly stage of this product[43]. Moreover, gross trade valuations will distort actual bilateral trade deficits as shown in Johnson and Noguera (2011). But the implications of using one type rather than another in empirical economic models, such as the gravity model, are still not well understood[44].

Trade-based measures of fragmentation may also be problematic since they do not allow one to differentiate across the use that is given to intermediate products. This may be towards the production of final goods for the domestic market or for further processing in another country. This latter form of production may be more representative of value chain activity and firms engaged in such modes of production may be 'different' to those engaged in supplying the domestic market as Bas and Strauss-Kahn (2011) highlight[45]. Trade based measures of VS cannot be used to differentiate across the use given to intermediates because trade classifications do not provide information on inter and intra industry linkages within countries. However, indicators based on I-O tables do capture such linkages and hence may provide more accurate measures of value chain activity. They may also bypass identification issues and offer a benchmark against which to compare the precision of these trade based measures.

[42] See Daudin et al (2008) and Johnson and Noguera (2011).
[43] Think of iPads being produced in China when the hi tech comparative advantage is held in the US
[44] Some insights into the implications of using these types of flows in an econometric specification can be found in Appendix A2.1.
[45] This literature argues that firms that are engaged in export markets tend to be more productive than those that are engaged in selling to the domestic market.

1.4.2. *INPUT OUTPUT BASED MEASURES*

Input-Output (IO) based measures of vertical specialisation have gained prominence. Hummels et al. (2001) propose a Vertical Specialisation Indicator (VSI) which captures the share of foreign value added embodied in exports. The VSI is identified when a country imports products which it then uses in some productive process to export. Because this indicator does not include imported intermediates used in the production of output destined for home consumption it is an indicator of *international interconnectedness* via production chains. It captures the *backward linkage* of a country with respect to the world through the use of inter and intra industry production connections which should make it a more precise measure of value chain activity.

However this precision comes at the expense of breadth of coverage. The calculation of the indicator hinges on the availability of input-output tables which tend to be obtainable only for a selection of more developed countries. Moreover, these generally have a limited temporal coverage and the relatively low level of disaggregation can hide important sub-sector specific linkages. Nevertheless, its ability to capture the interplay between foreign and domestic value added make it an invaluable tool in analysing the surge in vertically specialised trade[46]. However the VSI, as it stands, is unable to differentiate across the origin and destination of trade flows and hence it does not lend itself to the analysis of the spread of vertical specialisation across preferential partners.

The recent papers of Daudin et al. (2008); Koopman et al. (2011); and Johnson and Noguera (2011) provide important advances in disentangling the location of value added. Using I-O tables merged with trade data the latter attempt to capture the *value added content of gross exports* (the VAX ratio). This measure represents the inverse of the VSI (the import content of exports) since it focuses on the domestic rather than the foreign value added component of exports. It also goes one step further by taking into consideration the domestic content of re-imports. Its calculation hinges on a *proportionality assumption* through which the use of imported intermediates across

[46] In the discussion of Table 1.1 we argue how grasping the spread of vertical specialisation may hinge on tracking the location of value added.

domestic and foreign sources is distributed. This assumption sees domestic and imported inputs as being used in fixed proportions across all origins. If country A requires 0.5 units of inputs to produce one unit of output, then it will source inputs in this proportion from any origin, whether domestic or imported. The proportionality assumption is also extended to the destination of output where technologies used to produce domestic and foreign output (exports) are also assumed to be the same (although Koopman et al., 2008 relax this assumption).

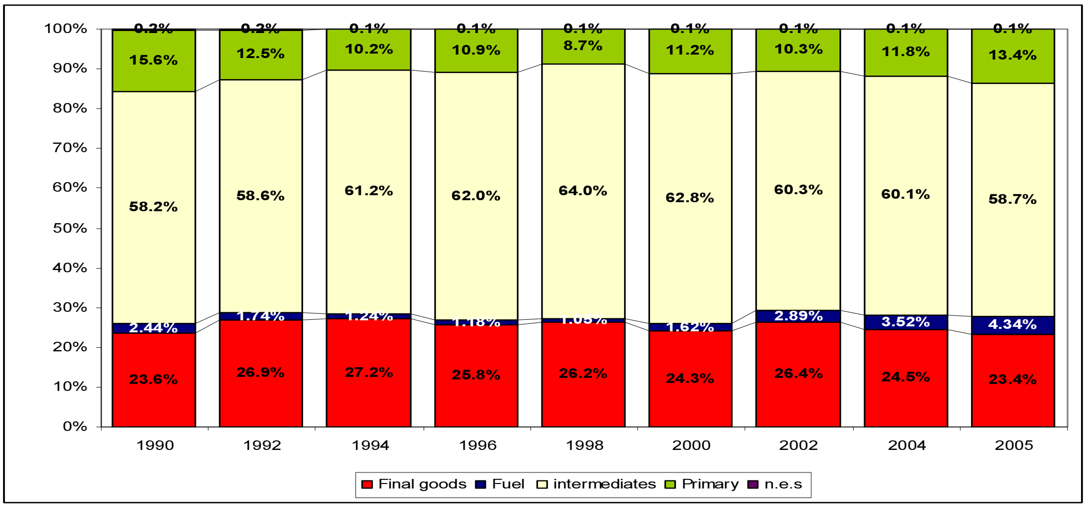
This set of assumptions is common in the IO literature (see Johnson and Noguera, 2011 for a wider discussion), they result in a strong shortcoming that arises from the use of IO tables for the calculation of such measures. This is that the indicators are computed rather than observed measures. Although the implications of relying on these assumptions are hard to pinpoint, as they will depend on how different the actual use of intermediates is across origins, these measures provide a strong asset in tracking the spread of production.

1.4.3. Comparing Input-Output and Trade Data

Capturing the extent and spread of vertical specialisation is challenging because, as anticipated, products can often act as both final and intermediate goods hence it is instructive to look at what we learn from using different methods to identify the extent of intermediate goods trade. One tends to assume that the rise in vertically specialised trade should lead to a rising share of intermediate imports over total imports[47]. However, looking at the evolution of world trade, in Figure 1.2, shows little change in the underlying trends[48]. This contrasts with the perceived notion that the last decades have witnessed a rise in vertical specialisation and may suggest that the BEC nomenclature is an imperfect identifier of this phenomenon. Alternatively it may imply that tracking intermediate goods trade is not an appropriate metric for capturing international production[49].

[47] see Feenstra (1998) and Yeats (2001).
[48] Similar results are found in Hummels et al. (2001), OECD (2010) and Chen et al. (2005).
[49] There are important price effects taking place. Prices have fallen substantially for intermediate goods in the last decades. This is an important issue and comes as a corollary to our hypothesis. The allocative effect of VS would suggest that intermediates will be produced where they become cheapest, hence there will be a generalised reduction in their price. This is not captured in the figure as we are dealing with nominal trade flows. If the price of intermediates has fallen faster than the price of final goods, we will not capture much change in intermediate trade patterns even if the volume of

Figure 1.2: Evolution of world imports by use



Source: Author's calculations, WITS- COMTRADE

In an effort to elucidate two separate but related issues; firstly the (true) extent of vertical specialisation and secondly to see how well the BEC nomenclature is able to identify vertical specialisation, it is possible to look at I-O tables and draw preliminary observations on the levels and evolution of intermediate goods trade. Comparing the evolution of the IO identified intermediates to those identified using the BEC nomenclature should provide some insights into how well this classification captures international fragmentation.

The OECD STAN database provides sectorally harmonised I-O tables for 42 countries. These are divided into domestic intermediates and imported intermediates at three points in time (circa 1995, 2000 and 2005)[50]. In order to draw preliminary observations on the spread and evolution of imported intermediates an aggregate OECDX table is created by summing up all individual IO tables[51]. This allows one to bypass trade classifications and identify the value of world intermediate goods trade

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these has increased. Irrespective of these price changes, the figure suggests that using trade data alone to track the process of vertical specialisation may be misleading.

[50] The time delimitation of the tables is not as clear cut as presented given that some countries report slightly different years or do not report in a given year. For these countries, we assume that the values reported are similar to those reported in earlier years where there might be a one-two year gap.

[51] The tables are in national currency and at producer prices, hence these are transformed into Dollars using exchange rates extracted from the Penn World Tables. The countries in the sample account for over 80% of World trade in 2008. The 42 countries are 1) OECD: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States. 2) +12: Argentina, Brazil, Chile, China, Estonia, India, Indonesia, Israel, Romania, Russia, Slovenia, Taiwan, South Africa.

by the ‘actual’ use of these in the economy rather than by ‘suggested’ end use as in the BEC classification. Panel (A) of Table 1.1 shows the evolution of imported intermediates for this OECDX aggregate during the three periods above delimited. It also shows the evolution of the use of domestic intermediates; total output; domestically consumed output; total exports and domestic value added. The final two panels (B and C) serve the purpose of comparing the identification of non-service sector intermediate goods across the I-O data (B) against those identified through the BEC nomenclature (C)[52]. This will give insights into how well the BEC nomenclature performs at this task.

The input-output data reveal that, for the OECDX aggregate, the share of intermediate imports to total exports has been increasing over time; however, the share of intermediate imports to total imports has witnessed a slight decrease[53]. In parallel, the share of intermediate imports in total or domestic output remains low. It has nevertheless witnessed increases which seem to be driven by the faster rise in imports than in output. The marked increase in the share of imported intermediates to domestic intermediates may be indicative of a source switching trend which is corroborated by the increase in imported intermediates as a share of domestic value added (which has increased by 24% in ten years). These trends lend themselves to the idea that vertical specialisation is not necessarily an additive process equating to increases in intermediate goods trade, but rather one where domestic value added is being substituted by foreign value added (corroborated by the decline in domestic value added over total output). This observation is not without consequence. Firstly it may be evidence of *true* gains from trade, where production is following comparative advantages and the world economy is becoming more efficient in allocation. Secondly, and following from the first point, this may be presenting developing countries with new opportunities to engage in value chain activity; and thirdly it may also mean that distributional concerns in the developed world may not be unfounded.

[52] For the same OECDX aggregate.
[53] Recall that this table is an OECD aggregate and hence does not represent a closed system where imports equal exports.

Turning to the trade figures, identified through the BEC nomenclature in the final panel of Table 1.1, a similar pattern emerges. The share of imported intermediates over total imports is declining. It also seems that the evolution of intermediate imports, as identified using the BEC nomenclature (C), follows a similar path to that found using the I-O data (B). Whilst it seems that the BEC nomenclature understates the 'true' value of intermediate imports, it appears to do so equally for the value of total imports, hence the share of intermediate imports to total imports are comparable across the two identification methods. This in turn could suggest that the BEC nomenclature may not be a bad identifier of intermediate goods trade[54].

Table 1.1: Evolution of Intermediate Imports

		1995	2000	2005	Change
I-O Tables (A)	Intermediate Imports	3428615	3689957	5916942	72.60%
	Total Imports	5382318	5999260	9404367	74.70%
	Domestic Intermediates	21770966	22900801	31787329	46.00%
	Total Output	52610565	54516731	75799556	44.10%
	Total Exports	5394328	5859587	9140678	69.40%
	Domestic Value Added	27050084	27133761	37404913	38.30%
	Int Imps/Tot Exps	0.636	0.63	0.647	1.80%
	Int Imps/ Tot Imps	0.637	0.615	0.629	-1.20%
	Int Imps/ Tot Output	0.065	0.068	0.078	19.80%
	Int Imps/ Dom Output	0.073	0.076	0.089	22.20%
	Int Imps/ Dom Ints	0.157	0.161	0.186	18.20%
	Int Imps/ Dom VA	0.127	0.136	0.158	24.80%
	Dom VA/ Tot Output	0.514	0.498	0.493	-4.00%
I-O Tables (less Services) (B)	Intermediate Imports	2883820	3162342	5022251	74.15%
	Total Imports	4759419	5282321	9191093	93.11%
	Total Exports	4243046	4500627	6889849	62.38%
	Int Imps/ Tot Imps	0.605919	0.598665	0.546426	-9.82%
	Int Imps/ Tot Exps	0.679658	0.702645	0.728935	7.25%
Comtrade (C)	Intermediate Imports	2413416	3223762	4873073	101.90%
	Total Imports	3889375	5227267	8423249	116.60%
	Total Exports	3855838	4916457	7921085	105.40%
	Int Imps/ Tot Imps	0.621	0.617	0.579	-6.80%
	Int Imps/ Tot Exps	0.626	0.656	0.615	3.90%

Source: Own calculations from OECD I-O STAN database and Comtrade. Values are in million $

Whilst it is important to note that the above analysis hides country and sector specific effects in its aggregate representation, it nonetheless poses an important question on the possible erroneous perception of vertical specialisation. It underlines the importance of carefully defining the phenomenon before proceeding with a more detailed analysis of its role amongst preferential partners. As a starting point, the

[54] This statement has to be read with caution as the underlying trade and output data come from different sources and are subject to different collection techniques and/or estimations.

above table shows that foreign value added has outgrown domestic value added by a factor of 2. This can be seen by comparing the change in domestic value added to that of intermediate imports (panel A) and also by the rise in the share of intermediate imports to domestic VA which, even if averaging 16% in 2005, has grown by 25% in a decade. This implies that, in looking at the spread of production, a greater focus should be placed on the location of value added rather than on the movement of intermediate goods across borders. This may be accomplished by looking at an indicator of vertical specialisation.

1.4.4. THE VERTICAL SPECIALISATION INDICATOR

The vertical specialisation indicator, as defined in Hummels et al. (2001), captures a sequence of production that sees a good being produced in at least two stages involving at least two countries where value is added to imported intermediates and the resulting output is exported. The value of the direct import content of exports for country i in sector k is defined by Hummels et al. (2001) as:

$$VS_{ik} = \left[\frac{imports\ of\ intermediates_{ik}}{gross\ output_{ik}}\right].exports_{ik} \tag{1.1}$$

The sum of these sectoral values gives the aggregate measure of the value of imported intermediates used to produce exports which can be calculated using input-output tables as follows:

$$\sum_k VS_{ik} = \sum_k \left[\frac{imports\ of\ intermediates_{ik}}{gross\ output_{ik}}\right].exports_{ik} = \mu A^M X \tag{1.2}$$

Where μ is a *1 x s* summation vector of 1's, A^M is an *s x s* technical coefficient matrix with elements $a_{n,m}$ (n=m) capturing the share of imported intermediates from sector n used by sector m needed to produce one unit of output and X is an *s x 1* vector of exports. Hummels et al. (2001) presents these values as a share of total exports so that:

$$\frac{VS_i}{X_i} = \frac{\sum_K VS_{ik}}{\sum_K X_{ik}} = \mu A^M X/X_i$$

(1.3)

Here X_i is a scalar representing the sum of country i exports. This expression captures the *direct* import content of exports (expressed as the share of intermediate imports over total exports) but it does not reflect how imported intermediates are used *indirectly* throughout the economy. To capture the indirect use of imported intermediates at different stages of domestic production, before these are embodied in an export flow, Hummels et al. (2001) introduce the Leontief inverse matrix ($[I-A^D]^{-1}$ to the above expression. Here A^D is an *s x s* domestic technical coefficient matrix which reflects the value of domestic intermediates over total output (rather than imported intermediates as was the case in the A^M matrix). The Leontief inverse captures the use of imported intermediates across each stage of domestic production[55]. Hummels et al.'s (2001) vertical specialisation indicator is then:

$$VSI = \mu A^M [I - A^D]^{-1} X/X_i$$

(1.4)

As the vertical specialisation indicator captures the content of intermediate imports embodied in exports and not in final output, it is a measure of *interconnectedness* with respect to the world. It is effectively *the amount of imported intermediates needed to satisfy a given export demand vector at current technologies*. Hummels et al. (2001) underline the importance, in recent decades, of this type of trade. They show that, for the period 1970 to 1990, 30% of the growth of 10 OECD countries' exports is explained by this type of trade. Yi (2003) then suggests that vertical specialisation accounts for 50% of growth of OECD exports. However this measure is not bilateral, and hence, in its current form, it is unable to capture the possible links between vertical specialisation and preferential trade[56].

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[55] Equation (1.4) gives the sum of all VS indices by I-O sector. To get the sectoral VS one can remove the vector of 1's represented by μ and diagonalise the export vector.

[56] Recently, measures of bilateral value-added trade (Daudin et al., 2008; Koopman et al., 2010; and Johnson and Noguera, 2011) have emerged. These rely on a similar technique to that proposed in the following section and can also be used to track production sharing. These measures were developed as this essay was being finalised, they are used to look at trade imbalances across countries and in particular to highlight differences between gross and net trade flows in a world with increased fragmentation of production. They identify the domestic value-added content of exports which is the inverse of the foreign value added of exports that is identified in the measures proposed by Hummels et al. (2001). Nevertheless there is still plenty that can be learned from the construction of a bilateral

1.5. AUGMENTING THE VERTICAL SPECIALISATION INDICATOR

Adding a bilateral dimension to the VSI is problematic in terms of data requirements but not in terms of method. It can be done by following Hummels et al.'s (2001) original equation (1.4) and changing the export vector and the imported technical coefficient matrix so that these reflect bilateral rather than aggregate flows. The problem is that the bilateral element of the A^m matrix is not observed and has to be constructed. This can be done by combining readily available trade data with the technical coefficients of the aggregate import matrix using a proportionality assumption to create an intermediate technical coefficient matrix by origin country[57].

1.5.1. THE INTERMEDIATE TECHNICAL COEFFICIENT MATRIX BY ORIGIN COUNTRY

To identify imported intermediate inputs by origin one can exploit the information contained in I-O tables that describe the linear interlinkages between sectors within an economy[58]. Consider the reduced I-O imported intermediate square matrix M that is presented below:

	Agriculture	Industry	Services	total imports
Agriculture	IM_{11}	IM_{12}	IM_{13}	TM_1
Industry	IM_{21}	IM_{22}	IM_{23}	TM_2
Services	IM_{31}	IM_{32}	IM_{33}	TM_3
Total Output	Z_1	Z_2	Z_3	

Here IM_{11}, represents the value of imported intermediates used by the domestic agricultural sector from the foreign agricultural sector in the production of output.

measure of vertical specialisation. In particular from the decomposition of this measure into backward and forward linkages.

[57] Different identification strategies are used in the literature. Johnson and Noguera (2011) rely on the proportionality assumption and assume that imports are used in the same proportion as domestic inputs. They post multiply the IO matrices by imports to obtain a bilateral imported intermediate matrix. Koopman et al. (2010) use the BEC nomenclature.

[58] Different identification strategies to capture the amount of imported intermediates by origin country were attempted. One of these used BEC identified products matched to the I-O classification in a similar framework as Koopman et al. (2010). However the match between I-O identified global intermediate inputs and BEC identified inputs was relatively imperfect where great differences were the norm rather than the exception.

IM_{12} then shows the value of imported intermediate products from the foreign agricultural sector used by the domestic industrial sector to produce output and so forth. This matrix, M, represents the aggregate use of imported intermediates, by each sector from all *j* countries and is readily observed from I-O tables. It follows that this total import use matrix must be the sum of the individual imported intermediate matrices with each partner; im_j, so that $M=\sum im_j$[59]. In order to calculate the degree of bilateral vertical specialisation one has to construct these unobserved bilateral matrices. This can be done by assuming that countries use intermediate imports from each origin in the same proportion that they use total intermediate imports; or in other words that the technologies used to produce products are the same irrespective of the origin of intermediate products. This *proportionality* assumption is commonly used in the IO literature[60]. To implement it one can calculate a set of coefficients that capture the average use of total imports across each sector by dividing each IM entry in the M matrix by total imports (TM) to produce a P matrix (the reporter country i is omitted from this exposition for presentational purposes):

$$P = \begin{pmatrix} p_{1,1} & \cdots & p_{1,m} \\ \vdots & \ddots & \vdots \\ p_{n,1} & \cdots & p_{n,m} \end{pmatrix} \text{ with elements i defined as: } \quad p_{n,m} = \frac{IM_{n,m}}{TM_n} \tag{1.5}$$

This matrix shows how one unit of total imports from a given sector is used (on average) in production sequences across the different sectors within an economy. By multiplying the *P* matrix, element by element, by a vector of country specific total imports tm_j (*s x 1* vector from country j) one can construct the im_j matrix:

$$im_j = \begin{pmatrix} tm_{1,j}p_{1,1} & \cdots & tm_{1,j}p_{1,m} \\ \vdots & \ddots & \vdots \\ tm_{n,j}p_{n,1} & \cdots & tm_{n,j}p_{n,m} \end{pmatrix} \tag{1.6}$$

[59] im_j is an *s x s* matrix. Each element shows the value of imported intermediates from country j.

[60] In Daudin et al. (2009) it is noted that a similar technique is used in Campa and Goldberg (1997) and Feenstra and Hanson (1997). Johnson and Noguera (2011:p20) note that these “assumptions imply that all variation in total bilateral intermediate and final goods flows arises due to variation in the composition of imports across partners”.

This then enables the computation of an imported intermediate technical coefficient matrix by origin country, A^m_j, through the division of each element of the new im_j matrix by the total output of each sector so that:

$$A_j^m = \begin{pmatrix} a_{1,1} & \cdots & a_{1,m} \\ \vdots & \ddots & \vdots \\ a_{n,1} & \cdots & a_{n,m} \end{pmatrix} \qquad \text{where} \quad a_{n,m} = \frac{tm_{n,j}\, p_{n,m}}{z_m}$$

(1.7)

This matrix captures the amount of imported intermediates, from a given partner, that are needed to produce one unit of output. The elements of this matrix are the technical coefficients which show the amount of imports from a given origin and sector ($tm_{n,j}i_{n,m}$) that are used in proportion to the output of that sector (Z_n). In an I-O framework, these imported intermediates have to be combined with domestic intermediates and domestic value added in order to satisfy a given demand vector[61].

1.5.2. Calculating Bilateral Vertical Specialisation: The Backward Linkage

The bilateral vertical specialisation indicator of country i with country j, VS_B_{ij}, or the backward linkage, can be calculated by combining the bilateral imported intermediate technical coefficient matrix, $A^m_{i,j}$, and the domestic technical coefficients matrix A^D_i with a vector of exports, $X_{i,j}$, through the following equation derived from an extension of Hummels et al. (2001):

$$VS\_B_{i,j} = \mu A_{i,j}^m [I - A_i^D]^{-1} X_{i,j} / X_{i,j}^{TOT}$$

(1.8)

The indicator captures the value of intermediate imports from country j used by country i to produce exports, it is the export weighted average of the sectoral degrees of vertical specialisation and ranges between zero and one. The *s x 1* export vector $X_{i,j}$, and the $X_{i,j}^{TOT}$ scalar which is the sum of this export vector, can reflect either

[61] An issue might arise in the calculation of indicators of vertical specialisation, from the fact that the m_j matrices are a fraction of the aggregate M matrix. If a country does not import, from a given partner, a particular product needed to produce output, then a shortfall in the provision of inputs may arise. It has to be compensated by either using more inputs from the domestic economy or alternatively by increasing the domestic value added. This issue is discussed at greater lengths in the Appendix A1.2.

exports of country i to country j or alternatively exports to the world. The use of world exports will capture the contribution that country j makes, in terms of intermediate imports, to country i's total exports whereas a bilateral export vector will measure the contribution of country j imports to country i's exports to country j. The extension of this indicator enables tracking varying dimensions of vertical specialisation which contrast with the original Hummels et al. (2001) indicator which only traced the backward linkage of a country with respect to the world.

It is important to highlight that this indicator is not a direct observation of actual vertical specialisation but rather a computed measure, or approximation, of the imported intermediate content of output that is needed to satisfy a demand vector. Because I-O tables allow one to capture the amount of domestic and imported intermediates that are required in the production of one unit of output, then it is possible to determine the value of imported intermediates that will be required to produce however many units of output are demanded by any partner country (an export vector).

This bilateral extension is also open to tracking the *forward linkages* of a country with respect to the world. These capture how intermediate exports feed into the production processes of other countries. In addition it provides a way of calculating a fully bilateral indicator that identifies the amount of intermediate goods from a country that are used in servicing that same country's demand for our exports (here the country of origin and destination of the import and export flow is the same). Such bilateral production methods are similar to the division of labour witnessed between the US and Mexico - i.e. maquiladora trade - where the US exports intermediate products to Mexico for assembly and then re-imports the assembled products. The extension made to this indicator also offers the possibility of capturing trilateral relationships between countries or how imports from one country are used to produce exports to a different country. Some of these combinations are summarised below.

		Exports	
		Partner	World
Imports	Partner	Partner intermediate imports used to service partner (e.g. maquiladoras trade)	partner intermediate imports used to produce total exports
	World	total intermediate imports embodied in exports to a given partner	Total intermediate imports used to produce total exports (Hummels et al 2001)

The calculation of this type of indicator hinges on being able to connect trade data by origin/destination to production data which can be easily done for merchandise trade. However complications arise from the absence of comprehensive trade data on services. Non merchandise inputs from the service sector feature heavily in I-O tables. However bilateral trade statistics for these sectors are not readily available which creates an additional hurdle in the calculation of the bilateral VS indicator. This requires making further assumptions about the remaining non-merchandise sectors in the economy. This is because the calculation of the indicator requires that the matrices be invertible (and hence square). To surmount this issue the entries of the bilateral imported intermediate technical coefficient matrix for non-merchandise sectors are assumed to be zero. This implies that the import vector used to derive the $A^{m}{}_{j}$ matrix is reduced to merchandise sectors only[62]. Analogously, the export vector (X_{ij}) will also have the same format with values reported for merchandise trade but zero values for non-merchandise trade. This implies that there is no ‘external’ service activity, i.e. no imports or exports, but that internally intermediate imports are still used to produce domestic service output[63].

Whilst it is somewhat problematic to only be able to capture vertical specialisation in merchandise trade, some initial investigations into the nature of vertical specialisation by sector suggests that this phenomenon is more prevalent in sectors

[62]This means that the imported technical coefficient matrix continues to be square, but has zero values for sectors in non-merchandise trade (The import vector used to devise the imported intermediate technical coefficient by origin matrix will have positive values for merchandise trade only).

[63] A second method of approaching this restriction is that of subsuming all non-merchandise sectors into an aggregate sector. This means that we reduce the size of the I-O matrices (both imported (A^{M}) and domestic (A^{D})) to a matrix where the last row/column represents the simple sum of the missing sectors. We then conjecture about these sectors using varying hypotheses. i.e. we can proxy for trade in these sectors by assuming that it follows a similar distribution to merchandise trade. So if the USA imports an average of 30% of its intermediate merchandise goods from NAFTA, it will import roughly the same proportion of its non-merchandise intermediate goods from NAFTA. Alternatively, we can try to proxy for bilateral service trade flows by use of aggregate service trade data.

that are engaged in manufacturing trade[64]. Furthermore, because most agreements involve merchandise trade liberalisation rather than comprehensive agreements on services it is hoped that this shortcoming will not be too problematic.

In order to 'test' how well this method captures the degree of vertical specialisation it is possible to compare how the computed VS figures vary against those of an indicator computed from an I-O table that details the origin and destination of trade. The Eurostat I-O tables decompose imports and exports into aggregate intra and extra EU destinations and hence provide a benchmark against which to 'test' the above developed method of capturing bilateral VS. The results from this robustness check are presented in the Appendix (A1.3) and show that whilst the values of the VS indicator vary somewhat across different methods, the proportions of intra and extra EU bilateral vertical specialisation remain close. The case of Denmark serves as an illustrative example. Here the total degree of VS calculated using the Eurostat tables alone is 0.277. The degree of VS calculated from the technical coefficients of this table merged with trade data, by the method above outlined, is 0.271[65].

This suggests that the above developed method of capturing bilateral vertical specialisation is in line with what one would obtain from bilateralised IO tables. The data also reveals that intra EU vertical specialisation is higher than extra EU vertical specialisation. Although this lends some supportive evidence to the idea that countries that are engaged in preferential agreements may exhibit a wider fragmentation of production structures than those that are not, EU countries also share other characteristics such as proximity or similarity in income which may also be driving these results[66].

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[64] See Appendix A1.6. And also Johnson and Noguera (2011) who suggest that manufactures have lower domestic value added than service activities as is suggested in the results of this essay.

[65] Decomposing this degree of vertical specialisation with respect of EU15 countries reveals that Denmark sources 71% of its intermediate imports from these preferential partners in a measure calculated solely with the Eurostat IO tables. The computed measure that uses the method developed here suggests that 71.9% of imported intermediates used in the production of exports are sourced from other EU15 countries. These shares represent the degree of bilateral vertical specialisation over total vertical specialisation hence these numbers do not imply that Denmark's degree of vertical specialisation with the EU is 0.7 but rather that 70% of the 0.27 VS is from the EU i.e. Denmark's degree of BVS with the EU is 0.196.

[66] Disentangling the FTA effect from other common factors between FTA partners is the subject of the second essay of this thesis.

1.5.3. THE FORWARD LINKAGE AND TOTAL VERTICAL SPECIALISATION

Grasping the full extent of vertical specialisation also requires quantifying the *forward linkages* that arise between countries. This linkage captures the supply of intermediate inputs that another country uses to produce exports as a proportion of originating country exports. Since the US' forward linkage with China, in value terms, is effectively the value of intermediate imports that China buys from the US to produce exports (the backward linkage), the forward linkage is the mirror of the bilateral backward linkage (also known as the VS1 in Hummels et al., 2001):

$$VSF_{i,j} = VSB_{j,i} = A_{j,i}^{m}\left[I - A_{j}^{D}\right]^{-1} X_{j,i} \tag{1.9}$$

Where $VSF_{i,j}$ ($VSB_{j,i}$) is an *s x 1* vector of country j's use of country i's intermediates in the production of exports. Rather than expressing this value as a share of destination country exports, it is computed as a share of origin country exports. The value of imported inputs used by China from the US divided by total US exports yields the forward linkage of the US with respect to China:

$$VS\_F_{i,j} = VSB_{j,i}/X_{i,j}^{TOT} = \mu A_{j,i}^{m}\left[I - A_{j}^{D}\right]^{-1} X_{j,i}/X_{i,j}^{TOT} \tag{1.10}$$

The combination of the forward and backward linkages gives a metric of the total degree of bilateral vertical specialisation (VS_T). This is the sum of the backward and forward linkages net of the backward and forward linkages so that country i's total vertical specialisation with respect to country j is:

$$VS\_T_{i,j} = VS\_B_{i,j}\left(1 - VS\_F_{i,j}\right) + VS\_F_{i,j}\left(1 - VS\_B_{i,j}\right) \tag{1.11}$$

The linkages are netted to avoid a double counting of inputs that arises from the presence of domestic and foreign intermediates in import and export flows. The intuition behind this calculation is that the backward linkage of the US with respect to China may already contain some American inputs that can be identified through the forward linkage (and vice versa for the forward linkage). Hence equation (1.11) nets out the domestic input content of the backward linkage and the foreign input content of the forward linkage[67].

1.6. AGGREGATE VERTICAL SPECIALISATION

The Input-Output database of the OECD is used to compute the different measures of vertical specialisation. It contains information on the use of domestic and imported intermediate for 42 countries at various intervals in time (see Appendix A1.2). In an effort to create comparable indicators of vertical specialisation spanning a longer period of time several transformations are applied to the database tables. First, the tables, which are available in domestic currency, are transformed into dollars using exchange rates from the OECD database. These are then *extended* (or extrapolated) under the assumption that variance in technology is small in years close to the base tables. Hence IO tables circa 1995 are extended till 1997. The 2000 tables are extended from 1998 to 2002 and the 2005 tables from 2003 to 2007. All values are then deflated to a base price in the year 2000 (using OECD aggregate producer price deflators for each country)[68]. The information from these tables is then concorded with trade data through the ISIC rev3 nomenclature which is extracted from the UN's Comtrade database. The indicators of vertical specialisation are then calculated following the above developed method.

The use of IO tables for the calculation of indicators of VS requires some cautionary words. Firstly, given that the OECD tables are based on countries' voluntary submissions, the harmonisation of these requires applying various transformations which may reduce their individual precision for the benefit of collective harmonisation. For example, countries use different collection methods and sectoral classifications hence harmonisation is sometimes difficult[69]. Some report Supply-Use tables at purchasing prices rather than basic prices and transformations need to be implemented to remove VAT and any subsidies. Secondly, the compilation of I-O tables is costly and is thus carried out across large time intervals. They provide a

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[67] The Appendix A1.6 details how one can go about calculating bilateral sectoral vertical specialisation.

[68] Sector and country specific deflators would have been preferable but were not readily available.

[69] Adding to this, sometimes there are holes in the I-O tables which are filled using different estimation techniques. This means that for some sectors values are estimated rather than recorded.

'snapshot' of economic activity in a given year making the extension of these, to obtain a panel, highly reliant on restrictive assumptions.

Extrapolating I-O tables can be done through a 'double deflation' methodology or alternatively by assuming that technical and interdependence coefficients vary little over time. For the purpose of this analysis the latter technique is chosen. According to UN (1999), variation in technological coefficients can arise; from changes in technology; changes in relative prices; and from imperfect data. The first is impossible to control for because the only information at our disposal is based on the technology present in the base year of the I-O table. The second can be dealt with by using deflators to produce tables in constant price values given a base year whilst the third is also beyond our control. Following a method that extends technology coefficients across time is not without implications. First, it constrains technological changes in the sample to three base years implying that variations in the captured linkage indicators only occur via changes in export and import values near the base year. Whilst this is a limiting factor, annual variation in technologies may be small. Vaccara (1986) suggests that technical coefficients vary annually in the region of 2% and UN (1999) also suggest that changes are fairly gradual[70]. Second, and a more general limiting factor of I-O analysis, is that technology is assumed to be linear (Leontief). This implies that intermediate imports are required in fixed proportions to output or alternatively that there is no substitution between the inputs used to produce output.

Nevertheless, the advantages of using the OECD IO tables are twofold. First, they provide an attractive temporal coverage and sectoral harmonisation; and second, they delimit the use of inputs according to origin; whether domestic or international (i.e. imported). This feature is exploited to identify the origin of inputs which is distinct from the methods used in Koopman et al. (2011) and Johnson and Noguera (2011). These rely on the GTAP database which does not always differentiate between foreign and domestic sources of inputs[71]. The use of the OECD database affords a

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[70] However, the variations in Vaccara (1986) are calculated during the 50's and 60's. There is reason to believe that the 90's saw much higher variation through the introduction of new information technology (IT) such as the internet.

[71] A look at the difference between domestic and international use of inputs through the OECD tables reveals marked differences and suggests that such distinction may be important.

less restrictive proportionality assumption where the use of inputs is allowed to differ across domestic and external sources but remains constant within the foreign sources. Koopman et al. (2011) use the BEC nomenclature for their identification strategy but as already anticipated this may be problematic due to the arbitrary nature of this classification. Another advantage of using the OECD database is that the temporal variance of the OECD tables is larger which implies that changes in the indicator of vertical specialisation are driven by both changes in technology and also changes in the shares of exports and imports. The GTAP database produces single IO tables that are, at times, quite outdated and hence indicators calculated using this database only vary in time according to changes in trade shares (although the GTAP database does afford a larger sample of countries).

1.6.1. Specialisation patterns

Country A's backward link to the world is defined here as the amount of intermediate imports that it uses from all partners to service the demand for its exports. Its forward linkage is then defined as the amount of intermediates it exports which are subsequently used by other countries to service world export demand. The indicators of these linkages present these figures as a share of country A's total exports.

Figure 1.3: Backward and Forward linkages

Distinguishing across types of linkages may be important. These may identify different types of specialisation and thus where a country locates within a value chain (i.e. as an assembler or as a supplier of intermediate products). Countries that engage in assembly activities should increasingly import intermediate products as they specialise in such activities and hence should witness a rising backward linkage with respect to the world. However, as specialisation unfolds and learning by doing takes place, assemblers may 'shift up the value added ladder' and internalise the production of some intermediate products. This implies that they will reach a point where domestic value added begins to increase and hence the intermediate import content of export may begin to fall. Such specialisation patterns suggest that an inverted U relationship, between the backward linkage and the position of a country in a value chain, may arise. As domestic value added increases, so too should the measure of the forward linkages as countries begin to shift towards higher value adding activities. This then suggests that a U shaped relationship would emerge between the forward linkages with respect to the world and the position of a country in a value chain.

These specialisation patterns may help explain the evolution of Mexican maquiladora trade. Originally, in the 1960's, maquiladoras were set up as giant assembly lines for US intermediate products. As Mexico specialised in assembling components into final goods for the US market one would expect that the foreign value added of exports would increase (i.e. a rising backward linkage indicator). However, as further specialisation takes place, new generation maquiladoras evolved into higher value adding activities - Bergin et al., 2008 suggest that maquiladora value added has tripled from since the early 90's. Hence the foreign value added content of exports should diminish in favour of greater domestic value added as Mexico shifts away from being a mere assembler. This would be in line with a falling backward linkage indicator and a rising forward linkage as is suggested above. Testing whether there is any evidence of such dynamic specialisation requires separating backward and forward linkages which can be achieved using the method developed in this essay.

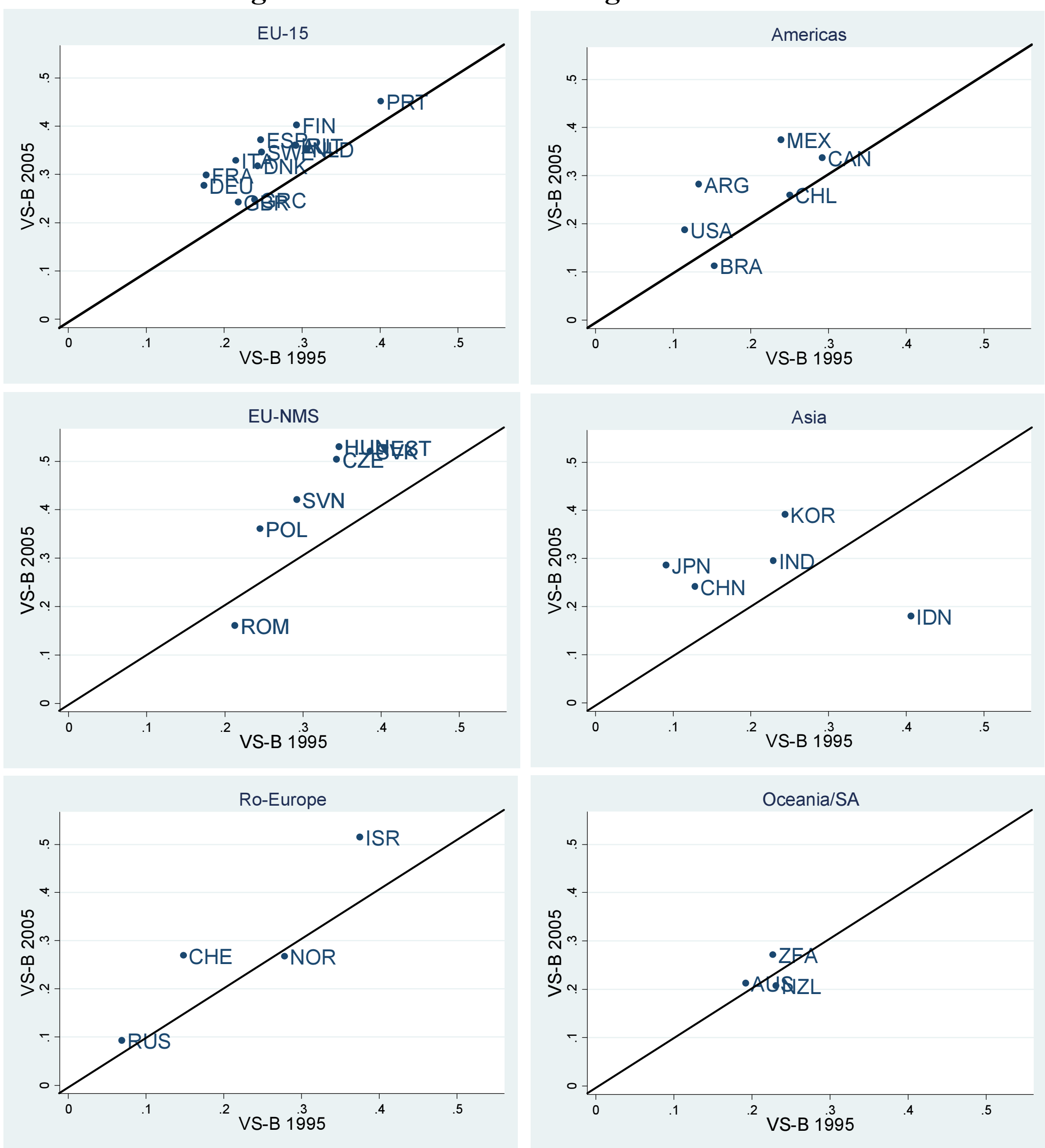
1.6.2. The Backward Linkage (VS_B)

This section discusses how backward linkages (VS_B) have evolved in time[72]. Figure 1.4 maps the evolution of the backward linkages for selected countries with respect to the world across regional clusters for the years 1995 and 2005[73]. The graphical representation facilitates looking at both the level and evolution of this measure across countries. Points lying above the 45 degree line represent countries which have witnessed an increase in the level of VS_B in time (and vice versa for points below this line). The results show an increasing trend in VS_B in time for all countries except Brazil, Indonesia, Norway, New Zealand and Romania. EU-15 countries exhibit strong backward linkages with respect to the world where in 2005 one fourth to one third of export value added in these countries was foreign. In

[72] This measure is the VSI developed by Hummels et al (2001).
[73] In the appendix this figure is presented in tabular form in Table A1.4.

contrast, EU-NMS countries show even higher backward linkages. The foreign value added of exports of the Czech Republic, Estonia, Hungary, Slovakia and Slovenia is close to the 50% mark. In the Asian cohort Japan and China more than double their backward linkages with respect to the world in a decade. On the other hand Indonesia exhibits a significant reduction in its backward linkages. Korea has the highest levels of VS_B in the region with Japan and India showing more modest values. The figures for China suggest that over a fourth of its exports are made using foreign sourced parts. In the North American region Canada and Mexico show high degrees of VS_B however these linkages have grown most for Mexico.

Figure 1.4: Backward Linkages 1995 and 2005



Source: Own calculations OECD I-O STAN database. For Table see Appendix Table A1.4

Certain preliminary observations on the nature of these linkages can already be made. In particular, and as anticipated by Nordas (2004), it seems that smaller countries show higher degrees of VS_B than larger ones[74]. The latter tend to have bigger domestic markets from which to draw intermediates from and appear to be less reliant on international backward linkages. Because the strength of the backward linkage (and also the forward linkage) is expected to vary according to the position of a country in an international value chain, a non-monotonic relationship is expected to emerge between income and backwards linkages.

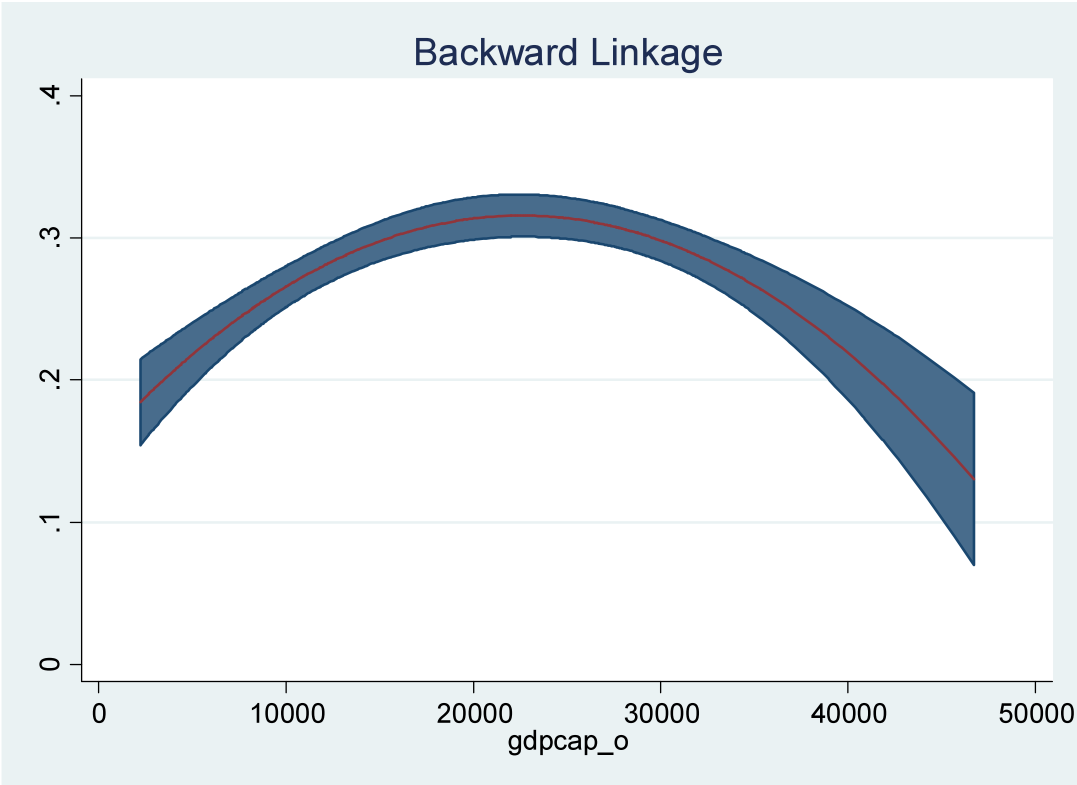
Entry into a value chain, for less developed countries, is likely to occur at the assembly level. This type of activity requires importing large amounts of intermediate goods and then shipping finished products. As countries begin to specialise in assembly, they also begin to import more and more intermediate goods and hence see a rising backward linkage (rising VS_B). This continues till they have developed enough supply capacity to move up the value chain and start producing their own intermediates. At this stage countries will start reducing their assembly activities and hence will reduce their backward linkages (falling VS_B). What will then arise is an inverted U relationship between position in a value chain and levels of backward linkages. Figure 1.5 provides evidence of this inverted U relationship. It plots the fitted values from a regression of the VS-B indicator against per capita GDP and the square of this term[75]. The patterns of specialisation that emerge are consistent with the story presented however they appear to diverge from the results obtained in the previous figure which saw that backward linkages were rising for most countries. One can reconcile these by thinking of the inverse U-shaped relationship as a long-run pattern of specialisation which is composed of many short term rising levels of backward linkages. The figure allows one to track the evolution of linkages according to levels of development which cannot be observed with the time frame of the sample that is used. However this raises the issue of whether countries move

[74] In the EU-15 panel the larger countries (Germany, UK, France, Italy and Spain) cluster closer to the origin. This is also true for the USA and Brazil in the Americas whereas the smaller Eastern European countries show very high levels of VS-B.

[75] The coefficients of this regression are reported in the appendix table A1.7. Both independent variables are highly significant. The sample size is of 39 countries for 12 years giving 468 observations and an R-squared of 0.11.

through the curve or whether this curve is shifting upwards in time through technological advances[76].

Figure 1.5: Inverted U relationship between VS-B and GDP per Capita



Source: Own calculations based on OECD STAN and Penn World Tables[77].

The new theoretical approaches to vertical specialisation (cf Grossman and Hansberg, 2008; Baldwin and Robert-Nicoud 2010) suggest that the process of international fragmentation of production may be associated with productivity gains. One can then look at the correlation between these two processes to determine whether there is prima facie evidence of such a link[78]. Figure 1.6 maps the correlation between aggregate backward linkages by country in 2005 and changes in output per worker from 2000 to 2005 obtained from the OECD STAN database. It

[76] Looking into this is beyond the scope of this essay but it provides an interesting exercise. Future work on this should exploit the OECD IO system to look at how technology drives changes in vertical specialisation. A preliminary idea on how to tackle this issue would be to calculate indicators of vertical specialisation using 1995 technologies only and then compare these to indicators of VS using 2005 technologies. The difference between these would then reveal the degree to which technology has driven the process of vertical specialisation.

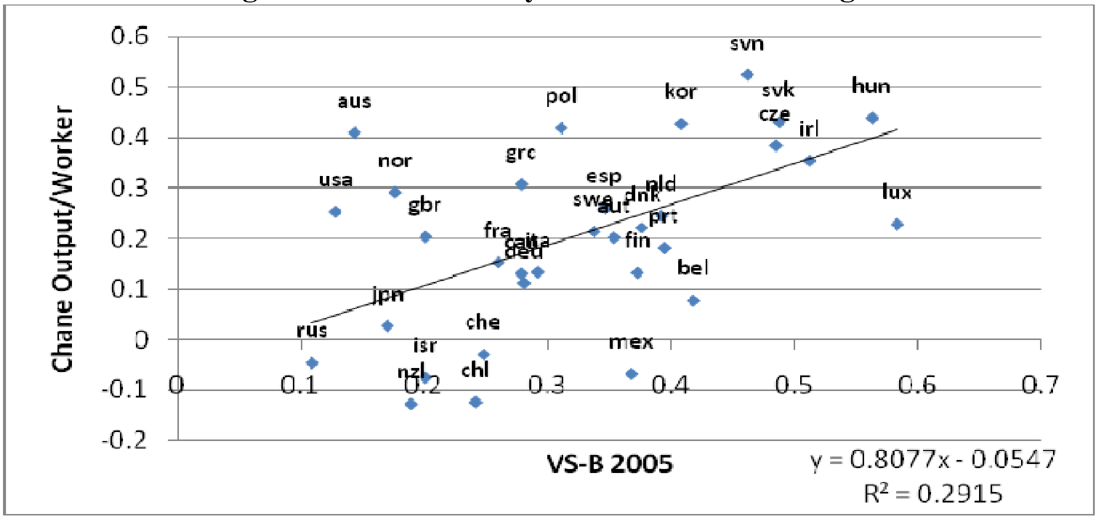
[77] The introduction of a cubic polynomial does not alter the shape of the curve.

[78] However, in light of the above results, it seems that looking at changes in backwards linkages and their correlation with changes in productivity might be misleading given that VS-B is non-monotonic. Hence we look at the correlation between our backward linkage indicator in the last available year and productivity growth.

shows a statistically significant and positive correlation suggesting that countries that are more vertically specialised seem to witness bigger positive changes in productivity growth[79].

The link between these processes may arise through two channels. Firstly, outsourcing uncompetitive segments of production can liberate resources into more productive sectors. This could increase overall productivity through a statistical effect where non-productive sectors exit the economy. Furthermore, a pro-competitive effect may arise from the introduction of international competition in finer segments of production. In addition, and given complementarities in value chain activity, it is possible that increasing the efficiency of one segment of the value chain increases the productivity of the entire productive process. Secondly, a gain may emerge through the *Smithian* channel. The creation of tighter backward linkages may result in finer and more efficient specialisation, greater technology transfers and learning by doing effects.

Figure 1.6: Productivity and Backward Linkages



Source: Own calculations of VS. Labour productivity, output and employment from the OECD STAN indicators (labour productivity indexed to base year 2000)

The correlation between the backward linkage indicator and changes in productivity should be interpreted with caution. Correlation does not imply causation. It may be the case that the most productive sectors of the economy operate in activities that are more easily offshoreable or indeed that productivity increases lead to a wider

[79] The correlation coefficient between these measures is a statistically significant 0.54 with a t-stat of 3.57.

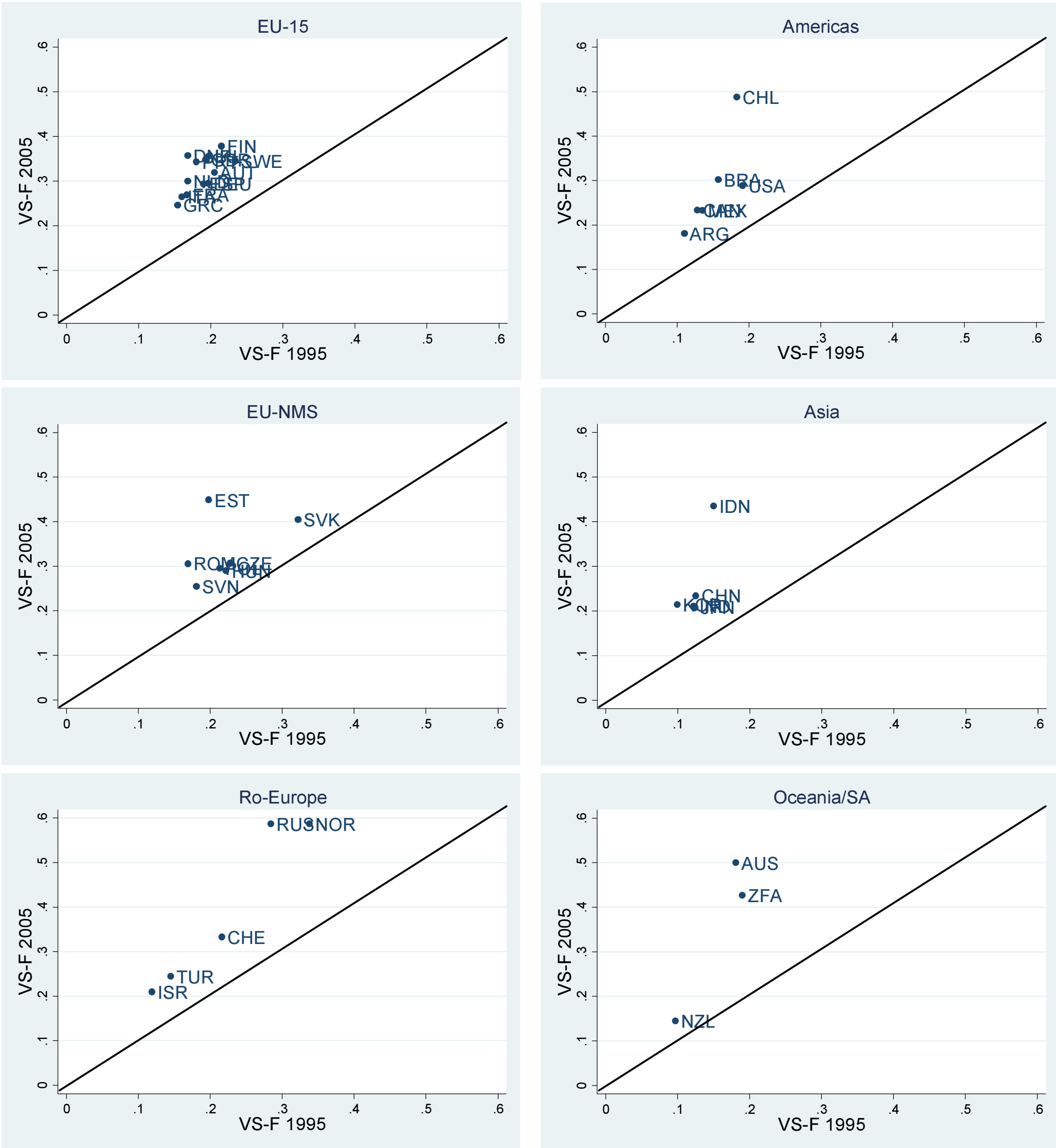
participation in value chain activities. Additionally it may also be the case that these two processes are driven by a common 'variable' and hence not related. Nevertheless, much of the literature points towards the idea that these processes could be interrelated which has positive implications for the way we think about vertical specialisation and for assessing the welfare consequences of such modes of production. In particular, it provides a channel through which trade may lead to economic growth.

1.6.3. THE FORWARD LINKAGE (VS-F)

The forward linkage indicator (VS-F) captures the intermediate export content of a country's exports and hence is, in some sense, the mirror flow of the backward linkage. It measures the use of a reporting country's inputs in the production of exports by all other countries (as opposed to the use of foreign input in the production of foreign output). Its quantification requires tracking the bilateral component of vertically specialised trade so that the *aggregate* value of the forward linkage of a country is the sum of the backward linkages of all countries with respect to that same country (i.e. Mexico's aggregate forward linkage is the sum of the use of its intermediates to produce exports by all other countries expressed as a proportion of Mexico's total exports).

Figure 1.7 summarises the evolution of forward linkages for the years 1995 to 2005 using the same set-up that was used to present the backward linkages. The figure shows that these linkages are increasing in time, and quite considerably, for all countries. EU-15 individual country forward linkages grew by 30% whilst the EU-NMS countries witnessed a more modest increase. In Asia; Indonesia and Korea appear to have doubled their forward linkages with respect to the world. China and Japan have also seen these linkages rise albeit at a slower pace. Russia stands out as the country with the largest forward linkage, but this may be driven by the increase in the price of petrol during the period under investigation. This explanation is also likely to apply to Norway's inflated forward linkage. In the case of Chile the driving factor should be the hike in the price of copper which is one of Chile's largest export products. Increases in commodity prices are also likely to be driving Australia's important forward linkage growth. Apart from these outliers, a noticeable trend that emerges is that higher income countries tend to exhibit larger positive changes in their forward linkages.

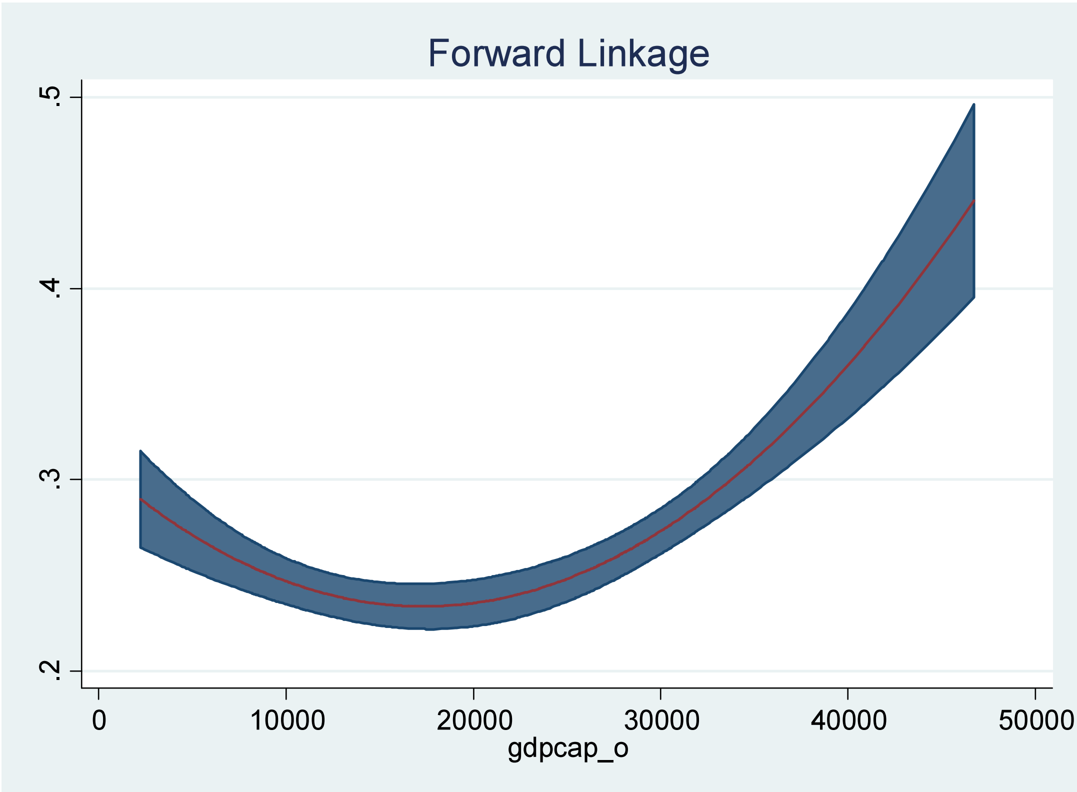
Figure 1.7: Forward Linkages 1995 and 2005



Source: Own calculations OECD I-O STAN database. For Table see Appendix Table A1.5

Because the forward linkage may be seen to represent the counterpart of the backward linkage, one could expect that the nature of this linkage is inversely proportional to that found for the backward linkage. Hence as the foreign content of exports falls, the domestic content of exports could be seen to rise so that a non-monotonic relationship between VS-F and GDP per capita also emerges. Building on the earlier example, if countries at lower positions in the value chain are increasing their use of intermediate imports and engaging in assembly, then they will be exporting larger proportions of final goods over intermediates. This will result in an initially decreasing forward linkage. As a country moves up the value chain, it will leave assembly lines for the production of higher value adding intermediates and hence will see forward linkages increase accordingly. In the case of the forward linkages, the relationship between this linkage and per capita GDP is expected to be quasi U-shaped. Figure 1.8 confirms this hypothesis through a similar plot of the fitted values from the regression of the forward linkage indicator (VS-F) with respect to GDP per capita and its squared term[80]. Comparing this figure to that obtained for the backward linkages (Figure 1.5), shows how the indent in the U is less pronounced. What emerges is that countries that have higher GDP per capita do have much larger forward linkages than countries that show lower levels of development.

Figure 1.8: U relationship between VS-F and GDP per Capita



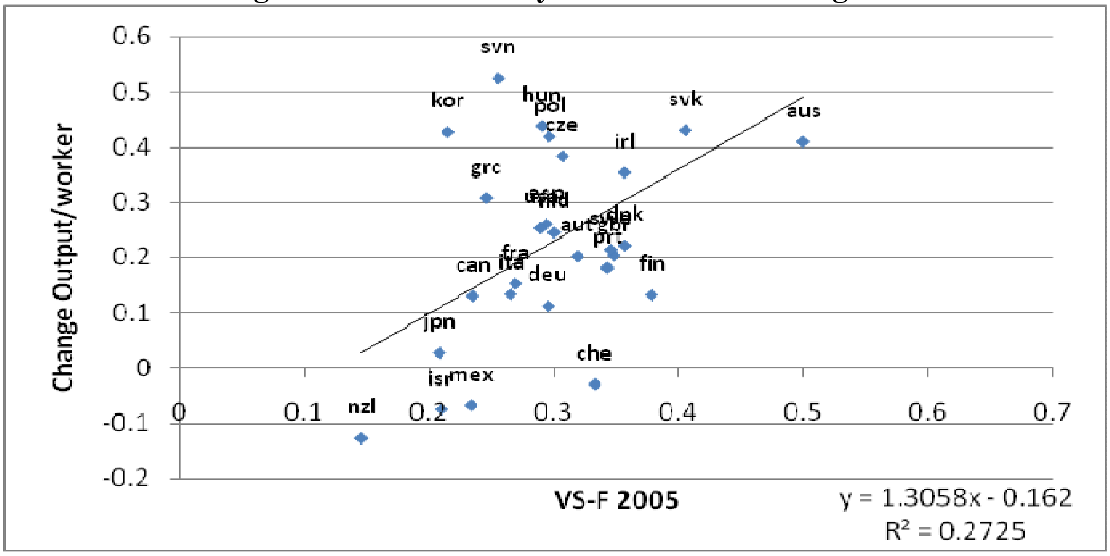
Source: Own calculations OECD I-O STAN database[81]

In addition, and bearing strong similarities with the backward linkage case, a positive and statistically significant correlation between these linkages and changes in

[80] Here again our sample is of 38 countries for 12 years giving us 468 observations. The GDP per capita variables explain 10% of the variation in VS-F. The coefficients of the regression are reported in the appendix table A1.7.
[81] Fitting a third degree polynomial does not substantially alter the shape of the curve.

productivity is identified (as shown in Figure 1.9)[82]. This again lends further supportive evidence to the earlier posited hypothesis of a possible link between vertical specialisation and economic growth[83]. The mechanisms through which these processes interact are likely to be similar to those discussed in the previous section.

Figure 1.9: Productivity and Forward Linkages



Source: Own calculations of VS. Labour productivity, output and employment from the OECD STAN indicators (labour productivity indexed to base year 2000). (T-stat 3.12)

1.6.4. Total Vertical Specialisation

Putting the forward and backward linkages together requires adding these up and subtracting the forward linkage component of the backward linkage and the backward linkage component of the forward linkage following equation (1.6) (to avoid double counting inputs). One should however be cautious in interpreting this indicator. It captures both the foreign value of exports and the domestic value of intermediate exports and hence identifies the total amount of a country's exports that are involved in value chain activity. Therefore, for the US, the total level of vertical specialisation with the world is the amount of intermediate inputs used from the world to service the world market, plus the amount of intermediate exports that the

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[82] The correlation coefficient between these measures is a statistically significant 0.52 with a t-stat of 3.12.

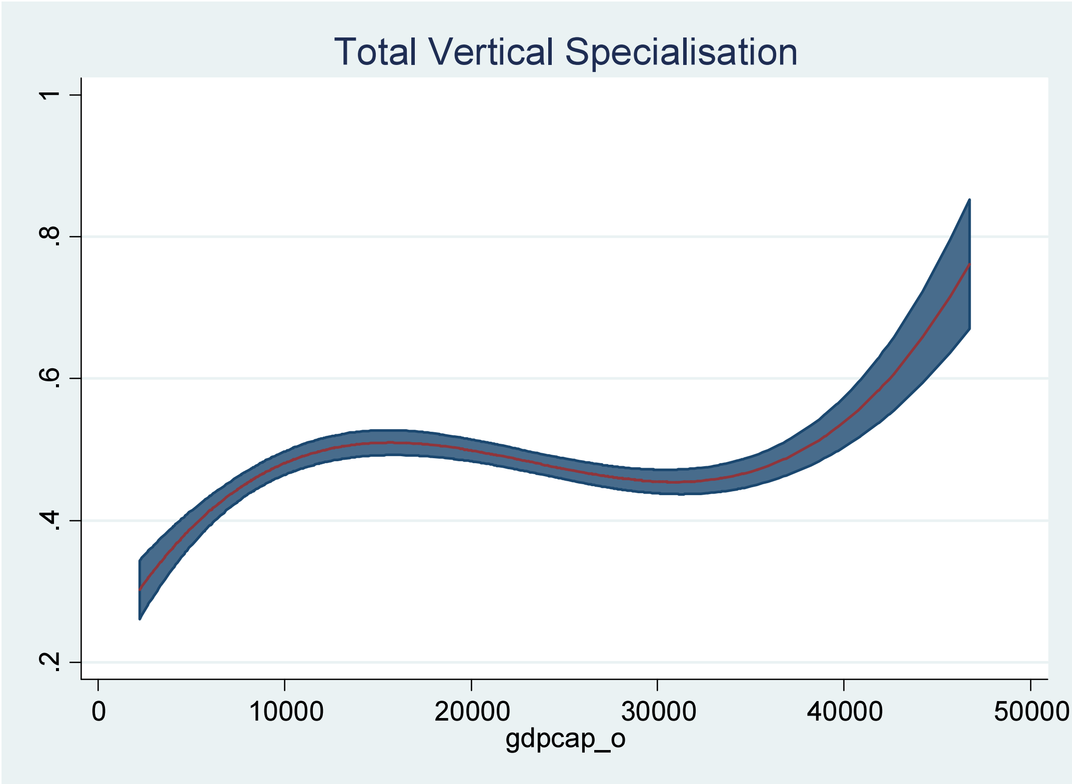
[83] Russia, Norway and Chile are removed from the calculations due to their reliance on petroleum or commodity exports.

world uses from the US to produce exports net of domestic and partner inputs[84]. In the appendix a table mapping the evolution of total vertical specialisation from 1995 to 2005 is presented (See Table A1.6). As expected, total vertical specialisation is rising in time. On average, 40% of EU-15 countries' trade is vertically specialised in the year 2005, for the EU-NMS countries this average jumps to 50%. In Asia, Korea and Indonesia show the highest levels of vertical specialisation with over 50% of their exports being engaged in international value chains. China and India follow closely with a share of 40%[85]. In the Americas, Canada and Mexico exhibit the highest share of trade involved in value chain activity (around 50% of total exports). Argentina, Brazil and the US are closer to the 40% mark.

Figure 1.10 plots the relationship between the total vertical specialisation indicator and GDP per capita. To accommodate for the different shapes that were captured when looking at the relationship between the backward and forward linkages with respect to development, a third degree polynomial function (i.e. a cubic function) is introduced to look at the nature of this linkage[86]. Total vertical specialisation exhibits a sideways S shaped curve composed of an initial inverted U form at lower levels of development, followed by a quasi U shaped curve at higher levels. This provides further supportive evidence to the story that sees countries specialising in different segments of production according to their position in the value chain. Interestingly, countries at higher levels of development (beyond a certain GDP per capita where the function is increasing) may be increasingly driving the process of fragmentation and selling their intermediates to countries in the bottom end of the GDP per capita spectrum. The rise in VS-T could be caused by the growing supply of intermediates towards countries located at the lower end of the spectrum. This could signify that the upward trend in total VS might be spurring a greater spread of value added across geographical locations.

[84] The backward linkage is netted from domestic inputs whereas the forward linkage is netted from partner inputs as per equation 1.11.
[85] See Table A1.5 in the appendix. One has to bear in mind that petrol exporters will tend to have higher forward linkages but also that petrol importers will have larger backward linkages.
[86] The estimation is carried out on 468 data points. The GDP per capita variables explain 15% of the variation in VS-T. The coefficients of the regression are reported in the appendix table A1.7.

Figure 1.10: VS-T and GDP per Capita

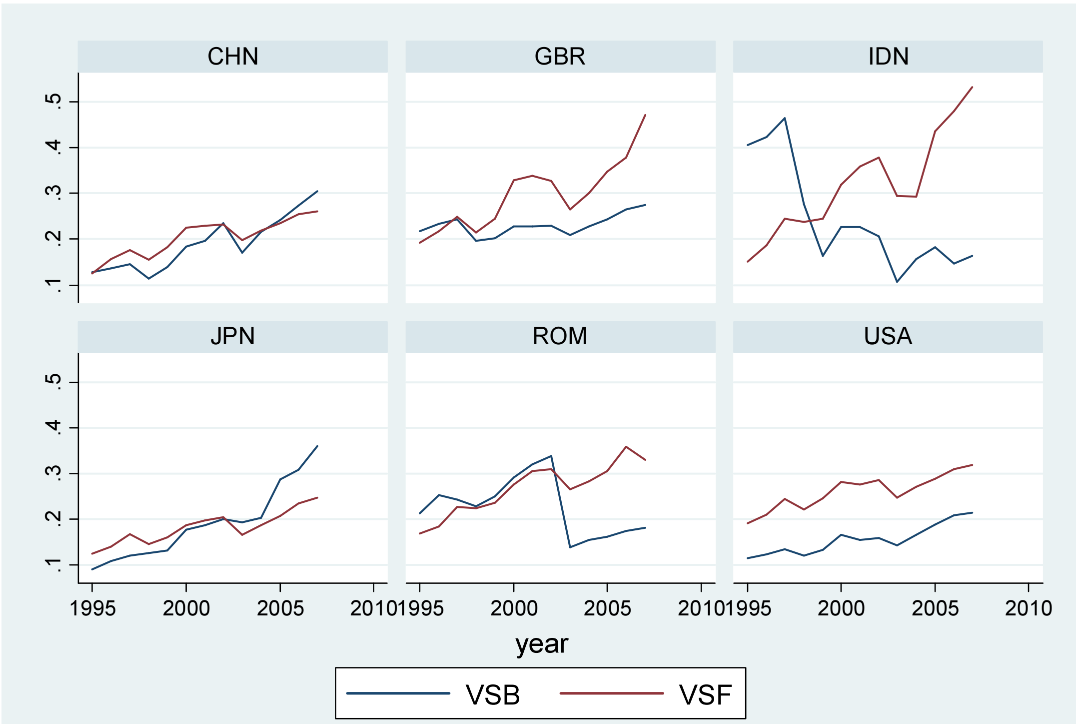


Source: Own calculations OECD I-O STAN database

The above figure is an aggregate representation of the countries in the sample and may help capture the long-run path of specialisation of countries. Individual countries will cluster along different points in the GDP per capita spectrum and exhibit different short-run specialisation patterns. These are further investigated in Figure 1.11 which tracks the evolution of forward and backward linkages for a selection of 6 countries with different economic characteristics.

The evolution of Chinese linkages with the world suggests that China is increasingly importing and exporting intermediates which would be in line with a position around the middle part of the value chain. As some sectors begin to climb the value chain others remain in assembly activities. However the data suggests that China is still a net importer of intermediates. At the high end of the per capita GDP spectrum, taking the example of the US and the UK, a different pattern of specialisation emerges. The more developed countries seem to have larger forward linkages than backward linkages and these also appear to move in a similar direction (i.e. they are both increasing). These countries seem to be net suppliers of intermediates but are also increasingly offshoring albeit at a slower pace. An interesting result is that of Japan which initially saw stronger forward linkages which, in time, give way to higher backward linkages. A possible fitting story to this evolution is that Japan specialised in selling intermediate products to its East Asian partners which were then exported to western countries as finished products. As these East Asian countries begin to climb the value chain, Japan increases its backward linkages with these countries[87]. The Indonesian (IDN) case is an interesting one. Although the patterns of specialisation presented seem to indicate a possible move up the value added ladder (i.e. falling backward linkage and rising forward linkage), looking at Indonesia's trading patterns reveals that this is not the case. The rise in intermediate exports is driven by exports of mineral products rather than by processed intermediates.

Figure 1.11: Backwards and Forwards linkages for a selection of countries 1995-2007



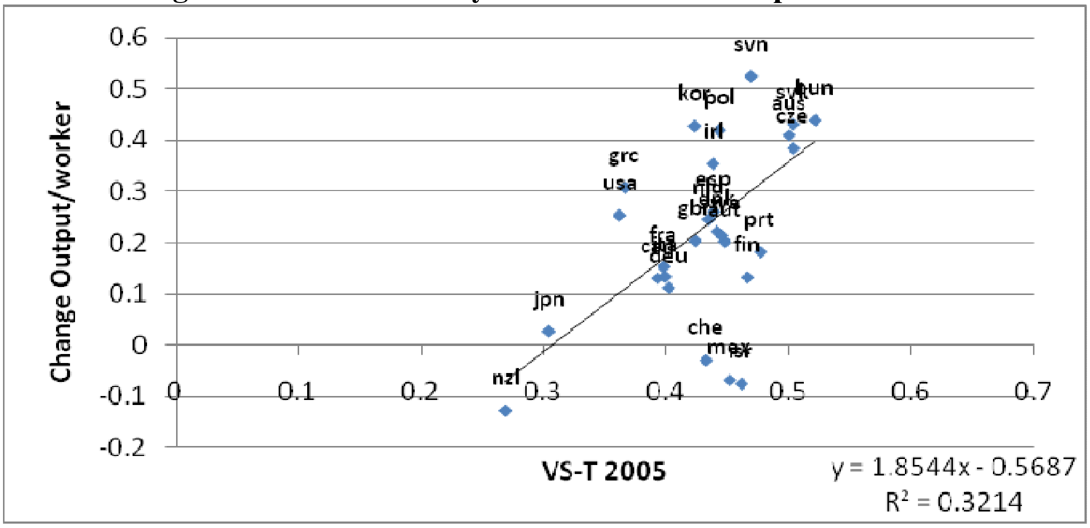
Source: Own calculations OECD I-O STAN database

Given the correlation found between the different linkages and changes in productivity, it comes as no surprise that a positive, and statistically significant, correlation also arises between total vertical specialisation and changes in productivity. The driving factors could again be a mix of allocative efficiency gains through increased exposure to international competition; economies of scale; niche

[87] Another fitting story is that Japanese multinationals are locating in East Asian countries and hence no producing from Japan but rather from offshore locations.

specialisation; and technology transfers. In Figure 1.12, a graph mapping this correlation is presented providing continued support to the idea that vertical specialisation and productivity growth could be linked[88].

Figure 1.12: Productivity and Total Vertical Specialisation



Source: Own calculations of VS. Labour productivity, output and employment from the OECD STAN indicators (labour productivity indexed to base year 2000)

1.7. Bilateral Vertical Specialisation

The technique for capturing vertical specialisation developed in this essay affords looking at how these linkages have evolved bilaterally. This means that it is possible to compare specialisation paths within and between regional blocks. This section provides a comparative static analysis of bilateral vertical specialisation across three broad regional areas; NAFTA, the EU and East Asia. It concludes with some observations about inter-regional vertical specialisation patterns. The indicator used for this analysis is one that measures the bilateral content of *total* exports rather than a fully bilateral measure[89]. This implies that the denominator of the calculation of the linkages is total exports rather than exports to a particular destination. This facilitates a cross-country comparative analysis.

[88] The correlation coefficient between these measures is a statistically significant 0.57 with a t-stat of 3.51.

[89] This indicator is used rather than a full bilateral measure because it allows one to decompose flows of intermediate goods along a common denominator and this facilitates the comparative analysis. Using a full bilateral measure would imply using different denominators and it would be hard to ascertain whether cross country differences would arise from changes in the numerator, i.e. the value of intermediate trade, or changes in the denominator (bilateral exports).

1.7.1. North America

NAFTA is a good and tractable example with which to begin. Figure 1.13 looks at US bilateral vertical specialisation with respect to its main preferential partners (Mexico and Canada) and other non-preferential partners (China, Germany, Japan, Korea and the UK)[90]. The vertically specialised linkages mapped in this figure capture the bilateral component of intermediates used to service world demand for exports. Hence, in Figure 1.13, the first graph shows the share of imported and exported intermediates to and from Canada as a proportion of US total exports to the world. What is particularly interesting in this figure is the evolution of the linkages between the US and its Northern American preferential partners. For Canada and Mexico the forward linkage is initially falling whilst the backward linkage is rising. This suggests that patterns of vertical specialisation across these preferential partners are changing. Whilst, a decade ago, the US was seen to export intermediates to these destinations, possibly for assembly, nowadays and increasingly, the patterns of specialisation are tending more and more towards the USA buying intermediates from these countries. This, again, may be evidence of a move up the value chain for these preferential partners.

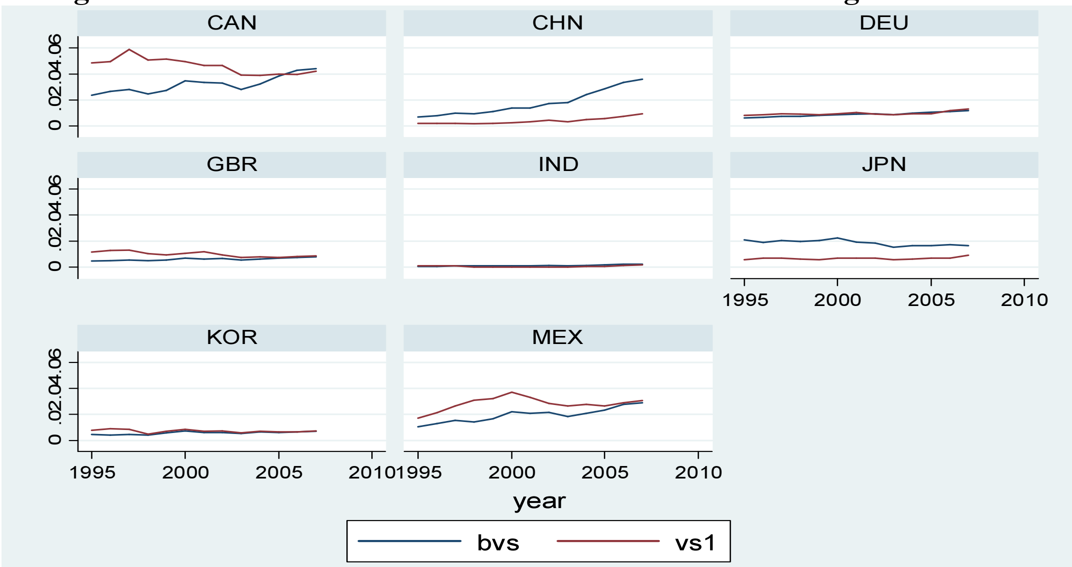
Also interesting is the rising dependence on Chinese intermediate imports in comparison to intermediate exports. It is often assumed that the US imports finished products from China and exports intermediates for assembly which makes these results appear counterintuitive. Two explanations may help explain these. First, the results may be driven by the rising share of Chinese imports in total US imports[91]. Second, US exports of intermediate products may reach China through different countries. Johnson and Noguera (2011) highlight that US imports from China contain significant US value added but that this value added comes indirectly from exports of intermediates to other East Asian countries. Linden et al. (2009) support these findings in their case study on the production process of the iPod where complex

[90] Korea only became a preferential partner very recently and has been included in the example to see if we can already discern any increasing linkages before the agreement was put into force.

[91] The actual use of intermediate imports by origin country is not observed, and the indicators are computed measures which serve as proxies. They rely on a proportionality assumption and this means that the use of imported intermediates is proportional to aggregate bilateral trade (import) flows. Hence if these are rising rapidly, so too will the backward linkage indicator.

multi-country production networks are highlighted[92]. Figure 1.13 also shows that the linkages with respect to European economies remain small, whereas those with Japan and Korea have seen little movement in time.

Figure 1.13: USA's bilateral backwards and forward linkages 1995-2007



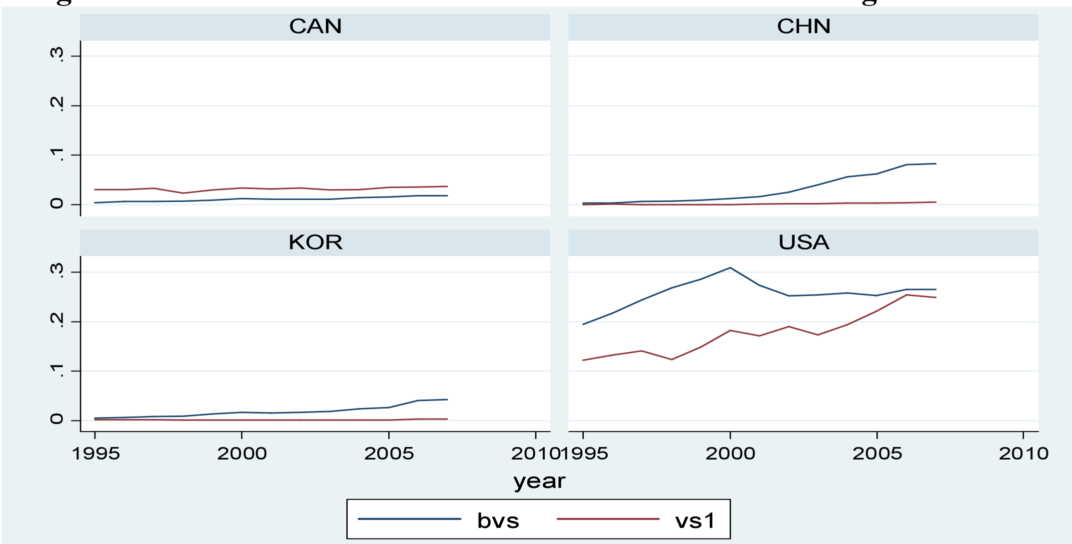
Source: Own calculations OECD I-O STAN database.
bvs=VS-B and vs1=VS-F

The case of Mexico is presented in Figure 1.14. Whilst it remains highly reliant on its backward linkages with the US, it is also increasingly developing forward linkages with the US. This might be evidence of a move up the value added chain as is also suggested in Bergin et al. (2008). The importance of the US in Mexico's aggregate vertical specialisation is quite overwhelming with 25% of its total exports being produced with American value added in 2005. Similarly, over 20% of its exports are seen to be incorporated into production sequences in the US for further re-exports. However the story does not, a priori, appear to be a completely preferential one as Mexico is increasingly reliant on intermediate imports from China and Korea[93]. In particular, as the backward linkages with the US fall, those with China seem to be rising. One can then conjecture that there might be a substitution taking place where Mexico is increasingly importing Chinese intermediates and then exporting processed products to the US[94]. Mexico's backward linkages with Canada are lower

[92] Johnson and Noguera's (2011) indicator nets out direct and indirect value added and hence might be better at capturing the real trade imbalances between countries.
[93] Koopman et al. (2011) show similar results and also highlight the growing importance of China and Korea as sources of intermediates.
[94] Bergin et al., 2008 also find some evidence of a growing dependence on Chinese and Korean trade.

than its forward linkages but the values are both low and stable in time suggesting that patterns of specialisation in the region are largely dominated by relations with the US.

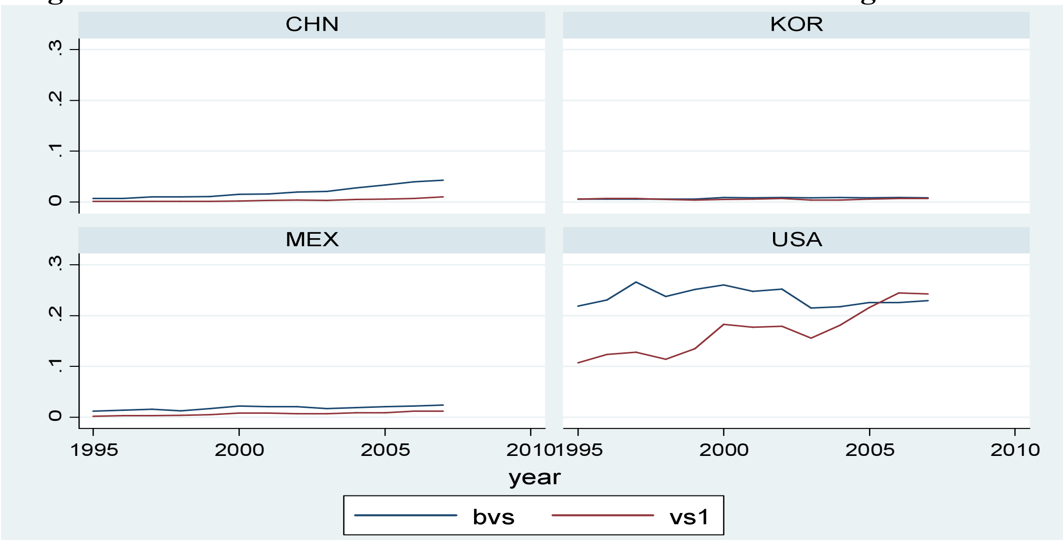
Figure 1.14: Mexico's bilateral backwards and forward linkages 1995-2007



Source: Own calculations OECD I-O STAN database
bvs=VS-B and vs1=VS-F

The Canadian example (Figure 1.15) also reveals the dominance of the US as a source and destination of intermediates. In 2005 around 22% of total Canadian export value added came from the US whilst 22% of total Canadian exports were being used by the US in export oriented production sequences. Here too bilateral vertical specialisation appears to be changing with a rise in forward linkages with respect to the US. Canada also seems to be more reliant on its backward link with Mexico than on its forward link although the share of trade that this occupies is relatively small. Canada's bilateral vertical specialisation with respect to China is larger and increasing on the back of a rising backward linkage.

Figure 1.15: Canada's bilateral backwards and forward linkages 1995-2007



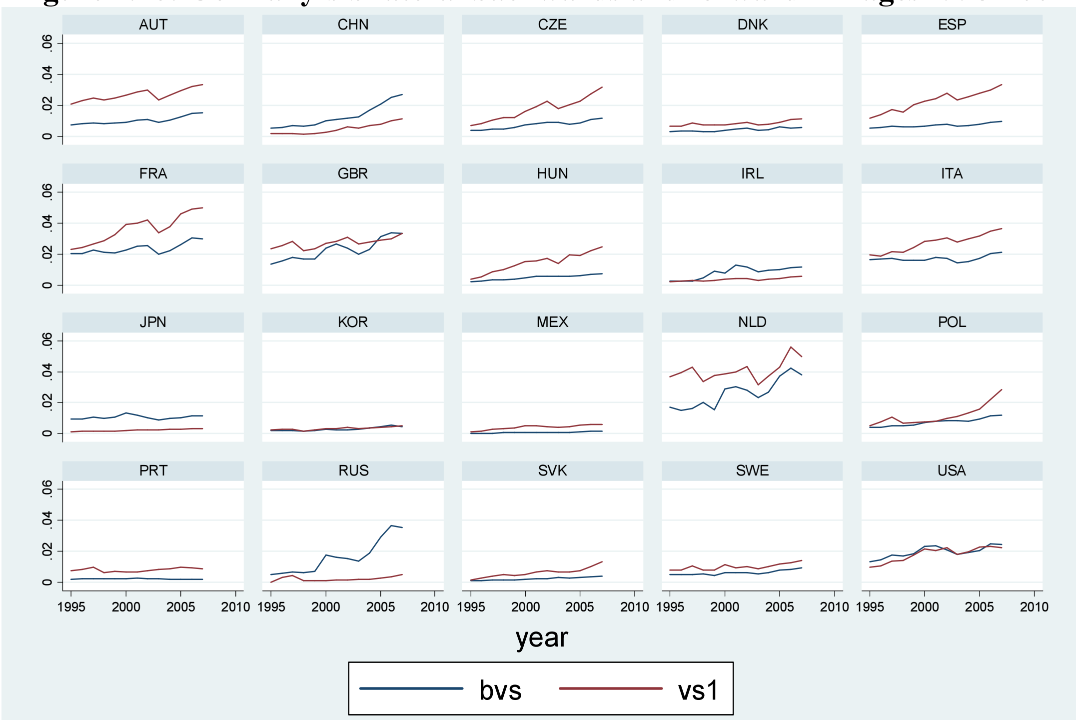
Source: Own calculations OECD I-O STAN database
bvs=VS-B and vs1=VS-F

1.7.2. The EU and The New Member States

Looking at the patterns of bilateral vertical specialisation in Europe is done through a more focused analysis of two countries in the region: Germany and Poland. Figure 1.16 maps the evolution of German linkages with respect to a selection of countries. Germany appears to be a leading supplier of intermediate products to other EU-15 partners. The main forward linkages are with Austria, France, Italy, Netherlands and Spain. There is also evidence of substantial growth in forward linkages with respect to Eastern European countries such as the Czech Republic, Hungary, Poland and Slovakia. Nordas (2007) highlights that the German automotive sector has increasingly relied on these countries for assembly purposes and these reported trends may be capturing such value chain activity. Where backward linkages are concerned, there is an increasing reliance on China as a source of intermediate inputs. Equally, Russia appears as an important partner in this respect. However, the nature of the linkages with China and Russia are likely to differ. The former should be more engaged in supplying intermediate manufactured products whilst the latter is an important source of petroleum.

There seems to be a strong preferential element in Germany's patterns of vertical specialisation. But European partners are also geographically close and hence distance could be driving these linkages. Disentangling the drivers of these flows may then require a more rigorous empirical analysis. However, a noteworthy observation is that the growing importance of Eastern European countries in German links appears to occur circa 2004 i.e. after the accession of these countries to the EU. This may, in turn, provide some supportive evidence pointing to a strong role for deep integration in the stabilisation and creation of value chains. Tariff barriers to trade having already been dismantled prior to these years, the big change between the relations of these eastern countries and the EU was the implementation of the *acquis communautaire* or the body of EU law into national legislation. The new laws and standards governing the internal market may have had an effect on the creation of new value chain activity.

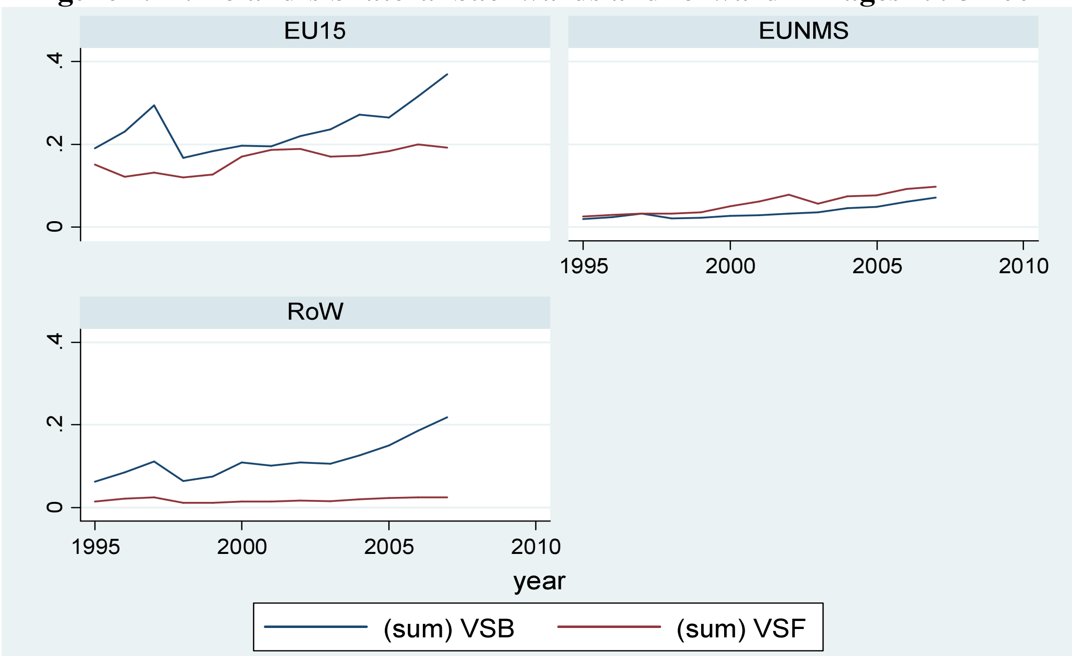
Figure 1.16: Germany's bilateral backwards and forward linkages 1995-2007



Source: Own calculations OECD I-O STAN database
bvs=VS-B and vs1=VS-F

It is also instructive to look at the evolution of backward and forward linkages from the perspective of an Eastern European country. Figure 1.17 presents the patterns of specialisation for Poland. It confirms the continued dominance of the EU15 cohort as both source and destination of intermediates. However there are differences in the patterns of specialisation between these traditional EU partners and the new member states. The growing backward linkage with EU15 countries are concurrent with a relatively stable forward linkage pointing to an increasing backward dependence with these partners. In contrast patterns of specialisation with other new member states show a prevailing forward linkage where Poland exports more intermediate products to these partners than it uses from them. In addition, and turning to changes in trends with respect to the EU-15 partners, there is evidence that the rate of growth of backwards linkages has been greater in the period after 2004 than in the previous years. This provides further anecdotal evidence supporting a link between deep integration and vertical specialisation. In terms of the evolution of Polish linkages with respect to the rest of the world there seems to be little action where the forward linkages are concerned but a rising dependence in backward linkages which is driven by imports of petroleum from Russia.

Figure 1.17: Poland's bilateral backwards and forward linkages 1995-2007



Source: Own calculations OECD I-O STAN database

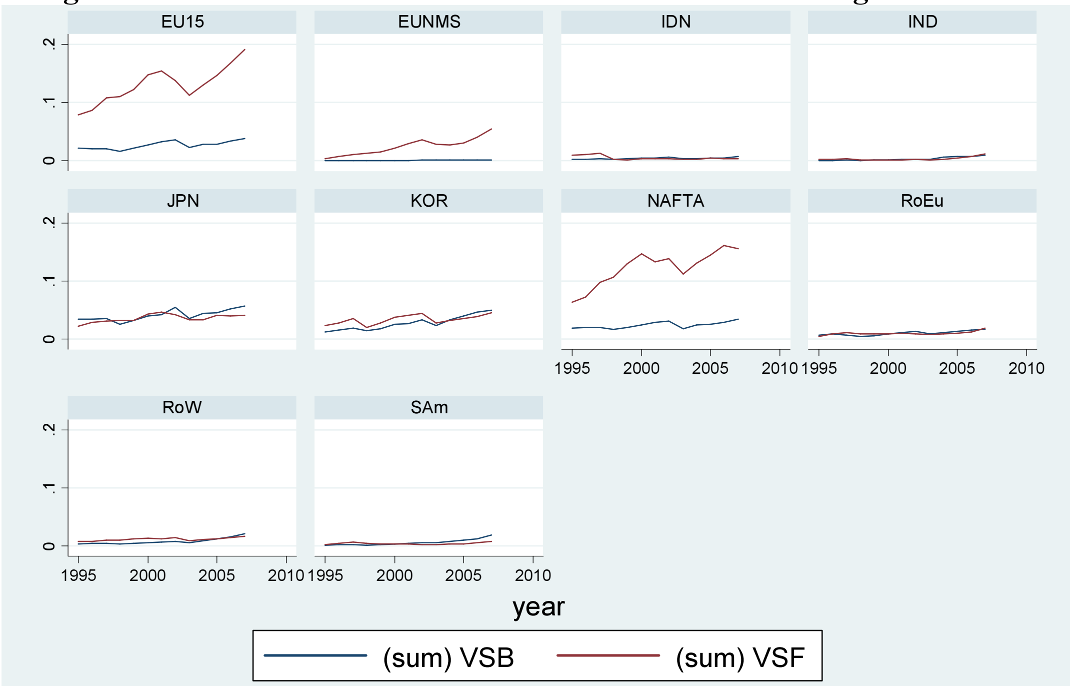
1.7.3. East Asia: China and Korea

It is often remarked upon that there are significant differences between the processes of integration in East Asia and those of the EU. In Asia, private firms are at the forefront of specialisation patterns and trade policy ends up playing catch-up (see Baldwin 2006b). This contrasts with the process of integration in the EU which seems to be predominantly led by public institutions (i.e. the European Commission and other supra national institutions such as the European Court of Justice). A priori, the results show high rates of vertical specialisation within both these regions. Hence a salient question to look at in future work might be whether there exists scope for an interventionist trade policy or whether a *laissez-faire* policy might be more effective in promoting this type of trade.

Figure 1.18 tracks China's vertical specialisation patterns. Earlier analysis showed that China was increasingly becoming a source of intermediate goods for both the EU and NAFTA. This trend is confirmed in Figure 1.18 where China's forward linkages are high and growing with respect to these partners. What is striking is the unidirectional nature of these intermediate flows highlighted by the difference between the very low intermediate use and the very high intermediate supply to these destinations. The rise in the latter is important but it is also worthwhile noting that China remains a large exporter of final goods to the EU and NAFTA. It may be the case that China sources its intermediate inputs from other East Asian countries rather than from the EU or the US as is generally thought. The study of Johnson and Noguera (2011:p27) find similar patterns of specialisation where "triangular production sharing" patterns emerge with Japan and Korea feeding intermediates to China to produce exports to the US[95]. However, the growing influence of Chinese intermediate products in these markets purports a possible change in specialisation pointing to an up-scaling of Chinese activities in global or indeed inter-regional value chains. In terms of linkages with other partners within the region, Japan and Korea emerge as the strongest partners. These appear to be important sources of intermediate products where the backward linkage is higher than the forward linkage even though both are rising. However the levels of these linkages remain small when compared to those with the EU and NAFTA. In fact, these links also appear to be of a different nature as differences between backward and forward linkages tend to be small and possibly intra-industry in nature.

[95] Similar results are found in Linden et al. (2009) who conduct a case study on the location of the value added of an iPod. They too find that a significant amount of intermediate goods come from Japan and Korea. Although a large part of the profits remain with American firms.

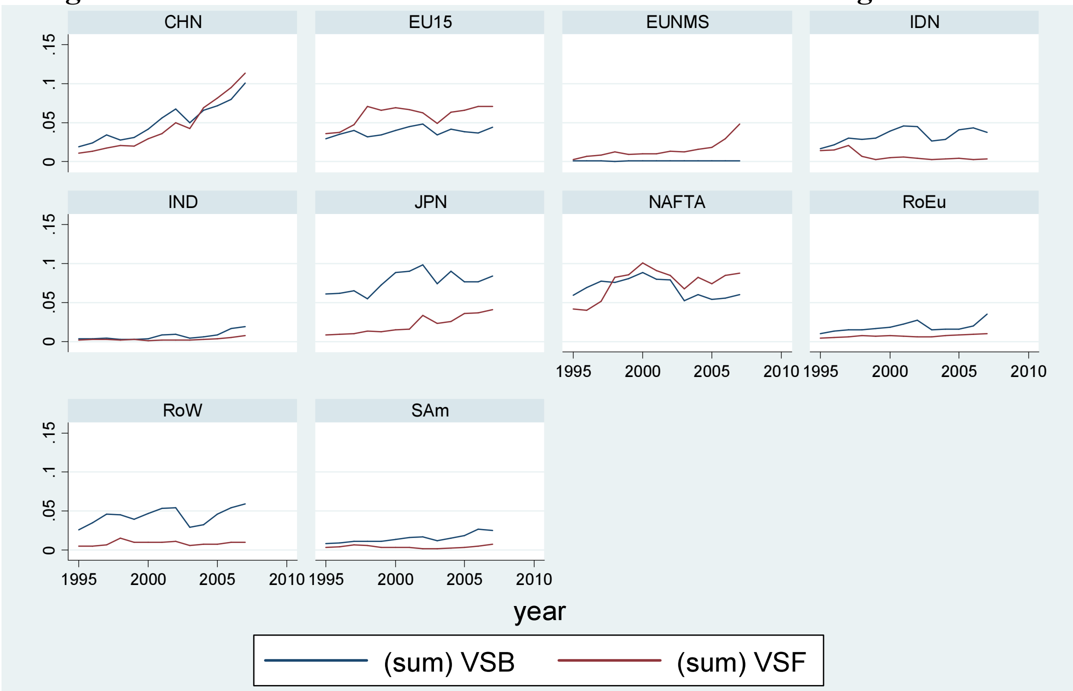
Figure 1.18: China's bilateral backwards and forward linkages 1995-2007



Source: Own calculations OECD I-O STAN database

When considering Korea's vertical specialisation patterns in Figure 1.19 it is noted that these have changed most with respect to China where both forward and backward linkages are growing fast and at similar paces. Within the region, Korea also shows strong backward linkages with respect to Japan, Indonesia and to a much lesser extent India. These patterns of specialisation suggest that it is an important supplier of intermediates to China, but it is dependent on intermediate inputs from Japan and Indonesia. Forward linkages are also strong with respect to partners outside the region, in particular the EU and NAFTA. The advanced negotiations of an FTA with the EU and the recent conclusion of an agreement with the US also suggest possible links between vertical specialisation and the formation of FTAs.

Figure 1.19: Korea's bilateral backwards and forward linkages 1995-2007



Source: Own calculations OECD I-O STAN database

1.7.4. Inter and Intra regional Observations

Several salient observations emerge from the above regional treatment of forward and backward linkages. These are easier to understand when subsumed into two broad categories. The first is a consolidation of linkages where existing trends are *amplified*. The second sees *changing patterns* in specialisation where the dominance of one link over another switches. The first type, where links follow a consolidating pattern, seems to be characteristic of the EU (i.e. Germany increasingly supplies intermediate products to its preferential partners). The second, where patterns of specialisation see a reversal of the dominant link, is more characteristic of the NAFTA region with Mexico and Canada becoming suppliers of intermediates to the USA rather than users. Intra-regionally, what emerges is that the EU process of integration is at a stage of inward consolidation whilst that of Asia and NAFTA is witnessing important changes in specialisation. Where inter-regional flows are concerned, China is consolidating its role as a supplier of intermediate products where these are predominantly towards the EU and NAFTA.

East Asia itself is increasingly vertically specialised. Evidence suggests that Japan and Korea are feeding inputs into China which is then selling products to North

America and the EU so that specialisation is also occurring extra-regionally. Just as Mexico has progressively become a source of intermediates to the rest of NAFTA, so China is also increasingly looking like a source of components rather than a mere assembler, which Korea is still for Japan. Meanwhile within the EU, Germany is increasingly importing intermediates from Japan and China and using them for its exports to other countries, notably developed EU partners. Poland remains an assembler[96].

1.8. Conclusions and Further Work

This essay's contribution to the literature on vertical specialisation is threefold. The first is through the development of a method that enables the extension of available indicators to capture the bilateral element of vertical specialisation which treats forward and backward linkages separately. This approach combines the use of trade data and input-output data in an innovative way. The second is the provision of a discussion on the non-monotonicity of these linkages which highlights some evidence purporting that countries appear to be moving up the value added ladder. The third is an appraisal of the interrelationship and spread of this process across preferential areas.

Some important new dynamics in the specialisation patterns across regions have been identified. Traditionally lower wage economies are expected to be net importers of intermediates which they can re-export to developed countries as assembled goods. However, in the case of US, China, Mexico relations, it is no longer the case that less developed regions just act as mere assembly lines for high value intermediate goods produced by more developed partners. The lower wage countries are increasingly becoming exporters of intermediates. Moreover prima facie substantiation of the

[96] A word of caution in the interpretation of these measures is worth repeating. The measure of vertical specialisation, and indeed 'value added trade' in Johnson and Noguera (2011), are computed rather than observed. In particular, the proportionality assumption applied in this essay, and in Johnson and Noguera (2011), implies that the use of imported intermediate is directly linked to changes in the composition of aggregate imports. Hence if the US increases its aggregate imports from China by 10%, the use of intermediates from China will increase by similar proportions (determined by the technical coefficients). This is limiting because the increase in imports may be driven by a rise in final good purchases. The advantage of Johnson and Noguera's (2011) indicators is that if the US increases its exports to Japan, and these feed into Chinese manufacturing, then they can net out US value added although their indicators remain computed rather than observed measures.

thesis that engaging in international value chains may be linked with changes in productivity has been presented.

The initial evidence presented in this essay also suggests that countries which are engaged in preferential trade deals show higher degrees of bilateral vertical specialisation. However the emergence of East Asian countries as sources of intermediate goods suggests the presence of other drivers of specialisation. Furthermore, countries engaging in regional trade agreements tend to be geographically close; hence the higher degrees of bilateral vertical specialisation may come as a result of proximity and not necessarily as a result of the agreements. It is equally possible that countries choose their bilateral partners well in that they exploit complementarities (Baier and Bergstrand, 2004). Nevertheless, one cannot discard the possibility that the perceived higher vertical specialisation within preferential partners is borne from the spread and depth of trade agreements. The empirical treatment of this question may reside in the endogenous trade policy realm where one tries to see whether trade agreements emerge as a result of increased integration of international value chains or whether these arise as a result of the trade agreements. Tackling these questions will require looking at the drivers of both regionalism and vertical specialisation in a more formal econometric setting. This is the focus of the remainder of this thesis.

ESSAY TWO

THE IMPACT OF FREE TRADE AGREEMENTS ON VERTICAL SPECIALISATION

Abstract

The concurrent international fragmentation of production structures and propagation, in recent decades, of FTAs suggests the presence of a link between these processes. In this essay, the impact of an FTA on this type of trade is investigated through a theoretically augmented gravity model of input trade. Controlling for the endogenous formation of trade agreements, through a set of country-year fixed effects, the empirical results suggest that an FTA increases the value of intermediate imports by 25%. However, when a more targeted measure of bilateral value chain activity is considered, capturing the value of intermediate imports used to service exports to the same country of origin, the FTA effect more than doubles to 65%. The results also suggest the presence of magnification effects which see bilateral value chain activity being more sensitive to changes in trade costs than traditional trade flows. They highlight that trade policy may play an active role in the propagation of such modes of production.

2.1. INTRODUCTION

This essay provides an empirical analysis of the impact of Free Trade Agreements (FTA) on vertically specialised trade[97]. The concurrent rise in the number of FTAs with the unprecedented growth in this type of trade (see Hummels et al., 2001; Yeats, 2001; Yi, 2003; and OECD, 2010 inter alia), strongly suggests that these processes are linked as does the evidence presented in the previous essay of this thesis. However, to capture the impact of an FTA on vertically specialised trade one has to isolate the trade policy element from other factors, such as proximity or income, which are also likely to determine the degree of bilateral vertical specialisation.

To this end, a theoretically motivated gravity model of input trade, similar to Baldwin and Taglione (2007 and 2011), is developed. The model draws on Ethier's (1982) concept of 'international economies of scale' where the division of labour is addressed through a Constant Elasticity of Substitution (CES) function on the production side. This functional form transposes the concept of 'love of variety' (Dixit and Stiglitz, 1977) to production in an attempt to capture the output gains that are described in Adam Smith's (1776) *pin factory* (see also Chakraborty, 2003). In the same way that consumers gain utility from consuming more varieties of products, firms may be seen to increase output through a greater spread in the use of intermediate input varieties (see Ethier, 1982 and Bas and Strauss-Kahn, 2011). This provides a representation of the gains that can be achieved from the fragmentation of production.

The impact of an FTA on this type of trade is then investigated through the estimation of the resulting gravity model of input trade. The empirical strategy draws on the endogenous trade policy literature to eliminate the biases that arise from the endogenous formation of trade agreements (Baier and Bergstrand, 2007). Unobserved heterogeneity is the likely source of bias and is caused by the presence of unobserved characteristics that simultaneously determine bilateral trade flows and the incentives to form trade agreements. It is suggested that a country-year Fixed Effects approach provides an adequate tool for capturing unbiased estimates of the FTA effect. The results then show that, on average and ceteris paribus, overall

[97] FTAs as defined in art. XXIV of the GATT/WTO.

imports of intermediate products are 25% higher between preferential partners. But the impact of an FTA is found to be 5 percentage points higher on intermediate imports used to produce exports, or, in other words, when these are part of an *international* value chain. The FTA impact is larger still (65%) on intermediate imports which are part of a *bilateral* value chain (i.e. where both the origin of the intermediate and the destination of the consequent export is the same country[98]).

These results suggest that imports belonging to a bilateral sequence of production are more responsive to changes in trade costs and income than traditional trade flows. This may be indicative of the presence of 'magnification' effects (Yi, 2003) which arise in vertically specialised sequences of production which are characterised by a back and forth movement of products across borders[99]. Because the removal of border barriers to trade can lead to sizeable reductions in the trade costs of such production sequences, FTAs can play an active role in promoting bilateral value chain activity. In the context of Romer's (1987) endogenous growth model, this puts forward a path through which trade policy may promote economic growth.

The methodological contributions of this essay are two-fold. First, it suggests that country-year fixed effects may be used to resolve issues of unobserved heterogeneity. These are less restrictive than the pair-wise fixed effects that are proposed by the literature (Baier and Bergstrand, 2007). These findings are particularly relevant for studies that use short panels where the variance of the FTA variable may be limited in time[100]. Second, this essay shows that a more widespread measure of intermediate goods trade, which relies on the identification of intermediate products through the BEC (Broad Economic Classification) nomenclature, performs as well as a measure that captures similar flows but is informed from Input Output tables. However, these measures do not serve as proxies for value chain activity as well as the more targeted measures developed in the previous essay of this thesis. It is found that the use that is given to imported intermediates is important in determining the impact that an FTA has on this type of

[98] An example of this type of trade can be found in the patterns of specialisation witnessed in the NAFTA region where Mexico exports intermediate products to the US who subsequently imports the finished processed good i.e. *maquiladoras* trade.
[99] Yi (2003) argues that the presence of these magnification effects help explain why world trade has increased at a faster rate than world GDP.
[100] This is likely to become problematic as trade agreements proliferate.

production. In particular, trade policy has a greater impact on value chain activity than it does on the import of intermediate products that are used to satisfy total output (domestic or exported).

The remainder of this essay is organised as follows. The second section provides a conceptual note on the role that trade agreements can play in shaping vertical specialisation. The third section then gives an overview of the challenges that are faced in capturing bilateral measures of vertical specialisation. It also discusses the empirical approaches used in the literature to analyse the impact of trade agreements on trade flows. Section four provides an appraisal of the theoretical literature focusing on how it can be applied to the case of vertically specialised trade. The fifth section presents a derivation of an empirically testable model of input trade. Section 2.6 discusses the empirical strategy, the data and the results obtained. Conclusions and a discussion of the main findings and shortcomings are given in the final section.

2.2. A Conceptual Note on the Impact of FTAs on Vertical Specialisation

There are two main channels through which FTAs may impact vertical specialisation. The first is through the shallow integration effects that arise from the removal of tariff barriers to trade. The second is through the removal of 'behind the border' measures which is commonly associated with elements of deep integration[101].

2.2.1. Magnification and Shallow Integration effects

The removal of tariff barriers to trade between preferential countries could have a two-fold impact on vertically specialised trade. This is because VS involves both an import and an export process. Because FTAs are reciprocal, this form of liberalisation may stimulate both a wider use of intermediate products from a preferential partner and also increase the market access for the associated exported

[101] To avoid repetition this section discusses different aspects of the possible role of FTAs on vertically specialised trade. It also provides a discussion of some of the issues that were highlighted in the previous essay but the reader is referred to that essay for a more in depth discussion.

product. This would occur when the reduction in trading costs leads to a reduction in the landed prices of both the intermediate good used and the final good produced. It then follows that the impact of an FTA on the amount of trade between two countries, in the presence of vertically specialised modes of production, should be positive (leaving issues of the extent to which this may be trade creating or trade diverting aside for now).

When production structures are shared between two countries and intermediate goods go back and forth numerous times between these, *magnification effects* may arise (Yi, 2003). Goods that cross borders multiple times incur import taxes at each border crossing. Hence the removal of tariffs could affect trade flows by a multiple of the amount of times that the product crosses a border. A simple mathematical example can help illustrate this point. Consider the value (v) of a product in any given country (A or B) to be represented by the simple equation $v = p\tau^n Q$ where p is the price of the product and is equal to one, τ is 1 plus the ad-valorem tariff barrier and represents iceberg trading costs, n is the amount of times that this product crosses a border and Q represents the quantity of this product which is also assumed to be unity[102]. Now consider this product moving across borders but not receiving any value added at any border crossing (this means that all values are held constant except the number of times the product crosses a border). Upon its first border crossing, i.e. when it is exported from country A to country B, n takes the value of one and the landed price in nation B is $p\tau Q$. But if this product is then re-exported to country A, the value of the product in market A becomes $p\tau^2 Q$. It can then be shown that the change to the value of the product is an increasing function of n; the amount of times the good crosses a border (holding all other things constant).

This crude example of tariff magnification effects suggests that removing a tariff barrier between two countries which are already heavily vertically specialised can have an important cost reducing effect tied to the degree of fragmentation, or border-crossings, between these countries[103]. Yi (2003) formalises this idea in a Ricardian framework. He argues that vertical specialisation can help explain the growth of world trade better than 'standard models'. These have to assume "counterfactually

[102] Assuming positive values and no drawback provisions.
[103] Although one can argue that drawback provisions will stop this magnification effect the idea still holds if you add a sequence of production involving three countries.

large elasticities of substitution between goods" (Yi, 2003:p.1) to reconcile the slow reductions in tariff with the large growth in trade flows in recent decades.

Hummels et al. (1999 p.25) hint that "as vertical specialization tends to magnify the effects of barriers, it may also magnify the welfare consequences, malignant or benign, of preferential barriers"[104]. Hence if there is indeed a higher responsiveness of trade flows to tariff cuts under more internationally fragmented production structures, then the Vinerian effects of FTAs, in the presence of vertical specialisation, could become more pronounced (i.e. magnified). And this will add to the fact that fragmentation may increase the base of tradables so that there will not only be more border crossings per product but also more products crossing borders. There might also be qualitative changes to how trade creation and trade diversion arises rendering their grasp even more complex. Because of the nature of vertical specialisation, there is room for trade creation and diversion occurring at both ends of the VS chain (import and/or export). If trade creation on the import side results in the reduction of input prices, it may then make the export industry more competitive and hence induce further trade creation on the export side. This introduces the possibility of complex feedback mechanisms. Additionally, there can be a simultaneous trade creating element on the export side and a trade diverting effect on the import side (or the reverse).

This increased dimensionality in transactions considerably complicates the traditional welfare analysis of trade creation and diversion (WTO 2011). Moreover, the new literature on offshoring and FTAs in the presence of incomplete contracts indentifies further channels of influence (Ornelas and Turner, 2008 and Antras and Staiger, 2011). Ornelas and Turner (2008) argue that the interaction between specific assets and incomplete contracts leads to a 'hold-up' problem that results in an inefficient amount of trade taking place. This hold-up problem arises because investment in production is carried out before payments are realised. The "ex-post haggling over prices leads suppliers to capture only a fraction of the return to their

[104] This was in the working paper that led to Hummels et al (2001). It seems that this statement did not make the cut for the final revision! However in light of the evidence presented in Yi (2003) this quote may remain relevant.

investment" (Antras and Staiger 2011:p10). This results in conventional trade models underestimating the responsiveness of trade flows to trade liberalisation.

2.2.2. What about the role of Deep Integration?

Where linkages between countries go beyond simple arms-length dealings and processes of international production demand common regulatory frameworks that ensure appropriate governance structures for value chain activity, deep bilateral trade agreements may prove even more beneficial. The creation of *common economic spaces* where institutional integration, market contestability, and regulatory cooperation are feasible may result in the establishment of positive externalities that facilitate the propagation of regional value chains. Although hard to define, deep integration generally involves some form of international cooperation in removing behind the border measures that restrict bilateral trade. These non-tariff measures (NTMs) generally arise from cross-country differences in regulatory frameworks.

It is hard to quantify the impact that deeper integration may have on value chain activity. This is because deep integration involves the creation of positive externalities which have wide-ranging effects. Conceptually, the formation of common economic spaces can set in motion mechanisms that enhance collaboration between firms. By reducing uncertainty in the realisation of contractual obligations, or through the creation of a favourable environment that bolsters investment, deep integration may not only reduce transaction costs but also provide an environment that is conducive to greater and more efficient economic interactions[105]. This may then lead to a wider propagation of technologies within an integrated area and may set in motion *learning by doing* mechanisms which can result in productivity gains and hence economic growth. Deep integration may also lead to larger trade flows between countries arising through the promotion of finer specialisation; a greater exploitation of economies of scale; or from the introduction of competition at finer levels of production.

[105] One example of deep 'institutional' integration is the EU's single market. It functions under a set of common regulations where the European Commission and the European Court of Justice (ECJ), supra-national institutions, defend the principles of the single market. If these are violated, the ECJ has the power of overturning a country or a firms' actions so that the regulations are adhered to. Similarly, the European Commission retains supra-national powers in issues related to competition policy. A common rule of law across an integrated area should result in a reduction in uncertainty and hence can promote area wide investment or cooperation between firms located in different MS.

An interesting feature of deep integration is that it need not necessarily involve deep institutional cooperation. The aforementioned gains can be achieved by private enterprises through self-imposed governance mechanisms (or standards). There are two interesting and contrasting examples of how the integration path and vertical specialisation can meet. The EU's deep integration initiatives that resulted in the creation of the Single Market may have played a pivotal role in the propagation of regional value chains. This is corroborated by the high degrees of vertical specialisation between EU members as seen in the previous essay. However the fast-paced integration initiatives in South East Asia seem to have come as a result of the widespread fragmentation taking place in the region. Regionalism in South East Asia seems to be playing catch-up to the rising demand for institutional harmonisation that has arisen from the regional spread of production networks (WTO, 2011). This then suggests that the process of vertical specialisation may come either as a result of, or lead to, further and indeed deeper institutional integration. This, in turn, raises issues relating to the endogeneity of these processes where vertical specialisation can lead to a greater demand for deeper trade agreements or alternatively deeper trade agreement can further promote vertically specialised trade[106].

2.3. CAPTURING THE EFFECTS OF AN FTA ON VERTICAL SPECIALISATION: PRELIMINARIES

The empirical analysis of the impact of trade agreements on vertical specialisation faces many hurdles; some of these were anticipated in the previous essay of this thesis. The first is that identifying products that are used as intermediates is not straightforward. Then there might also be issues arising from the valuation of these products where the 'double counting' of trade flows in trade statistics may be problematic. These issues result in the presence of a wedge between observed and 'actual' intermediate trade flows. They suggest that one needs to approach the use of indicators that serve capture vertically specialised trade with care.

[106] This issue is treated in a recent paper by Orefice and Rocha (2011).

The near absence of research into the impact of trade agreements on vertical specialisation is partly due to the elusive nature of what actually qualifies as an intermediate good – the *identification problem*. And also from the valuation of trade flows in national trade statistics – the *valuation problem*. These issues are discussed at greater lengths in the previous essay of this thesis and hence section focuses on some of the consequences that these issues might have on empirical analysis.

The identification of intermediate products is not straightforward. Despite the Broad Economic Classification (BEC) giving some guidance, complications in identifying intermediate products remain owing mainly to the non-exclusive use of these products. When products can be used as either intermediates or final consumption goods, these classifications can lead to an over or an under identification of the actual amount of trade in intermediates taking place. This suggests that different identification methods should be pursued in an empirical analysis.

The valuation problem then adds to this through a possible 'inflation' of the value of trade that is taking place between countries. Trade statistics are computed in such a manner that the entire value of a product, and not the value added, is captured at each border crossing. Resulting from this is a possible 'double-counting' of trade (see Daudin et al., 2008; and Johnson and Noguera, 2011). As there is little knowledge on the decomposition of value added between countries, it is hard to identify the severity of this problem. However the net/gross distinction in the way trade statistics are computed may have implications in the estimation of gravity models (this is discussed at greater lengths in the Appendix A2.1). But this only becomes an issue if the theoretical models suggest that net trade flows rather than gross trade flows need to be considered. The expenditure functions that are typically used to derive gravity point to the use of neither in particular and arguments for using net or gross flows can be equally defended. On the one hand, the realisation of an import involves paying the gross value of the product, however on the other, if this imported product contains domestic value added then one can argue that part of the product is already 'accounted for'. Much of the research in the field of the net/gross distinction has been concerned with obtaining net valuations of trade flows (Johnson and Noguera, 2011; Koopman et al 2008; and Daudin et al, 2008), but the implications of using one over the other in gravity estimations has received little attention to date.

But even if intermediate goods can be appropriately identified and valued, it is also possible that FTAs have an impact on these flows that is contingent on the use that is given to these products. Intermediate inputs can be used to supply the domestic market or alternatively export markets, and this distinction may be important. In the heterogeneous firm literature (Melitz, 2003), firms engaged in export markets possess a productivity advantage over firms that satisfy domestic markets. The work of Bas and Strauss-Kahn (2011) hints at the existence of similar differences between firms engaged in production for domestic markets and those participating in value chain activity. Because FTAs are likely to promote the activity of such firms to a greater extent than those solely engaged in domestic sales (see previous discussion on magnification), then it might be expected that the impact of an FTA is different across the use that is given to intermediate products. The use of indicators of bilateral vertical specialisation, as developed in the previous essay, may mitigate some of these problems and allow one to capture different facets of international production.

2.3.1. THE BILATERAL VERTICAL SPECIALISATION INDICATOR

The indicator favoured in this essay tracks *bilateral* vertical specialisation. Up until now, the main hurdle in looking at the role of trade agreements in enhancing vertically specialised trade has been that current measures of this phenomenon have only been able to capture *total* degrees of VS with respect to the world rather than with respect to bilateral partners. The extension of the VS indicator made in the previous essay of this thesis presents the opportunity of capturing the degree of vertical specialisation across country pairs. This then paves the way for an estimation of the role of trade agreements in this process. In its raw form, the indicator is based on Hummels et al. (2001) but it is extended so that the bilateral element of value chain activity can be identified. It is computed using input-output tables merged with trade data from the following equation:

$$VS\_B_{i,j} = \mu A^{m}_{i,j}[I - A^{D}_{i}]^{-1} X_{i,j} / X^{TOT}_{i,j} \tag{2.1}$$

Where μ is an *1 x n* vector of 1's, $A^{m}_{i,j}$ is the *n x n* imported technical coefficient matrix of country i from partner j, $[I-A^{D}]^{-1}$ is the *n x n* Leontief inverse, X_{ij} is an *n x 1* vector of exports of country i to country j, and $X_{i,j}^{TOT}$ is a scalar representing the sum of the values of this export vector (i.e. total exports to country j).

The indicator captures the value of imported intermediates, from a given origin, that are used in the production of exports to a chosen destination as a share of exports to that destination (the backward linkage). By embodying a production sequence where intermediate products are sourced from abroad, combined with domestic value added and subsequently exported, the measure captures the conveyor-belt nature that typifies international value chain activity. It is different from other measures that have been used in the empirical literature because it tracks the *use* given to intermediate products (rather than the overall value of intermediate goods trade as in Feenstra (1998) and Yeats (2001) which rely on the BEC nomenclature). The use is identified from the combination of the bilateral imported input coefficient matrix ($A^{m}_{i,j}$) with different output vectors. If the output vector where to reflect total demand (domestic and international), the indicator would just be the proportion of intermediate imports from country j over total output. However when the output vector reflects exports, as in 2.1, it should represent a measure of value chain activity.

It will be convenient, in the empirical section, to differentiate across three uses, or indeed types, of intermediate products. The first is the value of intermediates that are used by the economy, irrespective of the final use that is given to these. Such flows will be indexed with the suffix '_tot' throughout. The second captures the intermediate products that belong to a process of vertical specialisation, and are thus used to produce exports to *any* international destination (i.e. total exports). The suffix that identifies this instance will be '_bvs'. The final use that can be given to intermediate imports also involves an exporting activity, but this export is towards the country from which the imported intermediates originated (i.e. exports to country j). This will be identified through a '_bvsbil' suffix. This captures a fully bilateral element of value chain interactions where countries use each other's output in a series of sequenced production steps. A real world example of such production sequences arises in *maquiladora* trade where Mexico imports intermediate products from the US and subsequently exports finished products back to the US.

Although input-output measures of vertical specialisation are very useful, they also have their limitations. The country coverage of IO tables is restricted and so is the coverage in time so that these indicators can only be calculated for a selection of relatively developed countries during a rather short time span. The fairly aggregate sectoral aggregation of these tables also hides important sub-industry level linkages that cannot be captured[107]. In addition, the measures of vertical specialisation are computed, or inferred, rather than observed and can hence be driven by some of the restrictive assumptions that are needed for their calculation (see previous essay for further details). Nevertheless, these measures allow one to disentangle the use of intermediate products and hence are more in tune with 'actual' production linkages than trade based measures. These might then provide a more accurate depiction of value chain activity which motivates the use of this indicator in looking at the impact of FTAs on vertical specialisation[108].

2.3.2. Empirical Methods: the gravity model

Looking at the impact of FTAs on trade has generally been approached through a gravity model. It draws on Newton's law of gravity which sees the force between objects as a function of a gravitational constant times the product of the combined mass and the squared distance. Economists have taken the objects of this equation to be countries and used GDP measures to capture their mass in an effort to explain bilateral trade flows. The strong empirical explanatory power of this set-up has led to its widespread use despite a lack of initial theoretical grounding[109]. It was Anderson (1979) who was first to provide a theoretical backbone to Tinbergen's (1962) novel empirical application. The empirical success of the gravity model is now partly attributed to the fact that its derivation can be achieved on the basis of many different theoretical models (see Evenett and Keller (2002); Helpman et al. (2008); and Anderson (2010)). Over 30 years after his original contribution, Anderson (2010:p1) states that the model is no longer an "intellectual orphan".

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[107] Leontief 'technologies' are aggregated across a very narrow set of sectors.

[108] See the previous essay of this thesis for a wider discussion on the extension of this indicator to capture bilateral interactions and also a survey of the extent of vertical specialisation across countries and regional partners.

[109] Some of the most influential theoretical justifications can be found in Anderson (1979), Deardorff (1985), Bergstrand (1985, 1989), Anderson and Van Wincoop (2003).

The gravity model can be derived from an expenditure system where the amount of exports a country sells to another is a function of how much the partner country spends on tradable goods (from all destinations) times the share the partner country spends on a typical good variety in the origin country. This share then depends on the real price of the goods which then varies with the costs of transactions. As way of example, a first approximation to the derivation of a gravity model with complete specialisation and homogeneous consumer preferences in a frictionless world can be shown (following Anderson, 1979)[110]. Consider a world composed of two countries where trade is costless. Exports of country A to country B are determined by country B's marginal propensity to consume country A's products (s_A) so that $X_{AB}=s_AY_B$. Country A's total income (Y_A) is the sum of domestic sales and exports to country B. Where preferences are homogeneous ($s_A=s_B=s$) the following condition will hold $Y_A= s(Y_A+Y_B)$. Solving for s and substituting back into the export equation the simple frictionless gravity model is obtained[111]:

$$X_{AB} = \frac{Y_A Y_B}{Y_w} \tag{2.2}$$

Adding trade frictions (τ) to this model is relatively simple and yields a gravity specification much like equation (2.2) but where a τ parameter, capturing trade costs, is introduced in the denominator. Extending this to include a set of countries, and maintaining the complete specialisation and homogeneous preference assumptions, enables the estimation of the log-linearised gravity equation which has the following form:

$$LnX_{ij}=\beta_0 + \beta_1 lnY_{i,j} + \beta_2 lnY_{i,j} - \beta_3 \tau_{i,j} + u_{i,j} \tag{2.3}$$

where β_0=-ln(Y_w) and $u_{i,j}$ is i.i.d. Trade frictions (τ) between countries are generally captured through geographical indicators (great circle distances; contiguity) and institutional dummies (FTAs for example). Anderson and Van Wincoop's (2003) contribution was to augment this equation by incorporating 'multilateral resistance'.

[110] See Evenett and Keller (2002) for a discussion of the derivation of the gravity model under different assumptions such as imperfect specialisation.

[111] Where Y_w is equal to $Y_A + Y_B$.

They found that trade flows between two countries were not only affected by their proximity, but also by how remote these were from the rest of the world. They rationalised McCallum's (1995) puzzling findings that saw the border effects between Canadian provinces and US states reduce trade by over 2000% by adding relative price indices. They found that the inflated border effect fell to 60% when multilateral resistance is accounted for[112].

The gravity model of trade has since been extended and used in many ways. Rose (2003) sought to capture the impact of monetary unions on trade flows, and the use of these models to capture the effects of FTAs on trade flows is widespread; Soloaga and Winters, 2001; Carrere, 2006; Baier and Bergstrand, 2007; and Magee, 2008, are but a few notable examples. Through Helpman et al. (2008), the gravity model can now be derived in a world of 'heterogeneous firms' (Melitz, 2003) so that export market selection can be modelled (which deals with the presence of zeroes in the trade matrix). Chaney (2008) then uses a similar set-up to include the intensive and extensive margins of trade.

Extending the gravity specification to a world with intermediate goods trade has received little attention. One notable exception is found in Baldwin and Taglione's (2011) working paper. Although they are primarily concerned with the role of the 'mass' variables in a world with increased trade in parts and components, their approach sets an important precedent for the use of gravity models in looking at trade in intermediates. Baldwin and Taglione (2011) use the shorthand assumption, common in the economic geography literature, that trade in final goods is isomorphic to trade in intermediate goods, hence they derive their gravity model of intermediate goods trade from a consumer expenditure function that follows Baldwin and Taglione (2007). They argue that the mass variable in the estimation should be gross output rather than the value added measures of GDP that are commonly used. In a world that is interconnected and where demand comes from varying locations net

[112] McCallum's inflated results were also being driven by the size of the different regions.
Although AvW's model requires information on relative prices, which is often not available, and it assumes that trade costs are symmetric across partners, Feenstra (2002) shows that a similar specification can be obtained without the restrictive symmetric trade costs assumption. Additionally, Feenstra (2004) argues that multilateral resistance does not require data on relative price differences because multilateral resistance can be controlled for, in an econometric specifications, using reporter and partner country dummy variables.

measures of output are less representative of the interactions that take place and hence gross measures would be preferable. If indeed trade is measured gross, then so too should income owing to the general equilibrium conditions of the model where total imports, from all origins, including the domestic economy, are equated to total income.

Although only implicitly derived, Baldwin and Taglione's (2011) paper appears to suggest that trade in intermediates is motivated by similar factors that encourage trade in final goods. Hence if the derivation of gravity can be achieved through a production function, in lieu of the expenditure function approach used by Anderson (1979), then it should show similar attributes to its total trade cousin. However, such a derivation will demand greater emphasis on production functions. In particular one may need to consider that if the output of a given country can be used in the production sequence of another, then one is moving away from a world of competing trade to one where trade becomes complementary.

2.4. A REVIEW OF THE RELATED THEORETICAL LITERATURE.

Vertical specialisation, but more generally trade in intermediate goods, has been approached using an array of theoretical models. These have been grounded in the confines of traditional and 'new' trade theory and serve to explain different facets of what is a similar phenomenon. They range from; standard Ricardian models (Sanyal and Jones, 1982; Feenstra and Hanson, 1996; Deardorff, 2001; and Yi, 2003); H-O frameworks (Jones and Kierzkowski, 2001; Deardorff, 2001; Arndt, 2002; Baldwin and Robert-Nicoud, 2010); new trade theory approaches (Ethier, 1982; Burda and Dluhosch, 2002; Lüthje, 2001 and 2003); to New Economic Geography settings (Venables, 1996; Krugman and Venables, 1996; Fujita et al., 1999; Baldwin and Taglioni, 2011)[113]. Many of these approaches are theoretical in nature and not readily

[113] More recently, a theory of offshoring based on *trade in tasks* (Grossman and Rossi-Hansberg 2008) rather than goods gained prominence. It supports Blinder's (2006) call for a new paradigm suited to the *new unbundling* (Baldwin 2006 and 2010) phenomenon under which vertical specialisation falls. But Baldwin and Robert-Nicoud (2010) suggest that there might not be need for such a *new paradigm*. They argue that offshoring can be incorporated into the mainstream of trade theory through induced productivity gains arising via technological change.

testable but they provide the foundations of the model that will be presented in the next section.

A new theory explaining the causes and consequences of vertical specialisation is probably not needed. This is a new phenomenon, but it may still be driven by similar comparative advantages and economies of scale forces. They may have just become more apparent since they occur at finer levels and involve different units of analysis[114]. McKinnon (1966) was first to argue that trade in intermediate products "led a rather shadowy existence in the formal pure theory of international trade", this despite accounting for 60 - 70% of world trade. Ethier's (1979 and 1982) theoretical underpinnings then provided a first attempt at incorporating intermediate products into mainstream 'new' trade theory. In parallel, Sanyal and Jones (1982) also produced a model of trade in 'middle products' where, as in Ethier's (1982) derivation, all trade took place in intermediate goods[115]. Ethier justifies this approach by arguing that traded products tend to receive some form of domestic value added before they reach final consumer. What these papers suggest is that tackling vertical specialisation may best be approached from a producer's perspective. Indeed Ethier (1982:p391) argued that "producer' goods are in fact much more prominent in trade than are consumers' goods". And it seems that this observation is possibly more relevant today than when it was written[116].

2.4.1. Traditional Trade Theory approaches

Owing to growing empirical evidence on the prevalence of this type of trade, intermediate products and indeed vertical specialisation have received mounting attention. Yi (2003) was first in underlining the importance of vertical specialisation in explaining the growth of trade. Using a Dornbusch, Fischer and Samuelson (1977) dynamic Ricardian model, he showed how tariff dismantlement could motivate vertically specialised sequences of production arising through the increased exploitation of technological differences across countries. In contrast, the H-O

[114] see Blinder's (2006) new dichotomy arising from offshoreable and non-offshoreable tasks.
[115] Sanyal and Jones' (1982) model assumed a very specific form of production occurring in input and output tiers. The former saw the combination of resources (local) to produce output that would subsequently enter the world market. The latter would see domestic use of intermediate products combined with local value added to produce final consumption goods.
[116] see Feenstra 1998; Yeats 1998, 2001 and Hummels et al 2001 amongst others for accounts of the rise in intermediate goods trade and vertical specialisation.

approach to vertical specialisation (Deardorff, 1998) sees countries specialising in the segments of production which use their relatively abundant factor of production. Fragmentation introduces scope for further specialisation across segments requiring different factor inputs and hence this type of production yields the classical gains from trade but in greater magnitudes given that specialisation occurs over a larger array of products. Arndt (2002) linked this set-up to regional integration and argued that entering into an agreement with a country with different factor intensities could result in a more efficient allocation of tasks (resources) across countries.

Most of the new approaches to vertical specialisation rely on such cross-country differences as drivers of fragmentation. Grossman and Rossi-Hansberg's (2006 and 2008) theory of offshoring introduces the concept of *trade in tasks* supporting Blinder's (2006) call for a new paradigm suited to the *second unbundling* (Baldwin 2006 and 2010) phenomenon under which vertical specialisation falls. The basic idea is that fragmentation leads to gains that are akin to factor augmenting technological change. Fragmentation is beneficial because it exploits cross country differences in factor intensities. In this line, Baldwin and Robert-Nicoud (2010) argue that there might not be a need for a *new paradigm* as offshoring is akin to productivity gains that arise through technological change.

However, evidence suggests that much vertically specialised trade takes place amongst similarly endowed economies (see previous essay) and hence that models that incorporate product differentiation may be important too.

2.4.2. 'New' Trade Theory and Applications – the love of input variety

The 'new' trade theory models of Krugman (1979 and 1981), and Helpman and Krugman, (1985) are set in a monopolistically competitive world where product differentiation satisfies consumers' 'love of variety' (Dixit Stiglitz 1977). This set-up proved to be more in line with the patterns of trade of modern economies where the simultaneous import and export of similar final products was commonplace. In such models, consumers demand different varieties of products and gain 'utility' from consuming more varieties. However, recent evidence suggests that intra-industry trade is nowadays increasingly taking place in intermediate rather than final products (Yeats, 2001).

In the same way that traditional 'love of variety' models cater for consumers attaining a higher utility through the consumption of extra varieties, similar setups can also model how firms may attain lower costs of production through the use of more intermediate inputs. This may reflect the gains that can be derived from vertical specialisation. If the entry of a new product variety identifies an increase in the degree of fragmentation, then, it can be shown that, like in the case of the utility of a consumer, firms should be able to increase the output they produce holding everything else constant[117].

The 'love of variety' that drives models of product differentiation is intuitively easy to grasp, however transposing this modelling framework into a firm's demand for inputs requires a little more thought. One would need to identify how, and if, firms gain from having access to a greater landscape of intermediate products. A priori, a greater availability and demand for intermediate products presents firms with new opportunities to more narrowly specialise along finer defined comparative advantages. The fragmentation of production structures may also liberate resources occupied in the inefficient production of in-house intermediates. An increase in the amount of intermediate products available may also act as an insurance mechanism against an over-reliance from a particular supplier. It may also increase the diffusion of technology or indeed afford producers the option of buying a particular input that they would not have been able to produce themselves[118]. This points to the possible existence of a 'love of input variety'. And this has desirable modelling properties. It implies that the production function can be modelled using a CES aggregate of inputs in the classical Dixit-Stiglitz setting as in Ethier (1982)[119]. The division of labour can

[117] They can operate at a lower iso-cost line.
[118] See Goldberg et al (2009) for empirical evidence on the links between an increase in input varieties contributing to the expansion of product scope (as discussed by Bas and Strauss-Khan (2011) who also provide evidence of such links for a sample of French firms).
[119] Luthje's (2001 and 2003) adaptation of Lancaster's (1979) concept of 'ideal varieties' may also be important. This approach is borne from the assumption that for every final good, there exists an ideal intermediate good/input that fits the production sequence perfectly. If this ideal variety is not available, then firms will have to devote resources to the transformation of an input so that it matches the required ideal specifications. Contrary to the love of variety approach, the ideal variety approach posits that an increased use of intermediate goods does not translate directly into greater production

then be captured by the degree of fragmentation or the use of input varieties in production and can benefit from 'international economies of scale' (Ethier, 1982).

However, under such frameworks, the introduction of a new intermediate variety leads to a proportional marginal reduction in the use of all other inputs. This is a consequence of the monopolistic competition assumptions which require there to be a common price for all inputs used. Given the common elasticity of substitution and the fixed budget constraint which typifies these models; as the number of varieties tends to infinity, the quantity of each variety used tends to zero. This restriction implies that the technological requirements needed to produce a unit of output are uniform in the use of all available intermediate varieties. This stands at odds with what we learn from how firms operate or indeed what we see in Input-Output tables where technical coefficients vary and industries use inputs in different proportions. This suggests that these models may need to be altered in an effort to capture a heterogeneous use of input varieties. Indeed Krugman's original model (1979, 1981) included a preference parameter that served a related purpose. Using a similar set-up, where the preference parameter becomes a technological requirement, can bring these models closer to the realities of modern production.

In keeping with trying to reconcile these models with the realities of production, another addition may also be warranted. The traditional Dixit-Stiglitz approach to love of variety is unbounded. This implies that consumers derive the same amount of extra utility from the consumption of any extra variety, irrespective of how many varieties are already on offer. Transposing this concept to the case of a CES production function that aggregates intermediate inputs implies the existence of an unlimited 'love of input variety'. Such an outcome is much less desirable, and indeed defendable, in the presence of cost rather than utility functions. But it is possible to follow Ardelean (2006) in creating a bounded love of variety. The introduction of a parameter that identifies the number of varieties on offer and which is dependent on the elasticity of substitution can be used for such a purpose. This is akin to saying that when inputs are highly substitutable, then the addition of an extra product is less

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possibilities. Although a greater availability of intermediate varieties increases the probability of the ideal good variety being produced and hence gains may be achieved through this channel too.

beneficial to the production of output (the reverse also holds where the output gains from an extra variety are higher if products are not close substitutes). This reflects the fact that less specialised products, which might be more similar, are less valuable to the production process. Or similarly; that more specific inputs may be better adapted to production than more generic ones.

A monopolistic competition approach to intermediate goods trade implies the existence of an extensive margin of inputs as is implicit in the models based on Ethier's (1982) conjectures. More intermediate varieties used in production imply a finer division of labour which then suggests that the scope for vertical specialisation may be tied to the amount of intermediate varieties that partner countries produce. Countries that produce more varieties may then trade more with each other. This idea is similar to the 'vertical linkages' (Venables, 1996) that arise in the economic geography literature where firms' location is, in part, determined by how easily accessible downstream markets are.

2.4.3. New Economic Geography Insights

New Economic Geography (NEG) models may also be well suited to the analysis of vertical specialisation. Venables' (1996) model identified the linkages between upstream and downstream firms within an economic space. Krugman and Venables (1995; henceforth KV) captured the same relationship but they allowed a representative firm to take on the role of both upstream and downstream activities. The difference between economic geography and new trade theory models is that firms in the former are allowed to relocate across regions. Hence this literature is concerned with the forces that determine this location rather than with the origins of the flows of products. Nevertheless, its modelling insights are important as these incorporate sequences of productions where intermediate inputs are processed to produce output.

The KV model predicts that an increase in the number of firms within a spatial location brings about three important effects (Krugman and Venables 1995;p.864). The first is a reduction in the price of manufactured products, which, by construction, can serve as both intermediate and final products. The introduction of a new firm, or variety, reduces market power and hence sees a shift in the demand curve, implying a loss in firm profitability, for all producers. However, if manufacturing firms use manufactured inputs as intermediates, the reduction in price also reduces the total and marginal costs of firms. This may then reverse the loss in profitability. KV term this the forward linkage effect. Additionally, there is also a corresponding increase in the demand for products and this gives rise to increases in the total expenditure on manufactures. This is the backward linkage effect[120].

This approach to production may be relevant in the analysis of vertical specialisation for two reasons. Firstly, because the emphasis on the linkages between firms and the role of transport costs resembles the link between vertically specialised trade and regional integration. This is to the extent that trade agreements play a role in reducing transaction and/or trading costs. The second reason relates to the 'conveyor belt' approach which closely reflects value chain activity. More traditional delimitations of production generally assume that intermediate inputs always serve the purpose of producing final output, but if one is part of a sequenced production chain, then the output of one firm becomes the intermediate input for the next segment of production. If this is the case, then the efficiency of production of suppliers matters for your own efficiency of production (see Samuelson, 2001 for a simple implication of this in a Ricardian setting).

The NEG framework is useful in modelling vertical specialisation because this process involves the geographical dispersion of production. However, incorporating multiple locations to this type of set-up can be particularly tricky because of unstable or multiple equilibriums. Hence instead of augmenting the NEG models, one can draw on their characteristics to inform a theoretical approach to vertical specialisation as in Baldwin and Taglione (2011). This involves taking the separation of production as given rather than trying to explain how it arises. This is convenient because this investigation is not interested in how firms locate in different markets, but rather in the role of trade policy in promoting the process of fragmentation or indeed the origins of intermediate inputs.

2.4.4. Other Approaches

[120] Note that these linkages are different from those defined in the previous essay.

Whilst the models discussed above tend to be based on the traditional Krugman assumption of firm homogeneity, recent findings, from the heterogeneous firm literature, pioneered by Melitz (2003), suggest that this may be an unreasonable assumption. It is now well established that firms operate under different costing structures and that not all firms in an economy engage in export markets. This strand of literature incorporates this empirical regularity into a theoretical framework. It posits that firms within a country draw their productivity from a distribution. Those whose draw is above a certain threshold are able to engage in export markets because they can face a fixed cost that is required to enter these markets. A productivity draw below this threshold confines a firm to producing either for the domestic market or not at all[121].

One direct empirical implication of this literature, which might be relevant to the case of vertically specialised trade, is that the amount of traded varieties is a subset of total world varieties. This is consistent with the observation that countries which have larger domestic markets tend to exhibit lower degrees of vertical specialisation (Nordas 2004)[122]. A wider array of readily available intermediate products at home implies less dependence on world markets for inputs and hence the introduction of heterogeneities in the degrees of vertical specialisation across countries. The theoretical backbone of Helpman et al.'s (2008) model is of particular relevance here. They derive a gravity model using insights from the heterogeneous firm literature. In this model heterogeneity arises from the presence of a marginal cost with two components. The first is firm specific and its inverse identifies a firm's productivity in the production process. The second is country specific and identifies the productivity of the factors of production of a country. These marginal costs then determine how a firm can face the fixed costs associated to entering export markets. If income per capita can reflect the productivity of the factors of production in a country then richer countries should be able to sustain more exporting firms. This would imply that they would export more intermediate varieties.

[121] This is in line with the accepted notion that it is only the most productive firms that engage in export markets. However issues of causality remain unresolved. Are firms productive because they export or do they export because they are productive?
[122] Although some firms may also be able to fragment more.

Another possibility is that countries that use more imported components, or whose firms engage in wider international vertical specialisation, derive a productivity boost from this activity and hence are more prepared to engage in export markets. These productivity effects could be achieved through various channels. First through Ethier-type international economies of scale, and perhaps secondly through the backward and forward linkages predicted by the NEG models. The lower marginal costs that may be achieved through a better utilisation of inputs could then provide increased resources to face the fixed costs to exporting. This mechanism is not directly discussed in the heterogeneous firm literature which remains relatively silent on the origin of these productivity differences. A very recent paper by Bas and Strauss-Kahn (2011) suggests the presence of such a link between participation in value chain activity and productivity gains. Furthermore, the correlation between productivity growth and vertical specialisation observed in the previous essay of this thesis also lends some supporting evidence to this idea.

The above discussed theoretical approaches can guide an understanding of vertical specialisation. However, there is a parallel strand of literature that deals with the organisational aspects that arise from such modes of production which is also likely to be important. Supply side models such as that of Burda and Dluhosch (2002), discussed in the previous essay, are good half way steps between these. Here cost competition drives Smithian specialisation and fragmentation is modelled through an index, z, which denotes specialisation across stages of value added across within a value chain. Although fragmentation reduces production costs, it incurs a coordination cost arising from the larger complexities of the shared production sequences. The interplay between these costs then determines the desirability of engaging in vertically specialised trade.

This concept of a cost to the coordination of value chain activities comes from the literature pioneered by Ronald Jones and Henryk Kierzkowski[123]. They motivate a narrative on fragmentation based on producer service costs which fits in the broader context of the analysis of the organisational choices of firms and Multinational Enterprises (MNEs). It is concerned with the organisation of transactions and/or the

[123] See Jones and Kierzkowski (1990, 1997 and 1999) Also see Arndt and Kierzkowski (2001).

governance of value chains in the presence of international fragmentation. Here a distinction is made between various forms of transactions that occur either between or within firms (or MNEs) situated in different countries. These can take forms such as arms-length dealings or parent-affiliate trade. The organisational choices of firms may play a role in shaping vertical specialisation through, for example, the diffusion of technology across affiliate firms. In this line Markusen's (1989) Knowledge-Capital model involving investment flows is of particular relevance. More recently Antras and Staiger (2011) also identify other sets of costs that arise from the customisation of inputs and the lock-in effects arising from incomplete contracts between importing and exporting firms in the presence of offshoring.

One of the main challenges with approaching the analysis of the role of trade agreements on vertical specialisation through these organisational models is that the empirical analysis generally requires detailed data on firm activity and ownership which is not readily available or indeed comparable across countries[124].

Looking back at the different approaches that one can draw upon to model value chain activity suggests that there is no lack of tools to deal with this type of trade. However, tackling the determinants of vertical specialisation from one approach rather than from another will result in locking the model to the approach's dominant assumption. It is important to underline that the traditional frictions between the older trade theories of comparative advantages and those of product differentiation are likely to remain. The one favoured in this essay is the latter both for its convenience and its characterisation of value chain activity. Although this does not mean that traditional trade theory forces, in the form of comparative advantages, derived from either technological or factor endowment differences, are not going to play a role.

It is also worth mentioning that the organisational choices of firms, and to a broader extent the interactions between these, are also going to be important. The institutional arrangements governing transactions and the environment in which these operate will be chief. This is where trade policy, and particularly international

[124] Another notable contribution on the organisation of firms and production across national borders can be found in Grossman and Helpman (2004).

institutional cooperation, or regulatory harmonisation, is likely to play a role. Firstly through the elimination of tariff barriers to trade or the shallow integration effects, but perhaps more importantly through the role that deeper integration can play in bolstering value chain activity. The creation of stable trading environments need not only facilitate the search for appropriate partners, but should also provide a legal basis for economic interactions and disputes. A coherent rules-based system would then be conducive to the creation of 'thicker' markets which may play an active role in reducing transaction costs (see Antras and Staiger 2011).

2.5. A GRAVITY MODEL OF INPUT TRADE

The impact of FTAs on trade flows has traditionally been captured through the introduction of various dummy variables, delimiting the presence (or absence) of an FTA between two partners, to a gravity equation[125]. The goodness of fit of these models leads Anderson (2010:p.1) to argue that the gravity model is "one of the most successful empirical models in economics". However, these models are usually derived from consumer theory through an expenditure system (see Anderson (1979) and Anderson and Van Wincoop (2003)). This is an inappropriate setting for a model of input trade which should be approached from the production side. Baldwin and Taglione (2011) bypass this step by assuming that the demand for intermediate goods is isomorphic to final demand which is derived from consumer theory. This is a convenient and not unreasonable assumption, but some important insights may be lost in the process[126].

The aim of this section is to provide a model of input trade from the perspective of the producer. This is accomplished by relating input demand to typical gravity variables. It does not seek to provide an exhaustive theoretical framework of supply conditions across different countries in the presence of vertically specialised trade but rather to justify the use of a gravity model in subsequent estimations. In the process, the model draws on elements from Ethier (1982); Fujita et al (1999);

[125] There are many examples of papers that have used gravity models to look at the impact of trade agreements on trade flows but perhaps the most salient are Soloaga and Winters (2001) Carrere (2006) and Baier and Bergstrand (2007).

[126] It is also a very common assumption of the NEG literature.

Anderson and Van Wincoop (2003); Ardelean (2006); and mainly Baldwin and Taglione (2007, 2011).

A gravity model of input trade can be approached from the supply side, as in Helpman et al (2008) and Channey (2008), or alternatively from an input demand function. The former approach is chosen for its similarity with the traditional derivations of gravity (i.e. Anderson, 1979, Anderson and Van Wincoop. 2003 and Baldwin and Taglione 2007 and 2011) and also for its simplicity[127].

2.5.1. THE MODEL

A representative producer in country *i* produces output (X_i) by combining differentiated intermediate inputs (*x*). These are sourced from an array of origins M (M= j=1, 2, ...), who produce a heterogeneous number *n* of differentiated varieties. The substitution between inputs is captured by the parameter σ so that the production function is additively separable and exhibits a constant elasticity of substitution (CES). This is assumed to be above unity so as to reflect the *international economies of scale* of Ethier's (1982) model. The efficiency with which inputs are combined is captured by a country specific term A_i leading to the following representative production function:

$$X_i = A_i \left[\sum_M \sum_n x_{i,j}^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} \tag{2.4}$$

The CES aggregator captures the gains that can be achieved from the fragmentation of production structures. A particular case of this production function serves illustrate this point. If there are no technological constraints in the use of varieties; and all countries produce a homogenous amount of inputs because firms are symmetric across countries (i.e. identical cost structures in the production of intermediates), then it can be show that the above expression collapses to[128]:

[127] A supply side approach to the derivation of gravity with vertical specialisation, although highly desirable, is beyond the scope of this study. The demand side approach requires less limiting assumptions and serves capture the most important facets of intermediate goods trade.

[128] The identical cost hypothesis implies that the A_i term in this instance is the same across all countries and can be thought of being equal to 1. This simplification is for expositional purposes.

$$X_i = (Mn)^{\frac{\sigma}{\sigma-1}} x$$

(2.5)

This implies that holding everything else constant, output (X_i) is an increasing function of the number of intermediate products n that are used (assuming that the substitution parameter is above unity). If the number of intermediates used goes hand in hand with the degree of fragmentation of a production sequence, then this set-up mimics the gains originally depicted in Adam Smith's Pin Factory. This is because each 'task' leading to the creation of a pin can be seen to yield a 'new' intermediate product. So that the sharpening of the iron produces an intermediate good that is a 'sharpened iron piece'; and the process of adding the head of the pin then produces another intermediate product which is a 'sharpened pin with a head'. Then each step of the production of a pin can then be associated with the use of a new intermediate product.

The use of such a CES production function follows Ethier (1982) and is also similar to Romer (1987) and Chakraborty (2003). However, this type of production function is limited. On the one hand, it does not incorporate factor endowments and assumes that products are costlessly assembled. On the other, Ethier (1982:p391) noted that this type of function, in a monopolistically competitive setting, leads to an optimal production sequence where an "infinitesimal amount of each intermediate product is used over an infinite number of processes". This occurs because the assumed symmetries in the cost structures of firms across countries lead to a common price for any input variety and hence to a common use of the value of inputs from all origins[129]. The resulting counterfactually large (infinite) 'love of input variety' does not reflect the realities of production.

For the model to more accurately reflect these realities, the use of inputs in the production sequence is restricted through the introduction of two new parameters. The first is a technological parameter (φ) which reflects different uses of inputs

[129] This coupled with a budget constraint will imply that as more varieties are added to the system the value of each variety used will tend towards zero (i.e. spread across more varieties). So that as n tends to infinity then x tends to zero. Hence Ethier's statement of an infinite number of processes and an infinitesimal amount of input value.

across countries in the production sequence[130]. The second is a parameter (*n*) that captures heterogeneities in the quantity of intermediate varieties produced across countries[131]. Both these terms will enter the production function and will be decreasing in the degree of substitutability. Hence as σ increases (higher substitutability) the value associated to an extra variety *n* will fall[132]. Similarly the influence of the φ parameter will also fall as substitutability between inputs increases reflecting that producers will be able to substitute across varieties the more similar these are perceived to be (hence attributing less value to a particular input). Incorporating these variables yields the following production function[133]:

$$X_i = A_i \left[\sum_{M} n_j^{\frac{1}{\sigma}} \varphi_j^{\frac{1}{\sigma}} x_{i,j}^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} \tag{2.6}$$

A representative firm in country i produces output by combining inputs from different origins (these origins include the domestic economy). It uses more inputs from the origins that produce a greater number of varieties, n, and also from countries that produce the varieties that are most in line with the production technologies available. Although not derived, it is assumed that the supply conditions and the efficiency parameter generate the production of a heterogeneous amount of inputs by country[134]. Similarly it is assumed that all produced output is either consumed or enters into a production process as an input. One can then obtain the

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[130] This parameter ranges from zero to infinity and identifies the production technologies in a particular country. It is similar to Krugman's original preference parameter for varieties. Furthermore, because producers aim to satisfy demand and consumers can be seen to prefer some varieties over others, this term can also capture the taste for a particular variety from a representative consumer.

[131] Because the interest of this model is in the demand for intermediate products, a supply model is not explicitly presented, however the presence of different efficiency variables, homogeneous within countries but different across countries, can lead to a structure where some countries can sustain more firms than others when there is a fixed cost to producing or indeed exporting (as in the Melitz (2003) heterogeneous firm literature).

[132] Intuitively this implies that the love of variety exhibits diminishing returns as substitutability increases. This set-up is similar to that of Ardelean (2006) although an additional parameter that captures the love of variety has not been introduced here as there is little interest in tracking the love of input variety. Rather the aim is to reduce this so that it reflects a more realistic production sequence.

[133] The CES structure implies that the production function is additively separable and homogeneous.

[134] The presence of efficiency variables adjusts so that more efficient countries supply greater varieties of products. This is similar to the NEG models.

input demand function by minimising costs subject to the above production function[135]. These costs are the sum of the purchases of inputs from all destinations.

$$C_i = \sum_M n_j \varphi_j p_{i,j}(x) x_{l,j}$$

(2.7)

It can then be shown that the associated input demand function for products originating from country j is[136]:

$$x_{i,j} = \frac{n_j^{1-\sigma} \varphi_j^{1-\sigma} p_{i,j}(x)^{-\sigma}}{\left[\sum_M (n_j{}^{2-\sigma}\ \varphi_j{}^{2-\sigma} p_j(x)^{1-\sigma})\right]} C_i$$

(2.8)

The demand for products from country j is then a function of the relative cost of inputs from a particular country and C which captures the amount spent on inputs in country i (If all trade were to occur in intermediate products, C would need to capture gross output X_i[137]). The price term can be defined as follows:

$$p_{i,j}(x) = p_j a_j \tau_{i,j}$$

(2.9)

Where p_j is the producer price, a_j is the common mark-up in monopolistically competitive models (above unity and dependent on the elasticity of substitution term); and $\tau_{i,j}$ captures the bilateral iceberg trade cost which is above unity and represents the trade and transport barrier mark-up between countries. Much of what follows draws heavily on Baldwin and Taglione's (2007) derivation of gravity. Substituting the price equation (2.9) into the demand equation (2.8) and multiplying by the price term on the left hand side so as to capture the total value of inputs ($V_{i,j}$) yields;

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[135] Under monopolistic competition, total costs will be equal to total revenue due to free entry and exit of firms driving down profits to zero in each country. This means that it is also possible to approach the minimisation problem through the revenue function that is the sum of all sales in all destination markets.

[136] See Appendix A2.2 for a step by step derivation.

[137] This would reflect the concerns of Baldwin and Taglione (2011) which suggests that, where intermediate goods trade is concerned, measures of GDP in value added terms may be inappropriate.

$$V_{i,j} = \frac{n_j^{2-\sigma} \varphi_j^{2-\sigma} (a_j p_j \tau_{i,j})^{1-\sigma}}{\left[\sum_M n_j{}^{2-\sigma}\ \varphi_j{}^{2-\sigma} (a_j p_j \tau_{i,j})^{1-\sigma}\right]} C_i$$

(2.10)

Where $V_{i,j} = n_j\ \varphi_j\ p_j\ a_j\ \tau_j\ x_{i,j}$ is the value of the input flow from country j. Assuming symmetry across firms so that there is a common producer price, and noting that the sum of all imported and domestic intermediate varieties must equate to the value of total costs so that $C_j = \sum_M V_{ij}$, the above function can be expressed as follows

$$\sum_M V_{ij} = C_j = p_j{}^{1-\sigma} \sum_M \frac{n_j^{2-\sigma} \varphi_j^{2-\sigma} (a_j \tau_{i,j})^{1-\sigma}}{\left[\sum_M n_j{}^{2-\sigma}\ \varphi_j{}^{2-\sigma} (a_j p_j \tau_{i,j})^{1-\sigma}\right]} C_i$$

(2.11)

Solving for the price term yields[138]:

$$p_j{}^{1-\sigma} = \frac{C_j}{\Omega_\mathrm{i}}, where\ \Omega_\mathrm{i} = \sum_M \frac{n_j^{2-\sigma} \varphi_j^{2-\sigma} (a_j \tau_{i,j})^{1-\sigma}}{\left[\sum_M n_j{}^{2-\sigma}\ \varphi_j{}^{2-\sigma} (a_j p_j \tau_{i,j})^{1-\sigma}\right]} C_i$$

(2.12)

Substituting this expression into the demand equation (2.10) to eliminate the producer price and rearranging then gives a gravity type equation of the following form[139]:

$$V_{i,j} = \left(n_j \varphi_j\right)^{2-\sigma} (a_j \tau_{i,j})^{1-\sigma} \frac{C_i C_j}{\Omega_\mathrm{i} P_j}$$

(2.13)

The above equation is similar, in form, to most derivations of gravity (namely Anderson and Van Wincoop 2003, Feenstra 2004, Baldwin and Taglione 2007, 2011 and Helpman et al. 2008) except that it incorporates the number of varieties that each

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[138] The term Ω_i is often referred to as market openness (AvW 2003).

[139] Here the price term is defined by:

$$P_j = \left[\sum_M n_j{}^{2-\sigma}\ \varphi_j{}^{2-\sigma} (a_j p_j \tau_{i,j})^{1-\sigma}\right]$$

country produces and a technological parameter[140]. These enter the gravity specification in a similar fashion as Anderson and Van Wincoop's (2003) 'multilateral resistance' term. It is actually an augmented multilateral resistance term that reflects a world where countries produce a heterogeneous amount of varieties and are constrained by production technologies. Another difference with respect to the traditional gravity literature is that the general equilibrium condition only occupies the value that countries spend on inputs rather than the more common income term[141].

The model presented has its caveats which are worth noting. Firstly, it does not take into consideration the possible impact of the emergence of new varieties on the price index. Feenstra (1994) suggests that not accounting for this in aggregate import price indices can be problematic. He proposes the use of 'exact' price indices that account for entry and exit of varieties between years. Broda and Weinstein (2006) then provide an empirical implementation of these new price indices showing how gains from new imported varieties arise. The trouble with these approaches is that they require an in depth knowledge of trading structures and are complicated to aggregate to reduced-form scenarios. Feenstra (1994), Broda and Weinstein (2006) and Goldberg et al (2009) exploit the trade aggregation systems to identify new varieties arising in a single country, extending this to many countries in a generalised gravity structure raises a series of theoretical and empirical complications.

Secondly, the model has avoided an exact definition of the cost functions and in particular how these interact with market conditions so that different countries can sustain a different number of varieties. Although this would be highly desirable, it is beyond the scope of this essay. It is worth noting that the heterogeneous firm literature (Melitz, 2003), and in particular the cost structures of firms as determinants of participation in export markets as in Helpman et al.'s (2008) gravity model would be a good place to start with such a model[142]. If the productivity parameter could be associated to the degree of vertical specialisation then there would be a case for

[140] A similar specification can be derived in the case where there are no technological constraints as shown in the appendix A2.2.

[141] Because the value spent on inputs is likely to be lower than total income, one would expect that, upon estimation using GDP variables, the coefficients on this measure will be below unity.

[142] Chaney (2008) also provides a gravity model for heterogeneous firms but focuses more closely on intensive and extensive margins.

countries which are more vertically specialised being able to sustain higher productivity firms which engage in export markets. However such a structure would imply the presence of different price mark-ups across countries thus complicating the derivation of gravity.

Despite these shortcomings, the model presented provides a justification for using a gravity model to estimate input trade. It suggests that particular care need be placed on what is regularly termed as 'the mass variables'; where these should reflect gross purchases of inputs rather than the typically used total income (i.e. GDP) variable (as noted by Baldwin and Taglione 2011).

2.5.2. VERTICAL SPECIALISATION

To relate the indicator of vertical specialisation to the above derived input demand equation it is useful to recall the different components of the indicator. As defined in equation (2.1), vertical specialisation captures the imported input content of exports. More specifically it is the value of imported inputs from a chosen partner as a share of total exports to that same partner[143]. Hence the numerator of this expression is an input demand that is similar to that derived in equation (2.13). The denominator of this indicator is then a total demand for exports equation. Assuming that total import demand from a partner country is isomorphic to the input demand equation (as in Baldwin and Taglione, 2011), it can be shown that equation (2.13) can be modified to generate an export demand equation with the following specification:

$$V_{j,i}^{T} = \frac{Y_i Y_j n_j^{2-\sigma} \varphi_{i,j}^{2-\sigma} (a_j \tau_{i,j})^{1-\sigma}}{\Omega_{\mathrm{i}} \left[\sum_n n_j{}^{2-\sigma} \, \varphi_j{}^{2-\sigma} (a_j p_j \tau_{i,j})^{1-\sigma} \right]} \tag{2.14}$$

Here the subscripts are reversed from specification (2.13) to reflect that country i's exports to country j are country j's imports from country i ($V_{j,i}^{T}$). This function has similar determinants to those of the input demand equation. However a few changes arise. The technology constraints (φ) now represent taste parameters for consumers

[143] In its fully bilateral form although it can also be presented as a share of total exports rather than exports to the same country where the inputs originated.

but exhibit similar properties in terms of substitution i.e. the degree of substitution between goods used for final consumption and those used for input demand is assumed constant and the same. The number of varieties that each country produces also enters the specification in the same way. The main difference between (2.13) and (2.14) is found in the income terms that appear in the latter equation but not in the former. This is because income is assumed to be fully exhausted in the purchase of final and intermediate products whereas in equation (2.13) the assumption was that only a share of this would be exhausted by intermediate demand (C_i that is derived from (2.7)).

Deriving an expression that captures vertical specialisation in its share format can then be done by dividing (2.13) by (2.14) so that:

$$VS_{i,j} = \frac{V_{i,j}^{I}}{V_{j,i}^{T}} = \left(\frac{n_j\varphi_j}{n_i\varphi_i}\right)^{2-\sigma}\left(\frac{\tau_{i,j}}{\tau_{j,i}}\right)^{1-\sigma}\frac{C_jC_i}{Y_jY_i} \tag{2.15}$$

This equation suggests that the degree of vertical specialisation between two partners will depend on the relative amount of varieties that each produce; the relative preferences for these varieties; the share of output that is spent on intermediates; and the relative mark-ups and trade costs between partners[144]. What is particularly convenient about this set-up is that it lends itself to the elimination of unobservable factors that may bias estimated coefficients in a typical gravity setting. This is because some of the time invariant bilateral characteristic between partners will cancel out. Effectively, the multilateral resistance (P) and Openness (Ω's) terms have been eliminated[145]. These expressions can then be used to inform the empirical strategy.

[144] For simplicity it is assumed that mark-ups are the same across countries and hence are not presented in equation 2.15.
[145] The specification where the world becomes the destination of exports changes the above expression somewhat in the sense that the denominator is expressed with respect to the world rather than with respect to country j.

2.6. ECONOMETRIC ANALYSIS

Estimating the impact of a trade agreement on vertically specialised trade has to be approached with care. Traditionally, FTA impact effects have been captured through dummy variables introduced into a gravity model. However, Baier and Bergstrand (2002, 2004, and 2007) warn us that such an approach will need to account for the endogenous formation of FTAs. Countries select into agreements, and possibly for reasons that also drive their current level of trade. If two countries sign a trade agreement as a result of factors which are unobservable to the econometrician and which are correlated with current trade flows, then standard cross-sectional OLS estimations will be biased and the effects of a trade agreement may not be appropriately captured by the FTA coefficient.

Baier and Bergstrand (2004) argue that preferential partners tend to share similar characteristics that should theoretically enhance the gains from a concluded FTA. This implies that they have chosen their partners 'well' and also that there is a strong case for rejecting the hypothesis that the FTA variable is exogenous. Magee's (2003) work supports this idea. He finds that high levels of bilateral trade increase the probability of an FTA being concluded[146]. Using a cross sectional gravity model for the year 1980, Magee finds a positive FTA coefficient for agreements that were only present in the period 1985-2001. Hence countries engaging in preferential trade deals were already heavily engaged in 'above average' trade. In a similar vein, Holmes (2005) uses the minimum export share between two partners to predict the probability of these forming a trade enhancing FTA. Compelling evidence of endogeneity is also found in Baier and Bergstrand (2007) who show a strong instability both in the magnitude of the FTA coefficient and in its sign when running a series of cross sectional gravity estimations at varying time intervals. They argue that unobserved heterogeneity is likely to be the main cause for this.

To grasp the problem, it is useful to consider a 'true model' of intermediate goods trade taking the following form[147]:

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[146] This is sometimes known as the 'natural trading partner' hypothesis. It sees countries engaging in above normal trade as more prone in concluding trade agreements.
[147] Time subscripts are dropped for presentational purposes.

$$V_{ij} = X_{ij}\beta + v_{ij}$$
$$v_{ij} = c_i + u_{ij}$$

(2.16)

The value of intermediate goods trade between two countries (V_{ij}) is determined by a set of observable covariates X_{ij} and an error structure v_{ij}. The latter is formed of an unobservable component that is individual country specific, c_i, and a random error component exhibiting the usual properties ($E(x_{ij}| u_{ij}) = 0$). If the unobservable term c_i is uncorrelated with the covariates then one can estimate equation (2.16) using traditional OLS. This is because the composite error term comes to exhibit normal properties (i.e. is a random disturbance). However if $Cov(x_{ij},c_i) \neq 0$ then OLS will yield biased estimates of the β coefficients. In the case of vertical specialisation, as in the case for normal trade flows, this unobserved heterogeneity is likely to arise through the correlation between the unobservable variable, c_i, and the FTA dummy introduced in the covariates. Baier and Bergstrand (2007) argue that this arises from country specific characteristics which drive both selection into trade agreements and also the value of current trade flows[148].

An example can serve illustrate how unobserved heterogeneity arises. Consider the case where Country A has a larger than normal import flow from Country B because it has an 'affinity' for the set of products that this country produces. Symmetrically, Country B also exhibits similar affinities for Country A products so that these countries are close trading partners in terms of volumes of trade. Because these affinities cannot be observed by econometricians and affect both the degree of trade between countries and possibly the selection forces to form an FTA (i.e. its desirability), then not accounting for these, when estimating the impact of an FTA on trade flows, will yield biased estimates on the FTA coefficient[149]. Unobserved heterogeneity can also arise from differences in regulatory frameworks across countries. Again, if two countries have different standards for the production of

[148] Baier and Bergstrand (2007) suggest that biases in the estimation of FTA effects are likely driven by unobserved heterogeneity rather than omitted variables or errors in measurement.
[149] In this example, the bias is likely to be positive. This is because the FTA variable will be capturing the positive effect of the agreement but it will not control for the affinities that make country A and B trade more with each other. If these were appropriately controlled for, or if these were observed, one would expect the FTA coefficient to be lower.

automobiles, but share the complementary characteristics needed for value chain interactions, then they may wish to engage in bilateral regulatory harmonisation through an FTA. This difference in regulatory frameworks will be both a reason to engage in a preferential trade deal and also a factor that affects current, and indeed past, trade flows.

Consider the outcome variable VS with subscript 1 to be the observed degree of bilateral vertical specialisation between two countries that share an FTA and VS with subscript 0 to occur where there is no FTA. Ideally, if one could observe both VS levels with and without an FTA for a given dyad of countries for a particular year, then the Average Treatment Effect (ATE) of belonging to an FTA could be calculated as the difference in the means of the observed outcomes conditional on a set of covariates x[150]:

$$ATE = E(VS_1 - VS_0 \,|x) \tag{2.17}$$

Such an approach would yield consistent estimates under the assumptions that; i) the outcomes variables are independent so that the degree of VS between two countries does not affect that between others; ii) observations are drawn from a random sample; and iii) the treatment indicator (FTA) is mean independent of both VS_1 and VS_0 (ignorability of treatment). For the first assumption to hold general equilibrium effects, which are likely to be important where vertical specialisation is concerned, would need to be ruled out [151]. The second and third are similar in nature and are likely to be violated because of the aforementioned selection effects. It implies that there are variables which may be unobserved that determine both the participation and the outcome variable. If these can be controlled for, through observable

[150] Clearly it is impossible to observe the degree of vertical specialisation with a given partner in the presence and absence of an FTA, but this set-up is for expositional purposes so that one can delimit the problem that arises in the estimation procedure.

[151] The independence assumption is a very strong one that has been made in the literature and that is likely to be violated in this type of estimation. Not only are trade flows not likely to be independent, i.e. if I am sourcing my intermediates from one country I am not doing so from another, but also the FTA variable may not be independent either. Baldwin (1993) suggests that engaging in an FTA comes as a result of a dynamic process where 'juggernaut' and 'domino' effects arise. These reflect the fact that being left out of a large FTA can change incentives to form or join FTAs. There is also a growing literature that is concerned with spatial correlation in gravity models. A thorough analysis of these is beyond the scope of this essay, but it is important to note that this may be an issue in the estimation.

covariates (i.e. selection), then it is possible to estimate the ATE as follows (provided independence holds)[152].

$$E(VS|\, x,FTA) = E(VS_0|x,FTA) + FTA[E(VS_1|x,FTA) - E(VS_0|x,FTA)] \tag{2.18}$$

Dealing with this unobserved heterogeneity in cross-sectional estimations has been approached in a variety of ways. For instance, Magee (2003) and Baier and Bergstrand (2004) use an IV (Instrumental Variables) approach. But the reliability of their results hinges on finding suitable instruments that are correlated with the FTA variable but not with the unobservables that are driving trade flows. Baier and Bergstrand (2007) argue that this condition is not satisfied in these papers and indeed that any IV approach is going to be complicated on account of the selection variables being highly correlated with gravity variables[153]. A Heckman control function may also be problematic due to such strong correlations between the determinants of FTAs and trade flows. Hence more recently, non-parametric, matching techniques have been employed. Baier and Bergstrand (2009) do this for trade flows whilst Egger et al. (2008) look at the impact of trade agreements on the structure of trade (i.e. intra industry trade). These techniques are well suited to a cross sectional approach and are also accommodating because they do not impose constraints on the distributions of the covariates[154].

However, Baier and Bergstrand (2007) argue that cross-sectional estimations do not generally lend themselves to treating the endogeneity bias as well as panel data approaches do. If the 'true' model of intermediate goods trade in (2.16) has an unobservable, c_i, which is country specific, then it is possible to control for unobserved heterogeneity through the use of country specific dummy variables or fixed-effects (FE)[155]. Alternatively, if unobserved variables are also time specific, a

[152] We are equally interested in the average treatment effect on the treated (ATET) which specifies the effects of an FTA on vertically specialised trade in the presence of an FTA.
[153] Baier and Bergstrand (2007) argues that Magee's (2003) use of GDP similarities or intra industry trade in the selection equation does not remove the problems associated with unobserved heterogeneity given that the instruments used do not satisfy the independence conditions. These are likely to be correlated with the formation of FTAs and also the factors that cause trade.
[154] Such techniques are also useful because they can capture non linearities that may arise as discussed in Baier and Bergstrand (2009).
[155] Fixed effects are directly introduced because it is implicit that a model where the unobservables are allowed to be correlated with the covariates is preferable. Random effects models assume no

panel data approach with country-time fixed effects would also be appropriate. Hence one should be able to “draw strong and reliable inferences about the ATE of FTAs using the gravity equation applied to panel data” (Baier and Bergstrand, 2007: p.84). Feenstra (2004) also favours such an approach arguing that it is an appropriate technique to control for multilateral resistance (Anderson and Van Wincoop, 2003). One can then test whether such methods appropriately control for unobserved heterogeneity. Baier and Bergstrand (2007) suggest that if appropriate controls have been implemented, then current trade flows should be uncorrelated with future FTAs, and this can be easily tested econometrically.

Estimating gravity models conjures other challenges. One is the presence of zeros in the trade matrix. This affects the log-linearisation of the model and results in zero trade flows being indeterminate. Generally, the ad hoc solution of dropping the observations where trade flows are inexistent, or adding a marginal value to these is used[156]. But this approach does not deal with the reason behind the presence of zeros. The severity of the problem is proportional to the amount of zero’s in the sample and to the underlying reasons for the presence of these. Although Silva and Tenreyro’s (2006) Poisson Pseudo Maximum Likelihood (PPML) estimator facilitates the estimation of gravity in the presence of zero trade flows, it does not get to the bottom of the reasons for the presence of zero trade between countries. Helpman et al. (2008), in a gravity model that is derived from the heterogeneous firm literature, use a Heckman (1979) selection equation where the first step models the probability of trade occurring between two partner countries and the second step then uses the mills-ratio from this first step in a gravity equation.

Another challenge that has recently surfaced in the gravity estimation literature is to do with spatial correlation. In particular, most gravity models assume that the FTA variable is independent so that the formation of a trade agreement between two countries is determined by the characteristics of these countries alone. However there is a growing literature on the impact of trade agreements on third countries and

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correlation. Which is preferable can be determined on econometric grounds through a Hausman test. Another approach is the use of difference in difference techniques.

[156] Given that the natural logarithm of zero is undefined, adding a small value of trade to all observations can resolve this issue. Although this simple fix is useful, it does not take into consideration the fact that zero trade flows are indeed important because they can come as a result of selection effects.

indeed some models of FTA formation (Baldwin, 1993) suggest that the incentives to form, or join, a trade agreement change as a result of neighbours' engagement in preferential trade deals. Behrens et al. (2007) suggest that spatial autocorrelation models may be useful in dealing with such issues[157].

2.6.1. Data

Several measures of vertically specialised trade, which track the use of intermediate imports in the production of exports, are used in the empirical analysis. These are calculated from equation 2.1 using the Input-Output (IO) tables of the OECD STAN database. Without going into great detail on how these are calculated (see previous essay of this thesis for this), a few salient characteristics of the dataset are recalled. First, all IO matrices used are reduced to 25 sectors (25x25) which are homogeneous across all countries. This is done so as to match the trade data to the IO tables. The outcome largely reflects a manufacturing world where all service sectors are condensed into one sector[158]. Data is available for a selection of 39 countries and a period of 14 years (1995-2008)[159]. Because the IO tables are only available in periodic (generally 5 year) intervals, they are extended annually so as to obtain yearly estimates of the desired dependent variables. The extensions are based on the 1995 tables for observations from 1995 to 1997; those between 1998 and 2002 come from the 2000 base year tables; and the observations for 2003-2008 are from the 2005 tables. Values are deflated to 2000 prices using specific country deflators from the OECD and converted into dollars using exchange rates from the Penn World Tables.

The extension of the technological coefficients across years close to the base tables has certain implications. The first is that the technological coefficients are assumed

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[157] The incorporation of spatial correlation into gravity estimations is implicit in AvW who suggested that trade flows depended not only on the proximity of a partner but also on the distance to other third markets.

[158] This means that there is no service trade between countries. Given that the aggregate indicator is a weighted average of the sectoral VS, removing these can cause either an upward or downward bias in the actual degree of VS depending on the importance of service sectors in i) total trade and ii) vertically specialised trade. Preliminary observations suggest that VS in services seems to be lower than that of manufacturing.

[159] The countries in the sample are Australia, Austria, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States, Argentina, Brazil, Chile, China, Estonia, India, Indonesia, Israel, Romania, Russia, Slovenia, and South Africa.

to remain relatively stable in periods close to the base years. Although the Input Output literature suggests that this is a reasonable assumption (see Vaccara, 1986 and UN, 1999), one might expect changes in technological coefficients to be more pronounced as a result of the growing international fragmentation of production. This might result in a downwards bias in the measures of vertically specialised trade. However, the advantage of using the OECD database, as opposed to other sources of IO data such as the GTAP database, is that it covers more base years and hence allows calculated measures of VS to vary through changes in technology and also through changes in trade shares[160].

The technological constraints of the system, dictated by the proportionality assumption used, see the use of intermediate imports across origins as the same irrespective of the origin of the intermediate imports. Hence if Mexico requires 0.3 units of imported intermediates to produce one unit of output, it will import inputs in this proportion from all countries. This assumption is common in the literature and is also used in Johnson and Noguera (2011). One of the implications arising from the reliance on such assumptions is that the measures of vertically specialised trade are computed rather than observed measures. This implies that they are proxies for value chain activity.

2.6.1.1. Measures of Vertically Specialised Trade

The empirical analysis will begin with a calibration exercise that will use total bilateral trade flows, extracted from COMTRADE, to identify the most appropriate empirical approach to eliminating biases arising from unobserved heterogeneity. Once the appropriate empirical specification has been identified, the role of an FTA on several measures of vertical specialisation will be investigated. This will initially be done on the basis of the *value* of intermediate imports (equation 2.13) and subsequently on the share of intermediate imports over exports (equation 2.15)[161].

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[160] Unlike the indicators calculated by Johnson and Noguera (2011) which only exhibit variations through changes in trade shares.

[161] The rationale for looking at the role of trade agreements on the value of vertically specialised trade is that it allows one to track how an FTA affects backward and forward linkages simultaneously. It is convenient to recall, from the previous essay, that the backward linkage of Mexico with the US is the same, in value terms, as the forward linkage of the US with Mexico. Additionally, using values as dependent variables also facilitates identifying the role of an FTA as a share measure could be affected by FTA impacts on the numerator and also on the denominator.

Four different measures of the value of intermediate goods trade between countries will be looked at. These capture the three different *uses* that can be given to imported inputs where each of these identifies different involvements in value chain activity.

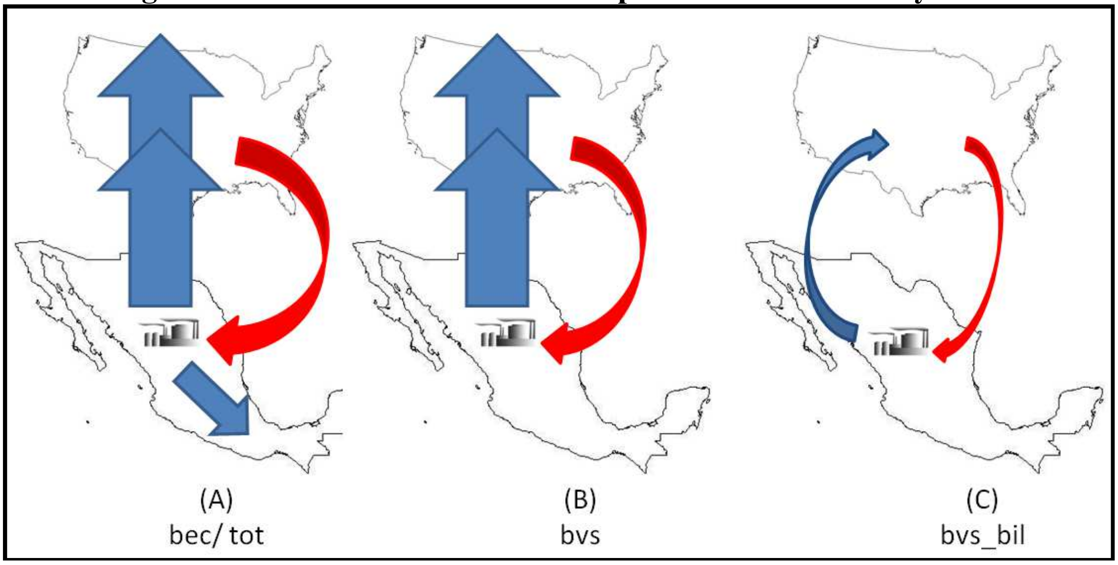
1. Intimps_bec: captures the value of total intermediate imports, from a partner country, identified suing the BEC nomenclature. It does not differentiate across the use of imports which here may serve to satisfy either domestic demand or exports. (see Diagram A in Figure 2.1)
2. Intimps_tot: is the same measure as above but uses IO tables to identify the value of intermediate imports rather than the BEC nomenclature[162]. (see Diagram A in Figure 2.1)
3. Intimps_bvs: measures the value of intermediate imports, from a partner country, that are used in the production of <u>world</u> exports. This measure is calculated using the OECD IO tables and trade data from Comtrade as per equation 2.1. (see Diagram B in Figure 2.1)
4. Intimps_bvs_bil: then captures the value of intermediate imports from a partner country that are used in the production of exports to <u>that same country</u>. This measure is calculated using equation 2.1 but with a different destination for export flows. (see Diagram C in Figure 2.1)

Figure 2.1 provides a visual representation of how intermediate imports can be used in productive processes using Mexico and the US as examples. The red arrows show the different intermediate import flows that the above measures capture. The difference between these is in the use that is given to the intermediate inputs which depends on the destination of the output flow here shown through the blue arrows. The first two measures (1) and (2) are depicted in the first diagram (A) of this figure. They both capture Mexico's total intermediate imports from the US but use a different identification criterion to identify imported inputs (the first using the BEC nomenclature the second using IO tables). They represent Mexico's total use of imported intermediates from the US irrespective of whether these inputs serve to produce domestic output or exports to any destination. Differentiating across identification strategy is useful because the BEC nomenclature has often been

[162] This is essentially the sum of the calculated bilateral intermediate import matrix.

described as arbitrary and hence comparing BEC identified intermediate imports with intermediate imports identified from IO tables will help test how arbitrary this nomenclature really is. The third measure is then associated with diagram (B). It captures the value of a subset of Mexico's intermediate imports from the US, namely those that Mexico uses to produce total exports. The final measure of intermediate imports, diagram (C), then captures yet another subset of Mexico's intermediate imports from the US but in this instance those which are used to produce products that are exported back to the US. As can be seen by the size of the red arrows, the value of imported intermediates declines as a more narrow use for imported inputs is identified.

Figure 2.1: Value of Intermediate Imports Differentiated by Use



In addition to looking at the impact of an FTA on the value of intermediate imports, it is also relevant to look at how an FTA affects the structure of trade. This is done by using an indicator of bilateral vertical specialisation, bvs_bil. The numerator of this measure is the value of intermediate imports (in measure (4)) and the denominator is the exports to the destination from which these inputs originated (see also equation 2.15). In looking at the role of an FTA on the structure of trade it will be important to bear in mind that an FTA is likely to affect both the numerator and the denominator of this expression and hence caution will need to be taken in its interpretation.

The rationale for differentiating across the use of intermediate products is that these can identify different facets of production sharing. The first two measures capture the aggregate use of intermediates, but the final two measures may be more representative of international and bilateral value chain activity respectively. This is because both the origin of the input and the destination of the resulting output is international. FTAs may impact such flows differently.

2.6.1.2. OTHER VARIABLES

The typical gravity variables are drawn from CEPII's gravity database. It provides the time invariant geographical indicators as well as the bilateral identifiers of the presence or absence of an FTA. This variable is coded so that it is equal to unity when there is an FTA between two partners in any given year and zero otherwise. It is extended to include the two extra years in the sample; 2007 and 2008 through imputation informed from the WTO RTA database (see appendix A2.3 for further details). This variable only captures reciprocal FTAs and hence does not identify unilateral preferences.

The theoretically derived gravity model of input trade (2.13) suggests that input varieties and technological constraints are also likely to be important in determining the value of intermediate imports. Partner country GDP per capita will be used as a proxy for the amount of varieties partner countries produce and non-linearities in this term will be introduced through the log of this variable squared[163]. The Finger-Kreinin (FK) indicator will be used to proxy for reporter country preferences for partner country goods or for the technological parameters (φ)[164]. This is a bilateral measure that captures the similarity in the composition of reporter and partner exports to the world. To the extent that a more similar composition of exports might be evidence of similar factor intensities in the production structures, this indicator can be used to gauge whether trade predominantly occurs between similarly endowed countries or not. Many gravity models use a GDP per capita variable for this very

[163] This is, in effect, a transposition of the Linder (1961) hypothesis which postulates that countries that have higher income demand more new varieties. Additionally, the correlation between varieties and GDP per capita is documented in Saure (2009) who uses Feenstra and Kee (2004) for the identification of varieties and correlates this measure with per capita GDP. Funke and Ruhwedel (2001) also suggest that varieties and GDP per capita are highly correlated.

[164] Finger Kreinin indicator represents the similarity in exports to the world between country *i* and *j*: $FK_{i,wld,t} = \sum_{c} \min\left(\delta_{i,wld,t,c}, \delta_{j,wld,t,c}\right)$. Where $\delta_{i,wld,t,c}$ and $\delta_{j,wld,t,c}$ are the share of exports from country *i* in product *c* to the world and the share of exports from country *j* in product *c* to the world, respectively. It captures the similarity of exporting structures across two countries and hence may be indicative of similarities in the factor content of exports.

purpose[165], hence including the FK variable should allow GDP per capita coefficient to more fully capture the variety effect rather than the factor endowment composition effect. The main variables used in the estimation are summarised below.

Table 2.1: Variables used in Gravity Model Estimation

Variable	Description	Source
Vertical Specialisation*	The import content of exports. Calculated using expression (2.1). (the variables used in the estimation are described in more detail below)	OECD STAN database and Comtrade. (see details in Appendix A2.3)
intermediate goods*	Calculated using expression (2.1) but presented in value terms rather than as a share of exports as above. (see Figure 2.1.)	See above.
Trade	Total exports and total imports (deflated[166])	Comtrade using WITS
GDP	PPP Constant 2000 prices (country deflators)	WDI
GDP per capita	PPP Constant 2000 prices (country deflators)	WDI
FK	Used to capture the production technologies of countries	Comtrade, calculated using TradeSift
Distance variables (trade costs)	-Contiguity =1 for contiguity -Comlang_off= 1 if same official language -Dist = Distance from capitals -Dist_w = weighted distance -Pop = population -area = area in sq kms	CEPII gravity database
FTA	-FTA=1 if countries in FTA, else =0	CEPII gravity database (extended for 2007 and 2008 using RTA database in WTO webpage)

Notes: * values deflated using OECD PPI[167]

2.6.1.3. *Characteristics of the Database*

The incidence of trade agreements in the sample is captured in Table 2.2. In 1995, around 25% of countries are part of a trade agreement where 192 dyad agreements are identified. This figure rises to 48% by 2008 with 357 dyads in an agreement showing the well documented rise in regionalism. Table 2.2 also suggest that the temporal variance in the FTA variable may be small. Indeed only 22% of dyads *switch* into an agreement during the sample period so that 77% of the possible dyads

[165] See a broader discussion of including GDP per capita in Markusen (2011).

[166] Baldwin and Taglione (2007) suggest that deflating trade data using a common country's price index, such as the US deflator (commonly used in the literature) can induce biases. An appropriate use of FE may also reduce biases from using nominal values.

[167] The OECD PPI is used to deflate the trade data although it is acknowledged that the choice of deflator is important. An alternative option would have been to use country specific deflators but it is possible that these are more revealing of changes in domestic non-tradeable goods rather than internationally traded products. Given that there is little information about trade deflators we will rely on econometric techniques to minimise price effects in the estimations (i.e. through the use of country-year effects).

are either in an agreement for the entirety of the sample time (25% of the sample) or in no agreement throughout (52% of the sample)[168]. Agreements with no temporal variation include the EU-15, NAFTA, EFTA, ANZCERTA and MERCOSUR. In addition, the sample is relatively euro-centric where, of the 196 dyad agreements in 1995, 105 involve the EU-15 agreements[169]. This may be problematic if unobservable characteristics of EU countries drive the results of the estimation. This can arise if differences in the depth of integration are important. Because an FTA between Chile and Japan is more 'shallow' than one between Germany and France, having a large set of 'deep' agreements in the sample may inflate the impact of an FTA on trade[170].

Table 2.2: Count of FTA variable by dyad 1995 - 2008

	YEAR	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
FTA	No	545	526	519	514	501	473	459	456	442	391	389	386	385	384
	Yes	196	215	222	227	240	268	282	285	299	350	352	355	356	357

Notes: The values show the number of dyadic agreements.

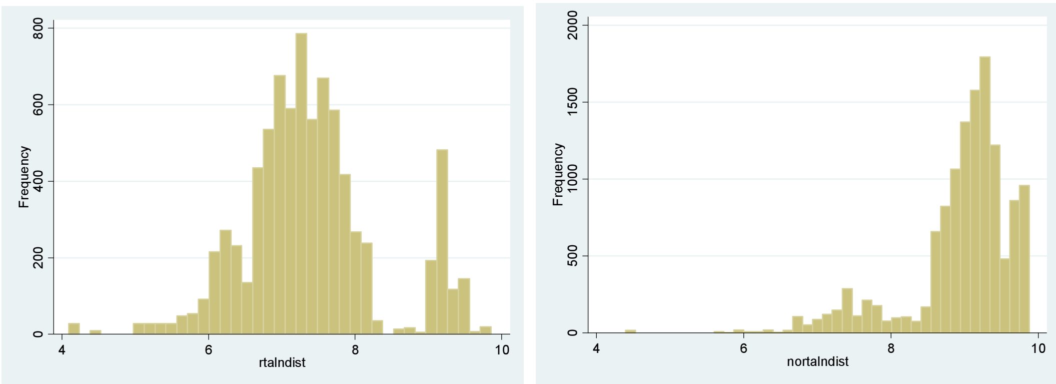
Although the sample is largely composed of developed countries from the OECD, it also comprises several emerging economies such as Brazil, China, Russia, India, South Africa and Indonesia. There are however no LDCs (due to data limitations) which implies that the analysis is constrained to a particular set of countries that have achieved a certain level of development[171]. Nevertheless, the 39 countries in the sample used in this essay represent just over 80% of world trade in 2008 where the EU-27 alone represents around 37% of world trade[172]. One of the positive consequences of using such a largely industrialised-country sample is the near absence of zero trade flows. Out of over 20,000 observations there are 79 zero's in

[168] Table A2.2. in the appendix, detailing the characteristics of the variables of interest, confirms a much lower within than between variation for the FTA variable in the sample.
[169] Note that this number is smaller than what would be expected if all EU countries were in the sample (i.e. 15*14=210) because Belgium and Luxembourg do not feature.
[170] Various robustness checks of the results are presented so as to ascertain that the results are not being driven by EU effects.
[171] Although we expect little value chain activity arising with these countries, not having them in the sample can be constraining. It would have been an interesting exercise to include these to relate usefulness of trade policy in promoting value chain participation in these types of countries. With our current sample we can only draw broad generalisations on such issues.
[172] The EU represents 48% of the trade data in the sample in 2008.

the trade matrix[173]. This suggests that the estimation of the gravity model should not concern itself too much with the presence of zero's in the trade matrix.

The geographical dispersion of the countries in the sample is shown in Figure 2.2. The left hand panel suggests that preferential partners tend to be geographically concentrated. However there is certainly evidence of a cluster of more distant countries engaging in preferential agreements[174]. To the extent that the gravity model will control for distance effects this should not be overly problematic.

Figure 2.2: Distance and FTA formation



Notes: The left panel shows the distance between FTA partners whereas the right panel shows the distance between countries that do not share an FTA. This is over the entire sample.

2.6.2. *Model Specification; Choosing the Fixed Effects*

The theoretical model derived in the previous section is an augmented gravity model which can be used to capture the impact of a trade agreement on intermediate goods trade. However, the empirical specification will need to be approached with care so that it accounts not only for the 'multilateral resistance' (Anderson and Van Wincoop, 2003) and 'openness' terms but also for the endogenous formation of trade agreements (Baier and Bergstrand, 2007). Furthermore, variety and technology constraints, which are not generally present in traditional gravity models, also need to be incorporated into the estimating equation. Not including these variables when looking at the impact of an FTA on intermediate goods trade could also give rise to

[173] 38 of which occur due to the lack of data for Russia in 1995.
[174] This cluster involves the FTAs of Mexico, Chile and South Africa with more distant countries and in particular with the EU. Essay 3 shows that there are many new 'distant' FTAs being signed and investigates some of the reasons behind this relatively new phenomenon.

incidences of unobserved heterogeneity (if these variables are correlated with incentives to form trade agreements).

One can mitigate, or even eliminate, many of the biases that arise from unobserved heterogeneity through the use of an appropriate set of fixed effects (see Baier and Bergstrand, 2007; Feenstra, 2004; and Baldwin and Taglione, 2007). Such models are preferable to random effects (RE) approaches because they accommodate for correlations between the unobserved variables and the FTA variable, which, according to Baier and Bergstrand (2007 - henceforth BB), are the source of the biases in such estimations[175]. BB estimate the following gravity model of trade:

$$\ln M_{i,j,t} = \beta_0 + \beta_1(\ln RGDP_{i,t} * \ln RGDP_{i,t}) + \beta_2(\ln DIST_{i,j}) + \beta_3(CONTIG_{i,j}) + \beta_4(LANG_{i,j}) + \beta 5FTAi,j,t + ui,j,t$$

$$\beta_0 = \alpha_{i,t} + \rho_{j,t} + \sigma_{i,j} \tag{2.19}$$

Imports of country i from country j at time t (M_{ijt}) are explained by covariates that capture economic mass (GDPs of reporter and partner country); geographical barriers (distance, contiguity and language); and trade policy variables (FTA). The economic mass variable represents the demand and supply conditions whereas the remaining variables reflect trading costs. BB introduce country-year and country pair fixed effects as control measures for unobserved heterogeneity (captured here in β_0)[176].

Following an assumption that sees the consumer demand for imports as isomorphic to a country's demand for inputs, the model derived in equation 2.14 can be log-linearised into the following estimable gravity model of total trade:

$$lnM_{i,j,t} = \beta_0 + \beta_1(lnGDP_{i,t} * lnGDP_{j,t}) + \beta_2(VARIETY_{j,t}) + \beta_3(PREF_{i,t}) + \beta_4(CONTIG_{i,j}) + \beta_5(LANG_{i,j}) + \beta_6(lnDIST_{i.j}) + \beta_7(FTA_{i,j,t}) + u_{i,j,t}$$

$$\beta_0 = \alpha_{i,t} + \rho_{j,t}$$

[175] Support for the use of a FE model over a RE is also established in the basis of a Hausman test.
[176] See Egger (2000) for a discussion of the superiority of FE estimation over RE models in a gravity setting.

(2.20)

The main difference between (2.19) and (2.20) is that the latter includes a variety and a consumer 'preference' variable. However, when estimated, these models are very similar. This is because BB's model incorporates country-year FEs which are collinear with the variety and 'preference' variables. This goes to show that using an appropriate set of FE can compensate for omissions in the gravity specification.

But the selection of the FE in these models needs to be approached with care. The choice of one set of FE over another will affect the variance of the variables and hence the interpretation of the FTA coefficient. The fixed effects in (2.19) include country pair controls which introduce a variable that fixes, or is collinear with, all country pair characteristics; hence if the cause of unobserved heterogeneity is bilateral and time invariant in nature then this serves as an appropriate control for unobserved heterogeneity. However, the use of such FE also restricts the FTA variable so that it only varies in time across a given dyad. Therefore the estimated FTA coefficient will capture the impact of *switching* into a trade agreement[177]. If the temporal variance of the FTA variable is large enough, then this is tantamount to calculating the impact of an agreement, and this is the case in BB's sample which ranges from the year 1960 to the mid 90's[178]. However in shorter panels, where many FTAs are in place throughout the entire sample period, the use of these FE will result in the FTA coefficient not being estimated for FTAs that are in place and do not vary in time.

The sample used in this essay contains data from 1995 to 2008, it comprises many agreements that were already in place at the beginning of the sample period and hence for which there is no temporal variance[179]. Therefore, estimating (2.20) using this sample and bilateral fixed effects would only capture the impact of new FTAs on trade flows, or the impact of 'switching' from no agreement to an agreement. This would imply that the effects of the EU-15, NAFTA, EFTA, MERCOSUR and ANZCERTA agreements would not be captured because these FTAs where in place before the beginning of the first year of the sample and there has been no 'switch' in

[177] This transpires by virtue of the within variation estimator that is characteristic of FE models.
[178] Although it is worth stressing that BB would 'miss' the effects of the original EEC agreement.
[179] It is limited because indicators of vertically specialised trade require the use of IO tables which are not available before 1995 in harmonised formats.

these in time (i.e. FTA=1 throughout sample period). This then suggest that tackling endogeneity issues may be *preferable*, in this instance, through a model that does not use pair-wise FE[180]. For this purpose, a set of interacted FE that control for reporter-year and partner-year characteristics is proposed[181].

The use of these is justified on various grounds; first, on the basis that these control for the traditional country specific and time varying multilateral resistance terms. Second, that they also provide appropriate controls for other important time varying unobserved characteristics such as the amount of varieties produced across countries and specific country technologies. This choice of FEs implies that one adheres to the assumption that the determinants of FTAs are country-year specific. Or that selection into agreements and trade flows are determined by common parameters that are country year specific. But the use of these controls has to be justified, particularly in light of BB's proposed use of bilateral fixed effects. Moreover, it is also important to understand how these country-year FEs affect the variance of the FTA variable, or in other words what the FTA coefficient captures in the presence of these controls.

The introduction of country-year FE implies the use of different intercepts for each reporter-year and partner-year observation. Hence, for any given reporter-year observation, the FTA variable varies across partners in that same year. So the FTA coefficient should capture differences in trade, intermediate or not, between say Mexico's preferential partners and those with whom Mexico does not share an agreement. Effectively, one would be comparing how much more Mexico imports from the US, a preferential partner, to how much it imports from a non preferential partner such as China in a given year and controlling for the different characteristics of these partner countries[182].

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[180] Another issue that arises from the use of pair-wise FE is that if the FTA variable does not exhibit temporal variance, then effectively an estimation that uses these is comparing a treated group of countries which have switched into an agreement against a control group of countries that have not switched. This control group will include countries that have not switched their preferential status but that are in an agreement throughout the sample and also countries that have not switched but are not part of an agreement. This may generate a downwards bias in the estimated FTA coefficient.

[181] Baltagi et al. (2003) use these in conjunction with reporter, partner, year and bilateral FE, but they are not interested in the FTA coefficient. Ruiz and Vilarrubia (2008) then suggest that country-year FE are appropriate controls for multilateral resistance terms.

[182] i.e. the within variance is country year specific with respect to partners.

Table 2.3 shows the results obtained from estimating equation (2.20) for total trade. The first column identifies the OLS estimates; the second column adds bilateral and time fixed effects (FE1); the third column includes individual country (reporter and partner) and time fixed effects (FE2); and the fourth column is the specification that includes reporter-year and partner-year fixed effects (FE3). Focusing on the FTA coefficient; the first column shows that the impact of an FTA on trade flows is of around 29%. Here there are no controls for unobserved heterogeneity or multilateral resistance and hence these estimates are likely to be biased. In the second column, the FTA coefficient captures the impact of *switching* into an agreement through the use of bilateral FE. This is associated with an 11% increase in bilateral trade[183]. In the third column, using individual reporter, partner and year effects, an FTA is seen to increase bilateral imports by 26%. The large difference between the results obtained in the previous columns may reflect the aforementioned constraints on the variance of the FTA variable imposed through the use of different FE.

The final specification then uses country-year FE. Here the sign and size of the coefficients are in line with the literature. The mass coefficient is positive and close to 1 and trade flows are decreasing in distance but increasing with contiguity and a common official language[184]. The FTA coefficient in this specification sees the impact of an FTA increasing the value of total imports by around 27%[185]. This is somewhat lower than the FTA effect found in the OLS estimation which may reflect an upward bias in the OLS estimates. This is consistent with Baier and Bergstrand's (2004) hypothesis that countries that engage in trade agreements have chosen 'well'[186]. The variety variable here only fluctuates across partners and hence is capturing relative differences in the varieties that partners produce so that more

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[183] This is calculated by taking the exponential of the coefficient.

[184] The mass variables take on a coefficient of 1 although many empirical studies find different coefficients for these. Baldwin and Taglione (2007) suggest that this may arise because of the inappropriate use of FE or indeed to an erroneous (or theoretically inconsistent) deflation of the independent variables. Other justification for coefficients above or below unity have been attributed to the importance of non-tradables within an economy.

[185] The results in this column also appear to yield lower standard errors on the time varying coefficients when compared to column (3). Although the standard errors are bigger on the GDP per capita variable. This is due to the fact that this variable is only fluctuating across partners in this specification.

[186] i.e. the FTA coefficient is higher in the OLS estimates because countries that share trade enhancing unobserved characteristics are more likely to engage in FTAs. Because the OLS estimation does not control for these factors, it attributes the higher trade flows to the FTA and hence the coefficient is upward biased.

varieties seem to increase trade flows but at a decreasing rate. The consumer 'preference' variable, which is captured by the FK and is bilateral and time-varying, appears not to be significant. This is perhaps because production structures matter predominantly for intermediate goods trade rather than total trade.

Table 2.3: The impact of FTAs on total imports

	Dependent Variable: lnimports			
	(1)	(2)	(3)	(4)
	OLS	**FE1**	**FE 2**	**FE 3**
		(repart)	(rep, par, year)	(repyear, paryear)
Lncombgdp	0.890***	1.014***	1.003***	1.060***
	(0.00407)	(0.0244)	(0.0466)	(0.0329)
Lndist	-0.761***		-1.063***	-1.065***
	(0.00982)		(0.0544)	(0.0171)
Contig	0.576***		0.244**	0.246***
	(0.0340)		(0.111)	(0.0316)
comlang_off	0.647***		0.564***	0.567***
	(0.0274)		(0.0984)	(0.0276)
FTA	0.254***	0.104***	0.234***	0.240***
	(0.0196)	(0.0322)	(0.0676)	(0.0331)
lngdpcap_d	-1.289***	1.215***	1.200***	1.187***
	(0.0841)	(0.183)	(0.145)	(0.386)
lngdpcap_d2	0.0676***	-0.129***	-0.128***	-0.0881***
	(0.00478)	(0.0102)	(0.00859)	(0.0218)
Lnfk	0.0920***	0.254***	0.00318	-0.0340
	(0.0180)	(0.0663)	(0.135)	(0.0411)
Constant	-21.69***	-40.39***	-31.84***	-37.84***
	(0.466)	(1.333)	(2.107)	(2.851)
FE: reporter	NO	NO	YES	NO
FE: partner	NO	NO	YES	NO
FE: Year	NO	YES	YES	NO
FE: bilateral	NO	YES	NO	NO
FE: reporter-year	NO	NO	NO	YES
FE: partner-year	NO	NO	NO	YES
Observations	20,631	20,631	20,631	20,631
R-squared	0.801	0.540	0.836	0.843
r2_o	.	0.388	0.867	0.809
r2_w	.	0.540	0.836	0.843
r2_b	.	0.383	0.951	0.799

Notes: Standard errors in parenthesis and clustered across groups (G). *** p<0.01, ** p<0.05, * p<0.1. Coefficients on Dummy variables not reported for brevity

The results presented in this final column are fairly standard. They will serve as a benchmark for future reference and also as a tool for testing whether the proposed FE resolve problems that arise from the endogeneity of the FTA variable. Recalling that BB used bilateral FE in addition to the country-year effects raises the question of whether the latter alone provide appropriate controls for the biases caused by unobserved heterogeneity. It is possible to test whether these biases are accounted for by re-estimating equation 2.20 with the incorporation of a future FTA variable (FTA+5 – which captures FTA status five years into the future). Baier and

Bergstrand (2007:90) suggest that "if FTA changes are strictly exogenous to trade flow changes, [a future FTA (FTA+5)] should be uncorrelated with the concurrent trade flow"[187]. Hence appropriate controls will have been provided if the future FTA variable is not significantly correlated with current trade flows.

Implementing this test requires some additional thought, particularly when the FTA variable exhibits a small temporal variance. If the FTA and the FTA+5 variables are highly correlated then the test may not capture whether the set of FE used control for unobserved heterogeneity. This is because a high correlation between these variables results in the FTA+5 variable behaving like the FTA variable which should be associated with positive trade effects. An example can help illustrate this. In 1995 Mexico shares an agreement with both the US and Canada and hence the FTA dummy is equal to one with each of these countries. Because Mexico still shares these agreements in the year 2000 then effectively the FTA and the FTA+5 variables are the same and this leads to a high correlation between FTAs and their future lags as shown in Table 2.4 (think of a similar issue also arising with the EU countries). This implies that the test might fail to capture whether the issue of unobserved heterogeneity has been resolved and that this failure will be due to the implementation of the test on a sample with a large prevalence of trade agreements before the sample period.

Table 2.4: Correlation Coefficients between FTA variable and its forward lags

	Fta	fta+3	fta+4	fta+5	fta+6	fta+7
fta	1					
fta+3	0.830	1				
fta+4	0.791	0.953	1			
fta+5	0.759	0.914	0.959	1		
fta+6	0.736	0.886	0.930	0.970	1	
fta+7	0.717	0.864	0.907	0.946	0.975	1

Source: Own calculations
Note: number of observations 15260

When this test is carried out on the full sample, the FTA+5 coefficient is indeed positive and significant (see Appendix A2.4)[188]. And this may occur even when issues related to unobserved heterogeneity have been resolved. The question that is being asked from the data is whether a future FTA affects current trade flows, hence

[187] This is effectively a test for reverse causality.
[188] See appendix A2.4 for a full sample table and a discussion

it seems reasonable that such a test be carried out on countries where the FTA variable has some temporal variance (i.e. for countries that are not in an agreement at the beginning of the sample)[189]. Effectively, refining the above question, what needs to be asked is whether countries that were *not* in a trade agreement exhibited high trade volumes with each other *before* an agreement was implemented. This suggests that the test should be carried out on a sample of countries that did not share an agreement at the beginning of the sample period. If appropriate controls for the sources of unobserved heterogeneity are provided, or controls for the reasons that cause countries to trade more or less with each other before and agreement, then the FTA+5 coefficient should not be significantly different from zero.

The results of this test, for this reduced sample of countries which were not in an agreement in 1995 are shown in Table 2.5. The positive coefficient on the FTA+5 variable in the first column suggests that countries that trade more are also more likely to form trade agreements. This OLS estimation does not control for the reasons behind countries trading more with each other pre-agreements and hence unobserved heterogeneity remains. The remaining columns of Table 2.5 show the results of incorporating the future FTA variable to the same estimations that were presented in Table 2.3. It shows that the two first sets of FE, namely bilateral FE combined with year dummy's (FE1) and individual country and time effects (FE2), continue to yield a positive FTA+5 coefficient and hence provide inappropriate controls for unobserved heterogeneity. However when the FE are country-year specific (FE3), the FTA+5 loses significance and the FTA variable recaptures its significance[190]. This implies that this type of FE control for the reasons that make countries trade more pre agreement and hence that suitable controls for the problems arising from unobserved heterogeneity have been provided, at the very least for the sample that is used in this essay[191].

[189] The selection criteria that are used identifies countries that had not signed an agreement by 1995. This includes country pairs that have no agreement throughout and also those that switch into an agreement during the sample period.

[190] A set of sensitivity test, using other future lags for the FTA variable can be found in the appendix (A2.4).

[191] Removing countries from the sample to carry out such a test may be problematic; it involves some form of selection. If this selection is driven by common factors then this test may be invalidated as it might not reflect whole sample properties. However the fact that the FTA+5 variable exhibits the desired insignificant coefficient implies that the proposed FE are appropriate for the sample that is used in this essay.

Table 2.5: Exogeneity test with FTA forward lag

	Dependent Variable: lnimports			
	(1)	(2)	(3)	(4)
	OLS	**FE1**	**FE 2**	**FE 3**
VARIABLES		(repart)	(rep. Par, year)	(repyear, paryear)
Lncombgdp	0.893***	0.909***	0.898***	0.815***
	(0.00944)	(0.0458)	(0.0744)	(0.0814)
Lndist	-0.853***		-1.411***	-1.415***
	(0.0193)		(0.101)	(0.0365)
Contig	0.611***		0.240	0.233***
	(0.0873)		(0.193)	(0.0656)
comlang_off	0.943***		0.838***	0.841***
	(0.0655)		(0.132)	(0.0425)
FTA	0.146***	0.00597	0.0918	0.224***
	(0.0351)	(0.0324)	(0.0548)	(0.0681)
FTA+5	0.262***	0.183***	0.228***	0.0183
	(0.0498)	(0.0615)	(0.0810)	(0.0777)
lngdpcap_d	-4.974***	0.794*	0.675	
	(0.303)	(0.433)	(0.599)	
lngdpcap_d2	0.265***	-0.103***	-0.0960***	-0.00751
	(0.0166)	(0.0230)	(0.0334)	(0.00660)
Lnfk	-0.200***	0.237	0.289**	0.284***
	(0.0357)	(0.155)	(0.140)	(0.0651)
Constant	-4.649***	-33.30***	-22.02***	-17.11***
	(1.512)	(2.650)	(4.702)	(4.099)
Observations	4,550	4,550	4,550	4,550
R-squared	0.745	0.517	0.847	0.864
r2_o	.	0.395	0.797	0.764
r2_w	.	0.517	0.847	0.864
r2_b	.	0.389	0.735	0.671

Notes: Standard errors in parenthesis and clustered reporter-year, *** p<0.01, ** p<0.05, * p<0.1

2.6.3. *RESULTS*

The previous section was concerned with establishing the credentials of using a country-year FE approach to resolve issues that might arise from unobserved heterogeneity. In this section, this model is used to estimate the impact of a trade agreement on vertically specialised trade[192].First this will be done for measures that capture the value of intermediate trade flows and subsequently the impact of an FTA on the structure or trade, captured through an indicator measure of vertical specialisation, will be investigated.

2.6.3.1. *THE IMPACT OF AN FTA ON THE VALUE OF INTERMEDIATE IMPORTS*

The impact of an FTA on the value of intermediate goods trade is considered first through the log-linearisation of equation (2.13):

[192] A test for endogeneity is also undertaken when the dependent variable is intermediate goods trade and can be found in the appendix A2.4 tables A2.6 and A2.7.

$$lnI^{I}_{i,j,t} = ln\left(C_{i,t}\,C_{j,t}\right) + (2-\sigma)ln\left(n_{i,j,t}\right) + (2-\sigma)ln\left(\varphi_{i,c,t}\right) + (1-\sigma)ln\left(\tau_{i,j,t}\right) - ln(\Omega_o) - ln(P^{1-\sigma}) \tag{2.21}$$

The dependent variable is the natural logarithm of the value of intermediate imports of country i from country j. This is a function of; supply and demand forces, $C_{j,t}$ and $C_{i,t}$ respectively; the amount of varieties that countries i and j produce, n; and their technologies, φ. The rest of the terms capture the typical trade cost variables subsumed in τ, and the multilateral resistance and openness terms. One of the first hurdles faced in this estimation is the choice of the 'mass' variables that capture the supply and demand conditions for intermediates. Baldwin and Taglione (2011) suggest that using the log of the reporter and the partner GDP is likely to be an inappropriate measure because "trade is measured on a gross sale basis whilst GDP is measured on a value added basis". Additionally, the theoretical model herein derived suggested that the mass variables need to be chosen with care as the general equilibrium conditions were set with respect to the gross use of inputs rather than a net measure of income which is calculated from the OECD IO tables[193]. Using per capita GDP to capture the number of input varieties and the FK indicator to measure differences in technologies suggest the estimation of the following gravity model of input trade:

$$lnI^{I}_{ijt} = \alpha_{i,t} + \rho_{j,t} + \beta_1(lnmass_{i,j,t}) + \beta_2(lnGDPcap_{j,t}) + \beta_3\left(lnFK_{i,j,t}\right) + \beta_4(CONTIG_{i,j}) + \beta_5\left(LANG_{i,j}\right) + \beta_6(lnDIST_{i.j}) + \beta_7 FTA_{i,j,t} + u_{i,j,t} \tag{2.22}$$

Table 2.6 presents the results of the estimation of equation (2.22) for four separate measures of intermediate imports that were discussed in the data section. The dependent variable in the first column is the log of the value of total intermediate imports identified using the BEC nomenclature (lnintimps_bec). In the second column, a similar dependent variable is used but it captures the log of the value of total imported intermediates identified using IO tables (lnintimps_tot). It is expected that differences in the reported coefficients of these estimations reveal the presence of systematic problems in the use of the BEC nomenclature. The third column then

[193] It is calculated by subtracting the value added of the economy from its gross output.

uses the log of the value of intermediate imports that are used to produce total exports to the world as the dependent variable (lnintimps_bvs). In the final column the dependent variable is the log of the value of intermediate imports that are used to produce exports to the same partner from which the inputs originated (lnintimps_bvsbil). Differences in the coefficient estimates between the estimations of these measures are expected to reflect how the use of intermediate imports might matter and in particular if there are differences between participating in an international value chain or in a bilateral value chain. The final measure is expected to show some evidence of 'magnification' because it reflects production sequences characterised by a back and forth movement of products.

Comparing the first two columns of Table 2.6 reveals little differences between the coefficient estimates in a model that uses the BEC nomenclature to identify intermediate products and one that uses IO tables. This suggests that there is little evidence of the BEC nomenclature being a 'bad' identifier of intermediate products[194]. Although this point may seem trivial, it provides a degree of comfort to the studies that rely heavily on this identification method. The FTA coefficient in both equations is of a similar size and suggests that countries import 25% more inputs, in value, from preferential partners than from non-preferential partners all else being equal. The comparison of these results with those obtained in Table 2.3 reveal that there are little differences in the impact of an FTA on total and intermediate imports and that, if anything, FTAs affect total imports more than they affect intermediates imports (this is in line with the results obtained by Orefice and Rocha, 2011).

Turning then to column (3), which reflects international value chain activity with respect to the world, it can be seen that the impact of an FTA exceeds that which was earlier reported. The effect of an FTA is 5 percentage points higher when intermediate products are used as part of an international value chain[195]. This, a

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[194] Notionally, perhaps both identification strategies are as bad as each other though! The correlation coefficient between these measures is 0.97.

[195] Chaney (2008) predicts that the elasticity of substitution across products affects the responsiveness of trade to changes in trade barriers differently due to opposing effects on the intensive and extensive margins of trade. The simple explanation for this is that when one allows for firm heterogeneity, a high degree of substitution reduces the associated profits that a firm can derive due to the intense competition in the market. Lowering trade barriers would then result in more competition which

priori, suggests that vertically linked trade is more sensitive to trade policy than normal trade in intermediates or that an FTA promotes this type of activity more than it promotes total or intermediate imports. Turning then to column (4), where the dependent variable is the value of the import content of exports from the same origin/destination, the effects of an FTA are seen to be much more pronounced. Here the FTA coefficient doubles so that an agreement increases the value of the intermediate imports used in a bilateral value chain by over 65%. The mass and distance coefficients also increase considerably which may reflect that this type of trade might be more sensitive to supply and demand conditions, as well as trade costs, than the other types of intermediate goods trade. Moreover, the positive coefficient on the variable capturing technology differences, the FK indicator, suggests that this term is a significant determinant of this type of trade where more similar exporting structures are associated with higher levels of vertically specialised trade.

These results are consistent with Yi's (2003) magnification effects. The large coefficient on the mass variable suggests a higher elasticity between this type of trade and GDP than that of normal trade. Yi argues that the presence of these magnification effects, which arise in vertically specialised modes of production, can help explain why world trade has grown faster than world GDP during the last decades. The coefficient on the mass variable is consistent with these predictions. Yi also suggests that these types of flows should be more sensitive to changes in trading costs and this is also supported by the data. Hanson et al. (2005) also provide evidence of this, in the case of multination activity in the US, as do Egger and Pfaffermayr (2005) and Chinn (2005) who identify magnification effects associated with two way trade in components.

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would in turn dampen the intensive margin of trade. In parallel a reduction in tariff barriers to trade increases the possibility of new entrants to capture market shares through higher associated profit prospects. This implies that "the elasticity of substitution magnifies the sensitivity of the intensive margin to changes in trade barriers, whereas it dampens the sensitivity of the extensive margin". If there are differences between elasticities of substitution across intermediate and final goods then the above is relevant for this investigation. To the extent that the elasticity of substitution of intermediate inputs may be lower than that of the associated final good then we can expect a higher responsiveness of new varieties entering the market through the reduction of tariff barriers. This may explain why intermediate goods trade is more sensitive to the FTA variable.

Table 2.6: The impact of an FTA on the value of intermediate imports

	(1) lnintimps_bec	(2) lnintimps_tot	(3) lnintimps_bvs	(4) lnintimps_bvsbil
Lnmass	1.062***	1.016***	1.018***	1.919***
	(0.0299)	(0.0298)	(0.0316)	(0.0420)
Lndist	-1.041***	-1.093***	-1.107***	-2.176***
	(0.0189)	(0.0176)	(0.0184)	(0.0373)
Contig	0.253***	0.257***	0.207***	0.413***
	(0.0315)	(0.0328)	(0.0333)	(0.0581)
comlang_off	0.534***	0.541***	0.561***	1.082***
	(0.0272)	(0.0282)	(0.0305)	(0.0514)
lngdpcap_d	1.133**	0.648*	0.500	1.302**
	(0.504)	(0.365)	(0.384)	(0.600)
lngdpcap_d2	-0.0798***	-0.0488**	-0.0384*	-0.0874**
	(0.0276)	(0.0213)	(0.0224)	(0.0341)
Lnfk	0.142***	0.0483	-0.0721	0.217***
	(0.0447)	(0.0441)	(0.0506)	(0.0717)
FTA	0.221***	0.225***	0.266***	0.503***
	(0.0378)	(0.0346)	(0.0378)	(0.0682)
Constant	-15.67***	-19.04***	-19.23***	-46.45***
	(2.747)	(2.111)	(2.223)	(3.253)
Observations	20,624	20,631	20,631	20,590
R-squared	0.839	0.831	0.817	0.87
Number of repyear	545	545	545	545
r2_o	0.786	0.797	0.737	0.763
r2_w	0.839	0.831	0.817	0.87
r2_b	0.725	0.762	0.626	0.696

Notes: The mass variable is the log of the product of purchases of inputs in the reporter and partner countries, standard errors are clustered by reporter-year. *** p<0.01, ** p<0.05, * p<0.1

The difference between the dependent variable in column (3) and that of column (4) lies in the use that is given to the imported intermediates. Differences in the coefficient estimates suggest that traditional gravity variables affect intermediate imports in different ways according to the use that is given to these. The results suggest that the purchase of intermediate imports from preferential partners is more pronounced when the resulting output is destined to the same preferential partner. Or, that trade policy seems to have a large effect on bilateral vertical specialisation and hence that FTAs may be able to effectively promote the propagation of bilateral value chains across preferential areas.

Another possible explanation for these large effects is that they might arise from the complementarity of trade flows as discussed in the previous essay and in Samuelson (2001) and Bas and Strauss-Kahn (2011). These papers suggested that importing complementary intermediate products could lead to positive effects on the competitiveness of the associated exported product. This might imply that the reduction in the cost of intermediates, accomplished though the FTA, may be increasing the efficiency of vertically specialised sequences of production and hence promoting a greater propagation of bilateral value chains.

These results may also be consistent with the recent theoretical literature that discusses offshoring in the presence of FTAs (Ornelas and Turner, 2008 and Antras and Staiger, 2011). If FTAs can mitigate 'hold-ups', through the creation of deeper agreements where common regulatory frameworks are created, then it is plausible that these have a stronger effect on vertically specialised trade than they do on normal trade (see Ornelas and Turner, 2008). Because new trade agreements involve the negotiation of deeper provisions (see WTO 2011), then they may be better at tackling the causes of these hold ups.

Two sensitivity checks are implemented in an effort to test the robustness of these results. First, it can be argued that the magnification effects identified arise from a 'double counting' of trade, or are a statistical construct. One would want to test whether these results remain when net flows, rather than gross flows, are used. Second, it is possible that the euro-centricity of the sample may be driving these results or that vertically specialised trade is only magnified in deeper pre-established agreements. One would then want to investigate whether these results remain when using a sample that does not include the large and pre-established trading areas.

The first column of Table 2.7 looks at whether 'double-counted' trade is driving these results by regressing a measure of intermediate goods trade that is netted from the domestic value that is embodied in the intermediate imports (lnnetintimps_bvsbil) against the same explanatory variables as above[196]. The results suggest that magnification effects remain and hence that these results appear not be driven by the 'double-counting' of trade.

[196] Details on how this measure is obtained can be found in the Appendix A2.5.3.

Table 2.7. Sensitivity tests, net flows and sample without large agreements

	(1) NET	(2) NO EU15, NAFTA, MERCOSUR	(3)
VARIABLES	lnnetintimps_bvsbil	lnintimpsbvs	Lnintimpsbvsbil
lnmass	1.920***	0.953***	1.824***
	(0.0418)	(0.0552)	(0.0942)
lndist	-2.166***	-1.245***	-2.413***
	(0.0374)	(0.0173)	(0.0358)
contig	0.393***	0.279***	0.622***
	(0.0579)	(0.0450)	(0.0749)
comlang_off	1.080***	0.671***	1.293***
	(0.0513)	(0.0318)	(0.0447)
lngdpcap_d	1.287**	-4.150***	-1.943
	(0.600)	(1.118)	(1.191)
lngdpcap_d2	-0.0863**	0.245***	0.111
	(0.0340)	(0.0660)	(0.0734)
lnfk	0.217***	-0.168***	0.0244
	(0.0716)	(0.0539)	(0.0680)
FTA	0.497***	0.357***	0.612***
	(0.0679)	(0.0456)	(0.0590)
Constant	-46.67***	7.942	-17.04***
	(3.268)	(5.005)	(6.212)
Observations	20,590	15,143	15,184
R-squared	0.870	0.813	0.855
r2_o	0.734	0.538	0.586
r2_w	0.870	0.813	0.855
r2_b	0.627	0.296	0.338

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

The final two columns of Table 2.7 then attempt to identify whether the results obtained in Table 2.6 hold in a sample that is less EU centric. It removes all agreements that existed in 1995 so that the EU15 agreement as well as NAFTA and MERCOSUR are no longer in the sample and then re-runs the estimation of the final columns of Table 2.6. The results also show evidence of magnification effects. The impact of an FTA on bilateral value chain activity (lnintimps_bvsbil) is twice as large as that found for the measure of international value chain activity (lninimps_bvs). Moreover, the magnification effects remain with respect to the other coefficients. But the removal of these large pre-existing agreements also seems to affect the coefficient estimates on some of the trade cost measures. In Table 2.7, the coefficients on the distance measures are found to be significantly larger than those reported in Table 2.6. This might hint at differences in the partners that are engaging in new FTAs. This will be researched further in the next essay of this thesis.

2.6.3.2. *THE IMPACT OF AN FTA ON VERTICAL SPECIALISATION*

This section looks at the impact of an FTA on the *structure* of trade through the bilateral vertical specialisation *indicator – bvs_bil*[197]. To this end, it is convenient to go back to the initial definition of the indicator (in equation 2.1). In its share format, it captures the import content of exports and has two components. The numerator is the value of intermediate imports used from a partner country to produce exports to that same partner - the *intimps_bvsbil* measure estimated in Column (4) of Table 2.6. The denominator is then the value of exports to the same partner where the imported intermediates originated. This is a structural measure of the degree of bilateral vertical specialisation and it can rise through:

1. Increases in the value of intermediate imports (holding the denominator constant); or
2. Reductions in export sales (holding the numerator constant); or
3. A faster growth in intermediate trade than in total trade

An FTA is likely to affect both the numerator and the denominator of this expression and hence the estimated FTA coefficients is to be interpreted as the degree to which agreements affect bilateral intermediate imports relative to bilateral total exports. Table 2.6 suggested that FTAs increase the value of intermediate imports used to produce exports to the same destination by 65%. The earlier results from Table 2.4 showed that total bilateral trade increased by 27% as a result of a trade agreement. Because the former effect is larger than the latter, then the impact of an FTA on the degree of VS is expected to be positive, i.e. larger positive impact on intermediate imports than on exports (case 3 above presented). The reduced-form equation capturing the determinants of bilateral vertical specialisation derived in equation (2.15) can be log-linearised to produce the following estimating equation:

$$lnbvs\_bil_{ijt} = \alpha_{i,t} + \rho_{j,t} + \beta_1(lnmass) + \beta_2(lnGDPcapdiff_{i,j,t}) + \beta_3(lnFK_{i,j,t}) + \beta_4(CONTIG_{i,j}) + \beta_5(LANG_{i,j}) + \beta_6(lnDIST_{i,j}) + \beta_7(FTA_{i,j,t}) + u_{i,j,t} \tag{2.23}$$

[197] An estimation using a measure that tracks the import content of world exports is analogous in form to the estimation in Column 3 of Table 2.6. This is because total exports, which would represent the denominator of the expression, do not vary across reporter-year and hence are collinear with the set of FE used.

The mass variable that is used in this instance should capture the share of output that the reporter and partner country uses for purchases of intermediates[198]. Such a measure is computed by multiplying the gross output of the country by the share of inputs that are used by the economy. The *GDPcapdiff* variable is the log of the ratio of the GDP per capita of reporter and partner countries and the rest of the variables are the same that were used in previous estimations. Table 2.8 shows the coefficient estimates for this measure of vertical specialisation. The indicator of vertical specialisation is rising in economic mass and falling in distance. Lower trade costs, captured by the distance, contiguity and language variables also increase degrees of vertical specialisation. The positive coefficient on the FK variable suggests that technology differences between countries matter and that the more similar exporting structures are the large then degree of bilateral vertically specialised trade. Turning to the FTA coefficient, the results support the initial claim which posited that the impact of an FTA on the degree of VS between two countries should be positive. The bilateral vertical specialisation of preferential partners is 28.5% higher than that of non preferential partners. This give continued support to the idea that trade agreements can help in the propagation of bilateral value chains[199].

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[198] This is to reflect the mass variables in equation 2.15: $\frac{C_j C_i}{Y_j Y_i}$.

[199] The estimates of an equation that places the bilateral use of intermediates to produce total exports as a proportion of total exports is omitted. This is because, with the use of the country-year FE, this expression is exactly like the one presented in the results of Table 2.6 column (3). This is because these fixed effects are collinear with the denominator of this expression and hence that the estimated model would be exactly the same is in that table.

Table 2.8: The impact of an FTA on Vertical Specialisation

	bvs_bil
lnmassbvs_bil	1.146***
	(0.0411)
lndist	-1.119***
	(0.0191)
contig	0.168***
	(0.0328)
comlang_off	0.522***
	(0.0286)
lngdpcapratio	-0.0270
	(0.0386)
lnfk	0.241***
	(0.0466)
fta	0.250***
	(0.0381)
Constant	-23.80***
	(1.033)
Observations	20,590
R-squared	0.815
r2_o	0.389
r2_w	0.815
r2_b	0.0573

Notes: standard errors are clustered by reporter-year,
*** p<0.01, ** p<0.05, * p<0.1

2.7. CONCLUSIONS

Much has been written about the proliferation of trade agreements or the rise in vertically specialised trade. However this literature has not focused on looking at the role of trade agreements in this process. This essay set out to fill this gap. The results suggest that countries involved in a preferential agreement import more intermediate inputs from each other than from non-preferential partners. This is not a surprising result but this essay is one of the first to provide solid econometric evidence on the magnitude of this effect. What is perhaps surprising is that the impact of an FTA on total and on intermediate imports (irrespective of their use) is of a similar magnitude, and this highlights that, in general, trade agreements do not impact one type of trade more than another. However, when one differentiates across the use of imported intermediates, or when one identifies the trade flows that may be part of a value chain, this result no longer holds. An FTA has a larger impact on imported intermediates that are part of an *international* value chain and the impact of an FTA is larger still on intermediate imports that belong to a *bilateral* value chain.

Imports that belong to a bilateral value chain also appear to be much more sensitive to changes in traditional gravity variables (i.e. trade policy, trade costs and economic mass) than other types of trade as Yi's (2003) theoretical paper predicted. Such magnification effects occur only when production sequences exhibit multiple border crossings and suggest that the removal of barriers may have large effects on this type of production sequences (evidence of similar magnification effects can be found in Egger and Pfaffermayr, 2005 and Chinn, 2005). What is most important about these results is that these effects appear to be driven by the presence of an FTA and not by other characteristics of partners which predisposes them to engage in an FTA or to have higher degrees of vertically specialised trade. This then points to an important role for trade policy in shaping patterns of bilateral vertical specialisation.

Although the derivation of a gravity model of intermediate goods trade from the perspective of the producer is novel, the theoretical contribution of this essay in this area is modest. Some of the base assumptions require a little more theoretical treatment. One of the weaknesses of the model is that the assumption that countries produce different numbers of varieties has not been backed by an appropriate supply side model that explains how these heterogeneities in production arise. Such a supply side model of vertical specialisation is desirable although beyond the scope of this essay. However, it seems reasonable that such a model would be based on the heterogeneous firm literature drawing on insights from the Economic Geography literature. This model would link the process of vertical specialisation to the productivity differences that firms exhibit within countries and would see more vertically specialised firms as having higher productivity draws. The recent paper of Bas and Strauss-Kahn (2011) is a good starting point for looking into this.

This essay would benefit from a greater focus on issues of spatial correlation and how this affects the dependent and the FTA variable. The rise in vertically specialised trade should lead to a greater co-movement of international business cycles and this should lead to elements of spatial correlation. Furthermore if the process of VS and FTAs is indeed highly linked, then signing an FTA with one partner and not another is likely to have repercussions that go beyond the two countries involved in the FTA. Capturing the average treatment effect of an FTA rests on the assumption that the FTA variable is independent but evidence on the contrary is increasingly coming to light. Indeed Baldwin's domino theory of regionalism is a good example of how the independence assumption is violated. Similarly, because fragmentation takes place between more than two countries, it is possible that dynamic effects arise and that exports to a third destination determine the demand for imports from any given partner. The incorporation of FDI flows into this type of analysis would also be desirable, particularly in light of Markusen's (1989) Knowledge-Capital model and the role of investment in the incomplete contract theory of offshoring and FTAs (Antras and Staiger, 2011). This essay has not focused on FDI on the basis that it is hard to differentiate between investment flows that serve create a production platform for value chain activity or those that serve relocate entire production processes in an effort to 'jump' barriers to trade (tariff or non tariff measures). This essay has also said very little about the organisational choices of firms which are likely to matter considerably, and particularly if the impact of deep integration is to be captured. Looking into these issues generally requires detailed firm level data.

Nevertheless, this essay makes some important methodological contributions to the literature. The first is that it shows that the use of country-year fixed effects provides appropriate controls for the unobserved heterogeneity that afflicts the estimation of the effect of FTAs on trade flows. The more traditional method that has been proposed by the literature deals with these issues through the use of additional pair-wise fixed effects (Baier and Bergstrand, 2007), however this may not be appropriate when the variance of the FTA variable is temporally limited. This is particularly important when using shorter panels. It is likely that newer proxies for vertically specialised trade cannot be calculated for as long a period as trade flows are available for and hence that the temporal variance of the FTA variable is going to become an issue in future studies. As more and more countries engage in regionalism, the temporal variance of bilateral FTAs is going to decrease. To the extent that bilateral pair-wise fixed effects only capture variance if there is a 'switch' from no agreement to an agreement, such a technique for controlling for unobserved heterogeneity has its days counted.

Another methodological contribution is that two different identification strategies for capturing the value of bilateral intermediate goods trade have been tested. The more traditional BEC nomenclature approach has often been criticised as an 'ad hoc' way of identifying these products (Hummels et al., 2001), but it is shown that it performs relatively well when compared to a method that identifies intermediate products through Input-Output tables. However, insofar as this essay suggests that the use that is given to the intermediate inputs is important, the BEC nomenclature, which fails to differentiate across the use of intermediate imports, may miss these important subtleties and hence is not a good identifier of value chain activity.

This essay has provided a solid econometric analysis of the role of trade agreements in the propagation of vertical specialisation but the reverse causality is equally interesting. Is it the presence of a trade agreement that leads to higher vertical specialisation or does prior vertical specialisation set in motion further demand for regionalism? The contrasting paths of integration of the European Union and ASEAN countries suggest that either path is possible hence looking at the role of vertical specialisation on the formation of trade agreements will be helpful in understanding the full link between these two processes. An interesting result that emerged from this essay is that the gravity coefficients obtained from a reduced sample of countries that have not yet engaged in trade agreements are somewhat different to those of the full sample. This points to the possible existence of differences in the characteristics of new preferential partners. This may then suggest that the changing nature of trade may be affecting the determinants of new regionalism.

ESSAY THREE

NEW DETERMINANTS FOR NEW FREE TRADE AGREEMENTS: GOVERNANCE, INTERDEPENDENCE AND VERTICAL SPECIALISATION

Abstract

The 'traditional' determinants of Free Trade Agreements (FTAs) fall short in predicting the countries that are involved in the new wave of 21st Century Regionalism. Partners are now more distant and exhibit greater differences in their capital labour ratios than they did in the past and this suggests that important changes in the political economy dynamics that determine the internal support for further liberalisation may be taking place. This essay argues that the changing nature of trade, captured through the rise in vertical specialisation, is driving these changes and introducing new motives for countries to engage in new FTAs. The presence of adequate governance mechanisms, which are conducive to a more efficient allocation of economic activity, and the rise in international production linkages are shown to motivate the formation of these new agreements.

3.1. INTRODUCTION

The well documented rise in regionalism has motivated a growing interest in looking at the determinants of free trade agreements (FTAs). The traditional empirical models of FTA formation, inspired by Baier and Bergstrand (2004), suggest that larger, similar and neighbouring countries have traditionally not only exhibited higher trade flows but have also been more likely to engage in FTAs (Baier et al. 2008). The fundamental hypothesis driving these models is that economic characteristics that make 'good' trading partners can predict the incentives that motivate the formation of successful trading arrangements. In contrast, the political economy models of FTA formation see agreements arising from an internal 'bidding' process between domestic interest groups (Grossman and Helpman, 1995; and Ornelas, 2005a,b,c). But evidence suggests that regionalism comes in waves (Ethier, 1998; Burfisher et al. 2003; WTO, 2011; and Baldwin, 2011), and that the partners involved in different waves display different characteristics. This then suggests that the economic and political economy determinants of FTAs may be evolving[200].

It is herein argued that the changing nature of trade, witnessed by the recent growth in vertical specialisation (VS), gives rise to new incentives to form new agreements and that this has spurred the new wave of *21st century regionalism* (Baldwin, 2011). The comparative static evidence presented in this essay shows that new preferential partners are more distant and less similar in their factor endowments than preferential partners involved in earlier waves of regionalism. This could be a manifestation of changing conditions in the game of regionalism. This essay puts forward the idea that the changing nature of trade, which involves complex and interconnected modes of international production, leads to changes in the incentives that determine the formation of new agreements through three distinct channels.

1. Via changes in the internal political economy dynamics;
2. Through a greater demand for appropriate regulatory frameworks that cater for the complexities of new economic transactions; and

[200] This may suggest that a) what makes good trading partners now is somewhat different from what made good trading partners in the past (i.e. changes in the economic determinants of FTAs); b) that there are changes in the political economy forces that determine the formation of agreements; or/and c) that there are new and more complex channels through which FTAs and trade interact.

3. By way of interdependence effects that are created from the wider spread of production across international borders.

These new channels of influence may help form a better understanding of the drivers of new trade agreements which involve not only new partners but also the negotiation of 'deeper' agreements that deal with behind-the-border measures (Baldwin, 2011; Orefice and Rocha 2011; and WTO 2011).

The role of vertical specialisation in the formation of new FTAs is indirect; in part, it acts through changes in the internal political economy forces that determine the conclusion of FTAs (in the guise of the theoretical models of Grossman and Helpman, 1995 and Ornelas, 2005a,b,c). A growing dependence on intermediate imports over domestic intermediates, or a rising VS, goes hand in hand with a diminishing influence of import competing firms in veering government decisions towards protectionist measures. This then results in the emergence of a larger relative lobbying mass in favour of more liberal policies. It suggests that countries that are more vertically specialised should be more likely to conclude FTAs. This is corroborated by the results of this essay which show that a 1% increase in the change in bilateral vertically specialised trade raises the likelihood of countries switching into an agreement by 9 percentage points. It also shows that countries which exhibit more globally vertically specialised *structures* of production are more likely to conclude FTAs.

The rising complexity of international trade transactions may also lead to a greater demand for bilateral regulatory harmonisation (Orefice and Rocha, 2011). This has made 21st century regionalism 'deeper' than traditional trade agreements (Burfisher et al. 2003; Ethier, 1998; Baldwin, 2011; and Orefice and Rocha, 2011). A link between vertical specialisation, regulatory structures and FTAs arises from the theoretical work of Antras and Staiger (2011). They suggest that *hold-ups,* which lead to inefficiently low levels of offshoring across countries, can be mitigated through the adoption of relationship-specific regulatory frameworks[201]. These can

[201] Hold-ups occur when uncertainty impedes the efficient functioning of economic transactions. The customisation of inputs generates relationship specific sunk-costs which cannot be recouped when contracts are broken (i.e. incomplete contracts). Uncertainty then leads to sub-optimal levels of economic activity between countries. See Antras and Staiger (2011) Ornelas and Turner (2008) and Marcoullier (2002).

take the form of deeper trading arrangements that cater for the idiosyncrasies of value chain activity. Following these insights, the idea that the desirability of engaging in a new trade agreement could be tied to the prevailing regulatory environment is put forward. Evidence supporting this claim is provided where it is shown that the inclusion of a variable that captures the minimum quality of the regulatory environment between two countries helps increase the predictive powers of an augmented FTA formation model. Increases in regulatory quality are associated with higher probabilities of agreements being concluded, however low measures of regulatory quality may also incite countries to sign new and deeper agreements in order to redress shortfalls in regulatory frameworks.

The wider delocalisation of segments of production also gives rise to greater interdependencies between agreements. The desirability of a trade agreement between two countries has been shown to depend on the participation of these countries in other FTAs (see Baldwin's (1993) domino theory of regionalism). Several papers have highlighted the role of these interdependence effects in the formation of trade agreements (Baldwin, 1993; Egger and Larch, 2008; Baldwin and Jaimovich, 2010 and Baier et al, 2010). However none has looked at the impact of interdependencies arising from the spread of vertically specialised trade as is done in this essay. Here too supportive evidence on the positive impact that these play on the probability of an FTA being concluded is provided.

Preliminary evidence of a link between the changing nature of trade and the creation of new FTAs is most apparent in South East Asia. Here the well documented rise in regional vertical specialisation, leading to the emergence of 'factory Asia' (Baldwin 2006b), seems to have motivated a rising demand for new and deeper trading arrangements (see WTO, 2011 and Baldwin, 2011). However such links are not confined to this region as the work of Orefice and Rocha (2011) suggests. They find that, in general, countries which trade more intermediate imports also tend to form 'deeper' agreements. This suggests that the changing nature of trade may be leading to a qualitatively different form of regionalism (Baldwin, 2011). This then highlights the importance of looking at new drivers of new regionalism, not least to identify emerging challenges that will be faced by the global trading system.

In capturing the impact of vertical specialisation on the probability that two countries engage in an FTA one is confronted with two separate issues of *endogeneity* which bias coefficient estimates. The first arises from *unobserved heterogeneity* whereas the second is caused by *simultaneity.* The latter occurs through the influence of FTAs on current trade flows and suggests the use of pre-agreement measures of trade flows in estimating FTA formation models. Unobserved heterogeneity then arises from the presence of unobserved variables (to the econometrician) which simultaneously affect both the probability of countries engaging in an FTA and also the levels of vertically specialised trade between these. This type of bias is the same that arose in the previous essay of this thesis when looking at the impact of FTAs on vertically specialised trade. However, the same solutions to these biases cannot be applied[202]. The binary nature of the dependent variable in an FTA formation model raises 'incidental parameters' problems (Neyman and Scott, 1948[203]) which cause complications in the estimation of binary panel data models with fixed effects. Hence controlling for unobserved heterogeneity, in an FTA formation model, requires the use of different control mechanisms than those proposed in the previous essay.

This essay tackles issues of endogeneity through cross-sectional and panel data approaches. The cross-sectional models rely primarily on a First Difference (FD) approach which looks at how *changes* in variables affect *switches* in FTA status. In addition, an instrumental variable (IV) approach is also used to introduce exogenous variation in the trade measures. In the panel data specifications, the unobserved elements that co-determine flows of vertically specialised trade and FTAs are isolated through; a conditional logit model; a panel IV approach; and a Mundlak-Chamberlain transformation. The empirical results support the claim that the changing nature of trade is affecting the incentives that lead to the formation of new agreements.

This essay is organised as follows. The next section reviews how the characteristics of countries involved in the different waves of regionalism have evolved. It argues

[202] Some of these solutions are not desirable either. In the previous essay, the focus was on capturing the impact of agreements not the impact of switching into an agreement. In this essay, the goal is that of looking at the determinants of switching into a new agreement. Hence the focus of this essay looks at a qualitatively different form of reverse causality.

[203] Also see Wooldridge, 2002 Chapter 15 p 484; and Greene, 2010 Chapter 9).

that changes in these characteristics support the need of a more focused study on the determinants of *new* trade agreements. Section 3.3 then discusses the role of the changing nature of trade in the formation of FTAs. In section 3.4, details of the database and indicators that will be used in the empirical section are presented. Section 3.5 then discusses the empirical models that are used to obtain the results presented in section 3.6. The final part of this essay concludes and provides some policy implications and further avenues for research.

3.2. WAVES OF REGIONALISM: OLD, NEW AND NEW NEW?

Regionalism is often described as a process that unfolds across different *waves*. This characterisation implicitly supports the notion that there exist changing circumstances that motivate these or that these exhibit different defining characteristics. Four different waves of regionalism are identified by Mansfield and Milner (1999). The first comes about with the emergence of green-shoots of European bilateralism in the 19th century and lasts till the beginning of the First World War. The interwar period then gives rise to a second wave of short-lived regionalism where discriminatory practices breed contentions amongst states which are unable to conclude multilateral agreements (Mansfield and Milner, 1999). But it is the third and fourth waves of regionalism, since the end of the Second World War, that are most discussed in the literature. These are concurrent with multilateral liberalisation and are often referred to as the old and the new waves (Burfisher et al., 2003, Baldwin, 1997, Ethier, 1998, and Baldwin 2006a)[204]. Although the historical and empirical narrative tends to be concerned with the impact of these concurrent processes (see Mansfield and Milner, 1999, Mansfield and Reinhardt, 2003, and Baldwin, 1997), the focus of this section is that of identifying the changing nature of the partners involved in each wave. This is to ascertain whether there are significant differences between old and new regional partners, and hence to establish if there is any prima facie evidence of new *new* regionalism (or *21st century regionalism* according to Baldwin, 2011).

The precise moment when new regionalism took over from old regionalism is hard to pinpoint. Mansfield and Milner (1999) place the third wave between the 50's and the

[204] Bhagwati (1993) refers to these as the first and second waves of regionalism respectively.

70's with the creation and expansion of the European Economic Community (EEC) and the European Free Trade Area (EFTA)[205]. However Baldwin (1997) places the birth of the new wave a little later, during the 80's. He argues that it arises from the *domino forces* created by the earlier Eurocentric round of preferential liberalisation[206]. These motivate the US to engage in bilateral trade deals as seen through the agreements with Israel and Canada and the beginning of negotiations with Mexico (Bhagwati, 1993; Baldwin, 1997; and Mansfield and Milner, 1999)[207].

Instead of focusing on the origins of new regionalism, Ethier (1998) underlines its characteristics. He argues that new regionalism involves a more diverse set of countries that engage in a wider range of negotiating issues. This qualitative change in the issues negotiated, and indeed the deepening of the provisions between preferential partners, is also what constitutes the distinction between old and new regionalism according to Burfisher et al (2003) and Baldwin (2011)[208]. However, whereas the former focuses more to the deepening of traditional agreements such as EU, the latter argues that the qualitative changes in negotiating issues arises as a direct response to changes in the typology of international transactions or - the *second unbundling.* Baldwin (2011) places these changes outside the traditional, or older, preferential blocks. The increased geographical distribution of production sequences across international borders, facilitated by reductions in coordination costs, leads to a greater demand for international disciplines. These typify *21st Century regionalism* which is distinct from new regionalism in this respect.

This latest wave of regionalism involves new partners that share an increasing willingness to arrive at common and deeper understandings in; investment

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[205] Although the US and Canada are also participants with the 1965 Canada-US Auto Pact. This period also sees a large failure of many regional initiatives as Bhagwati (1993) suggests (i.e. Pacific Free Trade Area; North Atlantic Free Trade Area; Latin American Free Trade Area; and Latin American Integration Agreement). These never came to fruition.

[206] Baldwin (1997) and Mansfield and Milner (1999) also argue that the concurrent rounds of multilateral negotiations play an important role in motivating this wave of regionalism.

[207] Bhagwati (1993) also recognises that these agreements may have come as a response to the earlier wave of European integration initiatives hence lending support to Baldwin's (1993) domino theory of regionalism.

[208] Burfisher et al. (2003) suggest that the qualitative difference between old and new agreements requires empiricists to reach further in their tools for the analysis of the impacts of agreements where in particular the links between trade and productivity require further theoretical and empirical treatment.

provisions; competition policy; and intellectual property rights[209]. Baldwin (2011) argues that these new found commonalities arise from a growing impetus in bolstering the trend that sees production locating in many different and international locations. He calls this the "trade-investment-services nexus" which, although representing a complex range of issues, manifests itself through the rise in vertically specialised modes of production. Baldwin's (2011) assertions lend themselves to the hypothesis that the rise in this type of trade, or the rising complexity in international economic transactions, should increase the demand for international arrangements in the form of new and deeper FTAs[210].

3.2.1. Characteristics of FTA Partners

Before turning to a more sophisticated analysis of the impact of the changing nature of trade on the formation of new trade agreements, a preliminary examination of the key characteristics of preferential partners is warranted. The stylised facts that emerge can help identify the evolving features of the partners that are engaging in FTAs across the different waves of regionalism.

Using CEPII's gravity database, which covers the universe of available dyads from the late 50's to 2006, 3 characteristics of preferential partners, whose choice is motivated by Baier and Bergstrand's (2004) seminal paper on the topic, are charted[211]. These are chosen to capture:

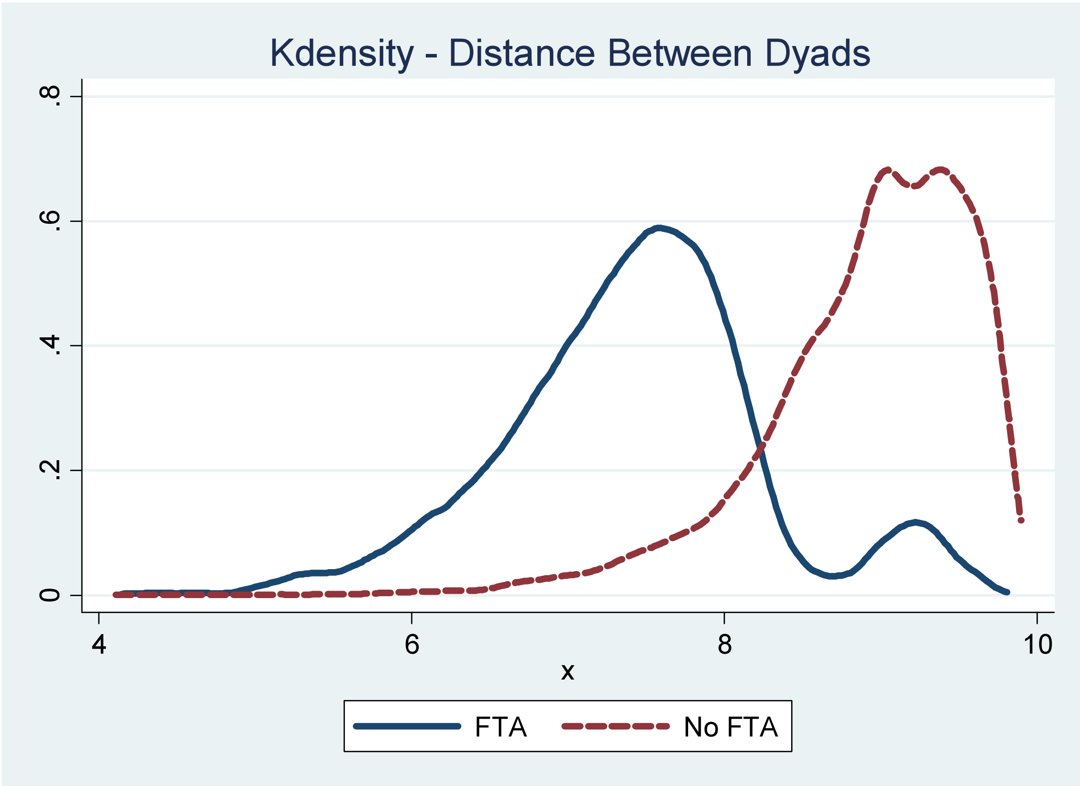
1) trading costs - through distances;
2) economic mass - through the absolute difference in the log of GDPs; and
3) differences in the composition of capital labour ratios - identified by way of the absolute difference in the logs of GDP per capita[212].

Dyads are then classified according to whether they share an FTA or not in the year 2006[213]. Figure 3.1 maps the differences between preferential and non-preferential

[209] See Baldwin (2011).
[210] This very proposition is tested by Orefice and Rocha (2011). They find evidence that intermediate goods trade leads to a wider demand for deeper provisions in FTAs.
[211] Baier and Bergstrand (2004) suggest that preferential partners tend not to be distant, share similar economic mass and have small differences in factor endowments.
[212] Egger and Larch (2008) show that the correlation coefficient of the capital-labour ratios used in Baier and Bergstrand (2004) and real GDP per capita is high (0.975).

partners in terms of distance. The density plots confirm a well known facet of regionalism – *preferential partners are close in proximity*. However, it also reveals the presence of a 'hump' nearing the end of the distribution of the FTA plot suggesting that more distant economies are also engaging in trade agreements[214].

Figure 3.1: Characteristics of FTA partners - Distance



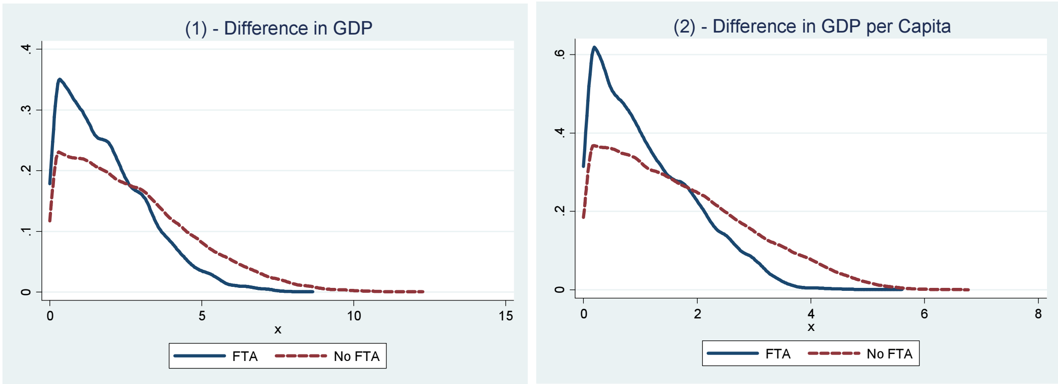
Source: Calculations from CEPII's gravity database. FTA is identified if dyad shares an agreement in 2006
Note: Distance = log of the distance between dyads

Figure 3.2 then looks at the distribution of the economic characteristics of dyads that share an FTA versus those that do not. The left panel (1) shows the absolute difference in the logs of GDP in the year prior to an agreement being signed. The panel on the right (2) maps the absolute difference in the logs of the GDP per capita across dyads in the year prior to an agreement being concluded. Panel (1) suggests that countries that are part of an agreement, in 2006, share a greater similarity in their GDP than those that did not participate in an FTA. The right hand panel then shows

[213] In the appendix (A3.1), the baseline year of 1960 is used to anchor the data as was done in Baier and Bergstrand's (2004) estimations. This is to avoid endogeneity arising from the possible impact of FTAs on the observed variables (GDP and GDP per capita). The results are qualitatively the same.
[214] A kernel density plot estimates, non-parametrically, the probability density function of a variable.

that FTA partners also share a smaller difference in income[215]. The stylised fact that emerges from these plots is that - *FTA partners tend to exhibit smaller absolute differences in both economic mass and income*.

Figure 3.2: Characteristics of FTA partners – Economic Mass and Income



Source: Calculations from CEPII's gravity database, economic data for year the agreement came into force. FTA is identified if dyad shares an agreement in 2006.

3.2.2. CHARACTERISTICS ACROSS THE DIFFERENT WAVES OF REGIONALISM

Much of the literature on new regionalism highlights the involvement of new partners (Ethier, 1998; and Burfisher et al., 2003). However, little has been said about the characteristics of these countries. Identifying the evolving characteristics of the countries involved in the different waves of regionalism can shed light on important qualitative differences in the characteristics of the different waves. These can be captured by looking at how, and if, the above presented stylised facts have changed across the waves. This requires defining the time periods that each wave occupies.

Dropping Mansfield and Milner's (1999) original first and second waves of regionalism due to lack of data, and following Bhagwati (1993) and Baldwin (1997); a first wave of regionalism is identified for the period between 1960 and 1985. A second wave is then defined for new agreements that enter into force in the period 1985-1995[216]. The last wave of regionalism then captures new agreements signed

[215] Appendix figure A.3.1 shows that these results do not change when using values of the economic variables in the year 1960.

[216] Bergstrand et al. (2010) also identify three waves of regionalism: The first from 1958-1973; the second from 1973-1989; and the last from 1989 onwards. The choice of cut-offs in this essay is different and is, in part, motivated by the availability of data in the empirical section. Nevertheless,

from 1995 to 2006[217]. Since the 1960's 1394 dyads are identified as having signed an FTA out of a possible 24,976 dyads. Our first wave saw the creation of 232 agreements; the second, the birth of 421; whilst the third, the creation of 741 agreements[218]. These numbers support the well documented rise in the formation of FTAs during the last decades.

Figure 3.3 presents a kernel density plot that maps the distribution of distances between preferential partners according to the identified waves of regionalism. The first observation that emerges is that the plotted distributions move towards the right as new waves of regionalism unfold. Although differences between the solid distribution, that identifies the first wave of regionalism, and the dotted one, that captures the second, appear to be small, the mean of the latter is somewhat higher. However it is the distribution of the distance between countries involved in the third wave which is most revealing. This is not only because it exhibits a higher mean, but also because it suggests that the 'hump' that appeared in Figure 3.1 is a new phenomenon[219]. The stylised fact that emerges from this analysis is that *the different waves are progressively involving countries that are more distant*[220].

several robustness checks to different specification of the waves are implemented in the appendix (see Appendix A3.3. in particular Table A.3.4).

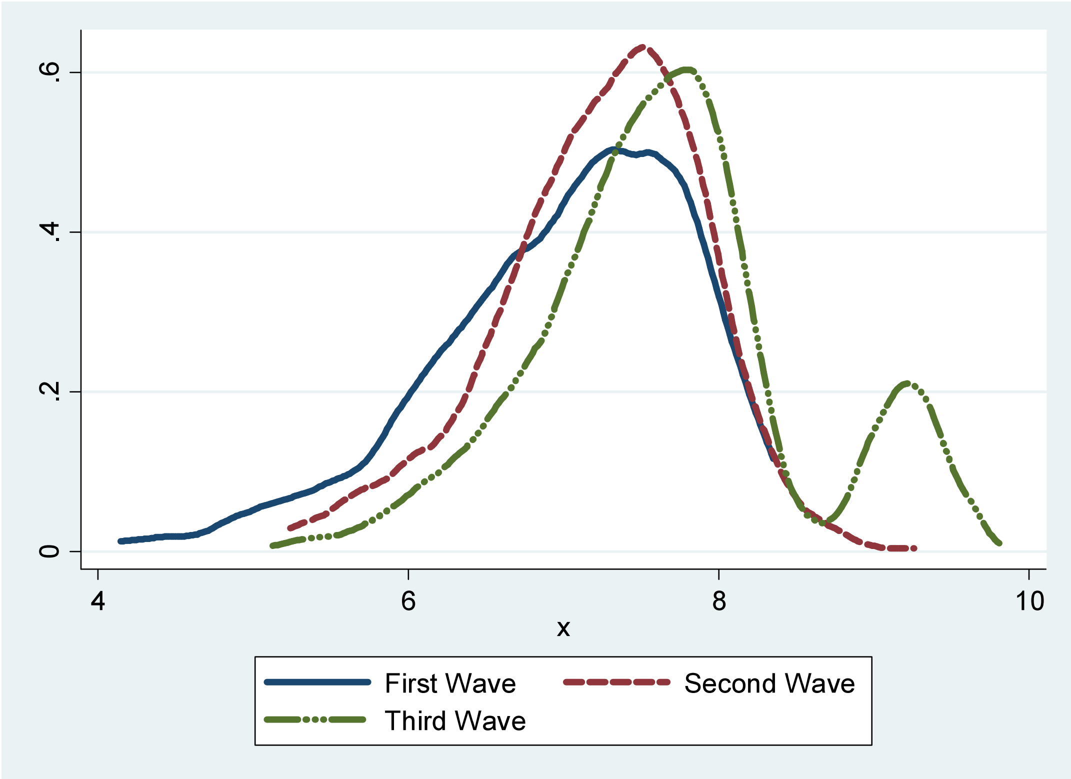
[217] Each wave is considered separately so that agreements that were implemented during the first wave are dropped from the sample in subsequent waves. Hence an agreement between Germany and France appears only in the first wave whilst the agreement between Germany and Spain appears only in the second wave. In this way, the agreements are classified by when they occurred rather than by how long ago they were implemented. This certainly raises issues of sequencing insofar as it is possible that countries sign with more distant partners as a result of having signed with all the partners that are close by.

[218] Agreements are identified by dyads hence the formation of the original EEC involving 6 countries means the creation of 15 'agreements' (6x5=30 divided by 2 to capture dyads =15).

[219] New agreements between 'distant' partners involve several key actors: the EU with Chile, Canada, Mexico and South Africa; Chile with the EU, the US, and Canada; and Singapore with the US, Switzerland, Jordan, Korea; as well as the US with Jordan. Additionally many prospective agreements are also between relatively distant partners i.e. EU and US with Korea as well as EU-GCC or MERCOSUR or indeed the Trans Pacific Partnership Agreements between Brunei, Chile, Singapore, New Zealand, USA, Australia, Peru, Vietnam and Malaysia, . This shows that the newest wave of regionalism appears to involve countries located in different hemispheres, whereas the early waves of regionalism involved North-North and some South-South agreements, the latest wave of regionalism may involve the creation of new North-South ties. See Manger (2009) for a discussion of this.

[220] Issues of sequencing remain important. It is possible that, once regions have been formed along geographic divides, subsequent waves capture expansions of regional blocks with neighbouring countries. However, if this were the case, then one would expect to obtain a flatter distribution with a higher mean. The emergence of the 'hump' nearing the end of the distribution and the fact that this was also captured in Figure 3.1, strongly suggests that there appears to be a new trend of regionalism involving more distant economies.

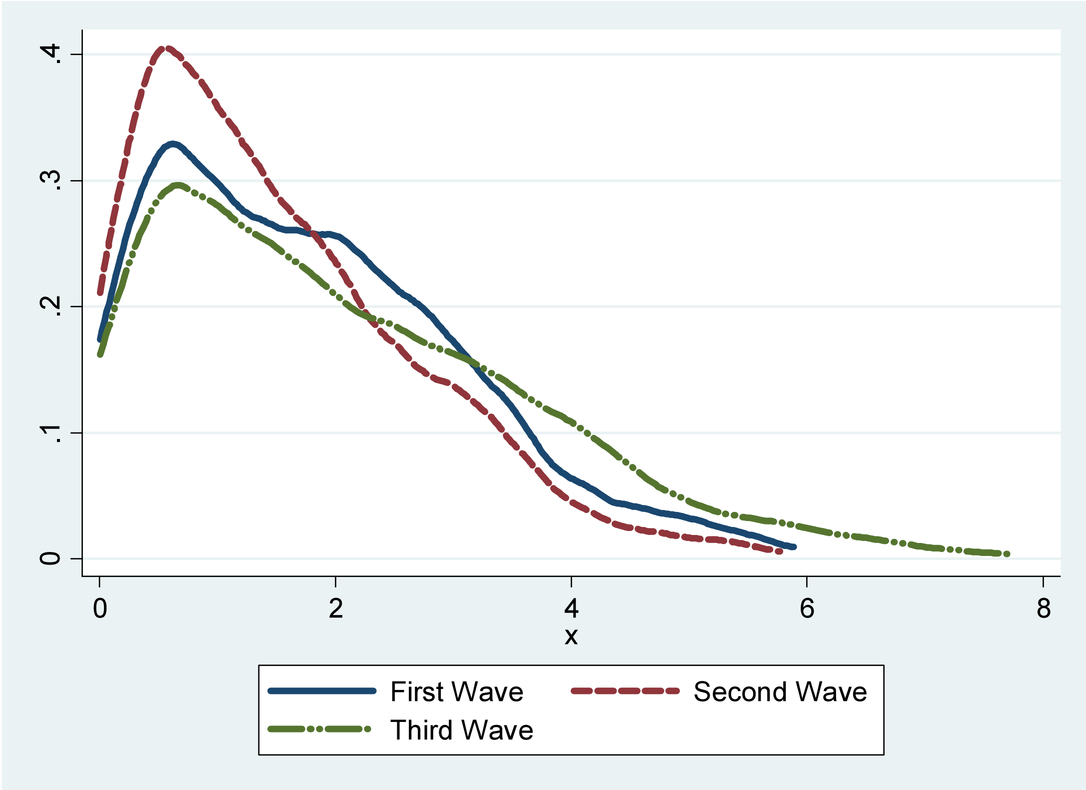
Figure 3.3: Distance between FTA partners across the three last waves of regionalism



Source: Calculations from CEPII's gravity database. First Wave identifies new agreements signed between 1960 and 1984. Second wave identifies new agreement signed between 1985 and 1994 and the third wave captures new agreements concluded between 1995 and 2006. Distance is measures as the log of bilateral distance.

Looking at the characteristics of preferential partners in terms of their similarity in economic mass reveals quite an uneven pattern (Figure 3.4). The first wave seems to involve countries with similar GDPs, however less so than the countries participating in the second wave of regionalism. Those that participated in the third wave then appear to exhibit a flatter distribution which suggests falling similarities in economic mass. Although there is no clear pattern in this figure, it seems that the first wave was more similar to the third than to the second wave. *FTA partners are still relatively similar, in terms of their economic mass, although less so for new agreements than for old ones.*

Figure 3.4: Difference in economic mass between FTA partners across the three last waves of regionalism

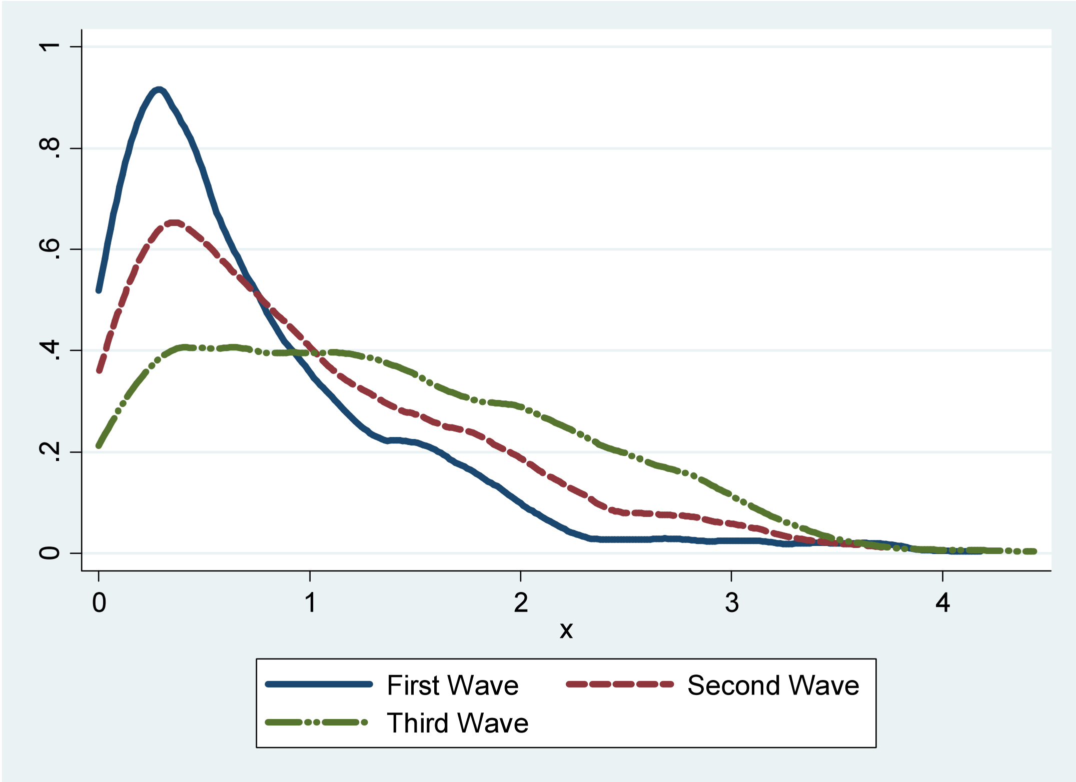


Source: Calculations from CEPII's gravity database data from first year of each wave. First Wave identifies new agreements signed between 1960 and 1984. Second wave identifies new agreement signed between 1985 and 1994 and the third wave captures new agreements concluded between 1995 and 2006. Differences in economic mass are measures through the absolute difference in the logs of the GDPs of the dyads.

Figure 3.5 then plots the difference in incomes across the waves of regionalism. Here a more discernible pattern emerges. The first wave clearly involves countries which share stronger similarities in their incomes. However as the second and third waves unfold this pattern begins to break and preferential partners become more dissimilar in their income. The third wave clearly has a much flatter distribution suggesting that *countries that engage in recent trade agreements tend to be much more dissimilar in income than in any other wave*[221].

[221] Earlier FTAs tended to be between countries situated in the northern hemisphere, however the evidence presented here suggests that there might be a greater incidence of North-South agreements during the latest wave (see Manger, 2009).

Figure 3.5: Differences in income between FTA partners across the three last waves of regionalism



Source: Calculations from CEPII's gravity database, data from first year of each wave. First Wave identifies countries that signed a trade agreement between 1960 and 1984. The Second wave requires there to be a new agreement between 1985 and 1994 whilst the third captures new agreements signed between 1995 and 2006. Differences in income are measures through the absolute difference in the logs of the GDP per capita of the dyads.

The 'stylised facts' that emerge from this analysis point to evolving features in the characteristics of new preferential partners. Whilst the first wave involved countries of similar economic mass, income and distance, the third wave appears to involve more distant economies that are more dissimilar in their income[222]. These observations may lend supportive evidence to Baldwin's (2011) claim for a separate analysis of 21st century regionalism. The implications of these changes are also important. Similarities in income reflect similarities in the factor composition of trade (Egger and Larch 2008), and hence the new wave of regionalism seems to be taking place between countries that are more dissimilar in their factor endowments. Although traditional models of trade would suggest that forming agreements between countries with such differences in comparative advantages makes economic sense, Mansfield et al. (2008) argue that political support for this type of agreement may be

[222] Overall countries participating in the latest wave of FTAs remain a little bit more similar in income than those that do not however much less so than was reported in Figure 3.2 panel (2). See Appendix Figure A3.3.

complicated due to the unequal distribution of factor rewards[223]. This implies that, often "good politics drives out good economics" (Mansfield et al. 2008:p69), or that agreements between countries with similar factor endowments may be politically easier to conclude[224]. Hence the changing characteristics of preferential partners may then be manifesting changes in the political economy conditions that determine the formation of FTAs. These might arise through changes in the nature of international transactions.

If the changing nature of trade is linked to changes in the desirability of engaging in a trade agreement then one could expect that countries that engage in new FTAs have seen their degree of vertical specialisation rise the most. Figure 3.6 provides prima facie evidence of this. It presents a kernel distribution plot of changes in the value of the log of vertically specialised trade, between 1995 and 2008, according to whether countries signed a new agreement during the third wave[225]. It shows that new preferential partners experienced a higher growth in vertically specialised trade than those that did not sign an agreement. This provides the prima facie link between the changing nature of trade and FTAs which motivates the focus of this essay[226].

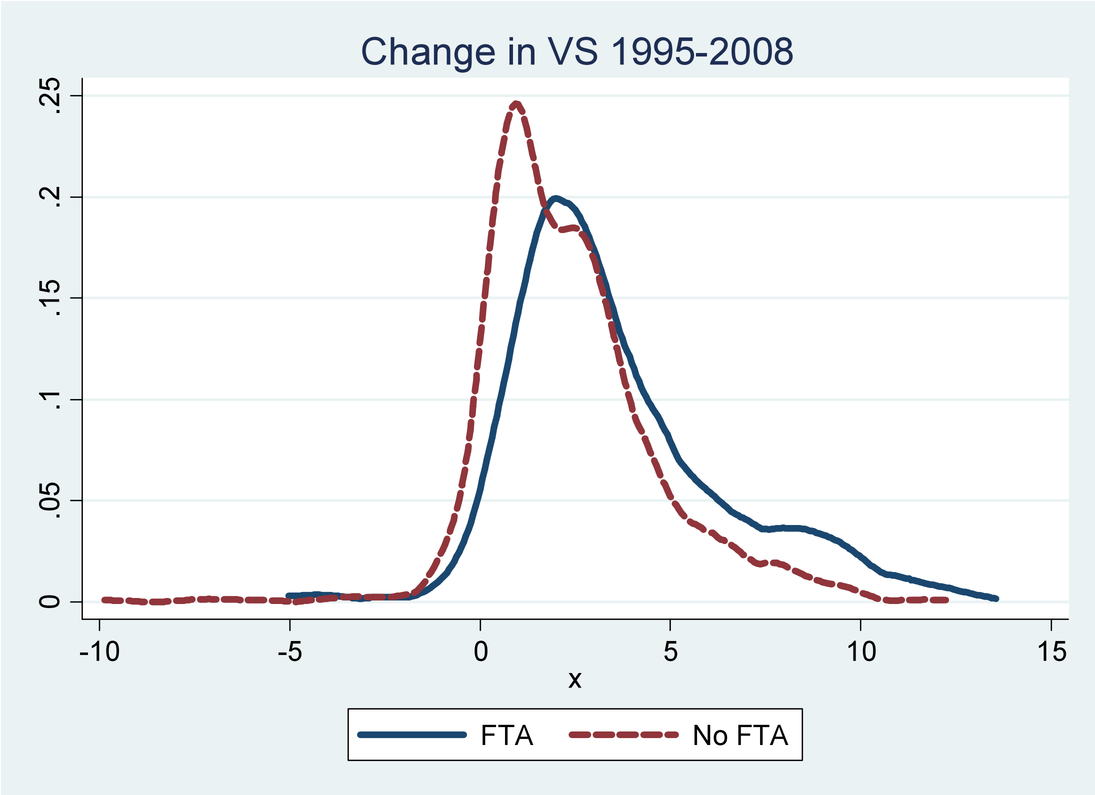
[223] If inter-industry reallocations are seen to be pronounced then voters may have strong views against such liberalisation.

[224] The large changes in factor rewards, as predicted by the traditional H-O-S theorems, can lead to internal frictions that garner opposition to trade agreements. Magee (2003) makes this point by showing the US House and Senate voting results for the FTA with Canada (CUSTA) versus that with Mexico (NAFTA) where the former was more easily passed than the latter. Mansfield et al. (2004:p69) argue that "adopting policies that antagonise important segments of society is ill advised".

[225] This is done for a subsample of 39 countries for which the value of bilateral vertical specialisation could be calculated. This indicator is calculated following the method presented in the first essay of this thesis. The characteristics of the sample used are discussed in the data section of this essay.

[226] It is noted that this plot may be driven by the impact of FTAs on vertically specialised trade. It serves the purpose of illustrating some prima facie evidence of a link between these processes.

Figure 3.6: Change in VS and new FTAs in the third wave (reduced sample)



Source: CEPII database for FTAs, Comtrade and OECD STAN database for calculation of the value of vertically specialised trade. Change in VS identified as the difference in the value of VS trade between 1995 and 2008

3.3. THE CHANGING NATURE OF TRADE AND FTAS

The literature on the determinants of FTAs is vast and has been concerned with an array of both causes and consequences. This section aims to give a non-exhaustive synthesis of this literature in view of determining how the changing nature of trade may affect the formation of new agreements[227]. This section begins with a more general discussion on how new forms of international production affect old, but still contentious, debates on the desirability of regionalism. This is followed by a more in depth discussion of the channels through which the changing nature of trade is expected to affect the formation of FTAs.

[227] Several other important contributions to the literature are omitted for brevity. This mainly concerns the literature on the links between terms of trade and FTAs See Ethier (2007), Bagwell and Staiger (1997, 2002). Also the important contributions of Yi (1996) and Freund (2000) are not widely discussed.

3.3.1. *OLD DEBATES, NEW INSIGHTS?*

During the 90's, Jagdish Bhagwati emerged as the leader of a movement that condemned regionalism as being a malignant force in the path towards global free trade. His concerns about discriminatory trading arrangements were voiced through two major questions. Firstly, would these agreements increase or reduce world welfare? And secondly, would regionalism be a stepping stone (supplement) or a stumbling block (alternative) in the path towards "multilateral free trade for all" (Bhagwati 1993:p32)[228]. In his review, Bhagwati (1993) suggests that the first question is an empirical one. Global welfare should depend on the relative strength of the trade creating and trade diverting forces that arise from preferential trade deals (Viner 1950). The second question then requires assessing the political economy forces that motivate the internal and external support to pursue one form of liberalisation over another – the incentive structure.

Bhagwati's concern was that these forces would lead to a fragmented world over a more favourable and all-inclusive non-discriminatory one. The debate is best summarised by Baldwin (1997). He argues that some see *discriminatory liberalisation* and focus on the benefits of liberalisation, whereas others focus on the discriminatory element and voice their concerns about its negative impact. Because the changing nature of trade is likely to be linked to both the impact of FTAs and the incentives that shape their desirability, an instructive exercise emerges from analysing how the rise in vertically specialised trade affects Bhagwati's concerns[229].

3.3.1.1. *IMPACT OF AGREEMENTS*

Bhagwati's first question related to the impact of trade agreements on global welfare[230]. Here, the early work on FTAs, initiated by Krugman (1991a, 1991b), provides some important insights. Krugman captured the impact of bloc formation on

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[228] See Freund and Ornelas (2010) for a comprehensive review of issues surrounding FTAs. Bhagwati, 1990, 1993 and 2008; and Bhagwati and Panagariya (1996) provide compelling arguments in favour of the stumbling block hypothesis. Burfisher et al (2003), Baldwin (2006), Estevadeordal et al (2008) propose counter-arguments. Panagariya (1999) provides a good review of the early literature and debate.

[229]Other concerns about regionalism arise from "attention diversion" (Bergsten, 1997:p574) which suggests that resources are limited and focused on bilateral deals rather than multilateral negotiations.

[230] Bhagwati claimed that global welfare falls as a result of regionalism compared to a multilateral alternative. This is because FTAs cause trade diversion whilst multilateral tariff cutting is only associated with trade creation.

world welfare by using trade costs to identify the trade creating and diverting forces at play. He found global welfare to be highly sensitive to the assumed structure of these costs. If these were to be zero, then Krugman (1991a) showed that FTAs unambiguously reduce world welfare, however when inter-continental trade costs are assumed to be prohibitive (Krugman 1991b) these results are reversed and FTAs become unambiguously welfare enhancing. This 'Krugman vs Krugman' debate (Frankel et al. 1995) spurred a flurry of papers that sought to capture the role of varying intra and inter-continental trade costs on welfare. Frankel et al (1995) and Frankel (1997) were examples of this. They extended the specifications of these costs along a continuum only to find similar ambiguities. Hence with theoretical support to global welfare enhancing and reducing scenarios, the debate would require an empirical appraisal to be settled.

Most empirical studies favour the idea that "trade creation has generally exceeded trade diversion" (Bergsten, 1997:p548), and hence that global welfare has risen as a result of regionalism. Baldwin (2011) provides a good summary supporting this view on the basis of the recent empirical evidence of Magee (2008) and Archarya et al. (2010). But he also argues that assessing global welfare, or the desirability of FTAs, through the quantification of the relative strength of Vinerian (1950) forces may be misguided. Agreements are no longer very preferential due to the high incidence of trade at zero MFN rates. Furthermore, high tariff, 'sensitive', products tend to feature prominently in lists of excluded goods in concluded FTAs. This leads to the existence of low preference margins and hence a low incidence of trade creation and trade diversion. Baldwin (2011) then argues that discriminatory liberalisation is no longer very discriminatory and hence FTAs should be seen as general liberalisation schemes[231].

However, the findings of the previous essay suggest that even low preference margins can lead to large trade effects when modes of production are vertically specialised and hence that Vinerian (1950) economics may yet be important. The traditional empirical analysis of trade creation and diversion has largely focused on the well understood welfare implications of FTAs in the presence of competing trade

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[231] Baldwin(2011:p20) "it may be more correct to view RTAs as general trade liberalisation schemes than as discriminatory liberalisations".

in final products. However, if trade is increasingly taking place across complementary intermediate products, then a new understanding of how these forces operate, in the presence of vertically specialised sequences of production, becomes progressively important in assessing the global welfare implications of FTAs.

Trade creation and trade diversion are likely to operate in much more complex ways in the presence of such modes of international production (see previous essays of this thesis for a more detailed discussion of this). They may impact either or both the importing and exporting elements of international value chain activity and thus introduce complex dynamics which make their welfare implications hard to grasp. Understanding the global welfare implications of FTAs then requires identifying how FTAs affect international production, and the results of the previous essays may help. The first essay showed that there appeared to be a correlation between the degree of vertical specialisation and productivity growth. This might, in turn, suggest that this type of trade may be associated with higher welfare gains than those associated with traditional trade flows (allocative efficiency). In addition, the second essay identified the presence of 'magnification effects' suggesting a higher responsiveness of vertically specialised trade to trade costs. This may then imply that the associated Vinerian (1950) forces may too be 'magnified' and hence retain an important role in grasping the desirability of FTAs even in the presence of low preference margins.

Nevertheless, the complexity of new trading relations (Baldwin, 2011), and the possible role of trade agreements in enhancing *deep integration*, also suggests that it is important to go beyond Vinerian economics. In his exposition of 21st century regionalism, Baldwin (2011) also argues in favour of a wider focus on barriers that impede the *connection of international production facilities.* He identifies 4 such behind-the-border-barriers; competition policy; movement of capital; intellectual property rights; and investment assurances. These do not lend themselves to traditional Vinerian analysis because these need not be discriminatory in nature in the same way that preferential tariffs are. In fact removing such non-tariff barriers, even on a 'preferential' basis, may result in the creation of public goods that could benefit countries outside preferential agreements (Baldwin 2011)[232]. Hence, if FTAs are more efficient at promoting this type of regulatory reform, through 'deeper integration', this may lead to larger preferential and non preferential trade flows and hence important global welfare gains. This would suggest that FTAs may not be as 'damaging' as Bhagwati feared.

3.3.1.2. Incentive Structures

The changing nature of trade may also introduce changes in the incentive structures that lead to one form of liberalisation over another (Bhagwati's second question). However, evidence suggests that multilateralism and regionalism could be endogenous processes[233]. Mansfield and Reinhardt's (2003) findings posit that it is the growing membership of the GATT/WTO that incites a country to embrace bilateral trade deals. As membership grows, a partner's negotiating leverage falls and the uncertainties associated with a failure of the multilateral system rise. Like-minded countries are then pushed towards bilateral trade deals as an insurance mechanism against such failures[234]. Contrasting evidence also suggest the presence of reverse causality. Estevadeordal et al. (2008) show how regional liberalisation in Latin America may have led to reductions in applied MFN tariffs and Baldwin (2011) provides further evidence of this trend. He argues that, since the Doha Round began in 2001, there has been a concurrent increase in regionalism with an observed reduction in applied MFN tariffs (through unilateral liberalisation)[235]. This then suggests that different forms of liberalisation may be complementary rather than substitutes. The changing nature of trade may help explain why this arises.

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[232] Baldwin 2011:p26 calls this "the public-good nature of regulatory reform". He suggests that the complexities of 21st century trade deals make it hard to discriminate as it is often hard to determine the origin of multinational nationality (i.e. services or exchanges in a world where fragmentation is rife and value added is performed in many different locations). It is still possible to discriminate against certain goods, but more complex barriers against services, procurement or investment decisions are harder to enforce.

[233] See Freund (2000) and Ethier (1998) who argue that multilateral tariff cuts facilitate the propagation of FTAs.

[234] in addition to possible undesirable outcomes in dispute settlements (Mansfield and Reinhardt 2003).

[235] Baldwin (2011) shows evidence of important MFN cuts in many new emerging regions which have embraced FTAs (South Asia; East Asia; Middle East & North Africa; and Sub Saharan Africa, Baldwin, 2011:p17). In a separate paper Baldwin (2006b) argues that the binding of tariffs, through FTAs, may also be important.

As international fragmentation unfolds, so too do changes in the costs and benefits of engaging in liberalisation. The propagation of international production introduces the possibility of enhanced gains from liberalisation as comparative advantages are being exploited at a finer process rather than product level. And the costs of liberalisation, which are primarily political in nature, may also begin to fall. As countries become more interconnected, and trade in intermediate products increases, protectionism is likely to increasingly become a production tax rather than a measure that fosters, or protects, domestic production[236]. This may reduce the internal opposition towards liberalisation so that governments may begin to more freely embrace liberalisation as a form of industrial policy (This would cater for access to cheaper products for both consumers and producers).

Whether this liberalisation is unilateral, bilateral or multilateral is hard to tell. It may depend on the ease of negotiating one alternative over the other. However, because vertically specialised modes of production involve not only seeking access to cheap intermediate imports but also opening markets for the associated exported products, bilateral deals may be preferred. But one type of liberalisation does not preclude the other. And, in the presence of vertically specialised trade, unilateral and bilateral liberalisation may be complementary. Once liberalisation has been achieved on the export side, through an FTA, countries may seek to reduce their MFN tariffs so as to capture cheaper sources of intermediates and gain competitiveness in preferential markets[237]. The case of Mexico, shortly after concluding NAFTA, is a prime example of such a strategy[238], and the earlier cited evidence provided by Estevadeordal et al. (2008) and Baldwin (2011) also lend support to this idea. If there are indeed complementarities between these processes of liberalisation then Baldwin's (2011:p23) assertion that "the old building-stumbling-blocks approach is

[236] Tariffs are more likely to increasingly fall on intermediate products and this has undesirable consequences for domestic value added as suggested by the effective rate of protection logic.

[237] It need be noted that issues regarding Rules of Origin and the overlapping nature of trade agreements will increasingly be important. It is perhaps in consolidating these that the WTO can play a strong role.

[238] The first essay of this thesis shows how Mexico witnessed an important rise in VS with respect to the US as a result of NAFTA but that subsequently Mexico has embraced intermediate imports from China. Concurrent with this is an important degree of unilateral liberalisation.

logically misstated" may hold true due to the endogenous nature of the different liberalisation strategies[239].

However Antras and Staiger (2011:p.4) warn us that "the rise of offshoring can be seen to present the WTO with a profound institutional challenge". Their argument is that this type of trade leads to a greater demand for deeper forms of regulatory cooperation which are moulded to the idiosyncrasies of the value chain interactions between countries. Because bilateral agreements may more readily cater for these, then they might be preferred to a multilateral alternative[240]. As the debate continues to gather momentum (see Bhagwati, 2008 vs Baldwin, 2011), and in the current climate where the Doha Round appears to falter, the only certainty is that "regionalism is here to stay" (Baldwin 2006a:p1451) whether for good or for bad. Understanding the forces that drive the formation of new FTAs is then crucial in assessing the likely direction of the multilateral trading system.

3.3.2. Political Economy, Governance and Third Country Effects

Bhagwati (1993) anticipated that the incentives of three key agents would need to be considered in forming an understanding of the 'threat' of regionalism. Governments - who ultimately decide whether or not to pursue preferential liberalisation - would be the decision-making agents. These would be influenced by; consumers; domestic special interest groups; and interest groups located in third countries. Grossman and Helpman's (1995) theoretical political economy model introduces some of these actors into a government's objective function in an effort to model the forces that shape the decision of engaging in a trade agreement[241]. The choice of participating in an FTA is made after weighing the gains for voters and exporting industries against the possible losses that would befall import competing industries from the in or out scenarios. The nature of the game is one where industry interest groups make contributions, commensurate on profits, which aim to veer government decisions

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[239] Baldwin's quote finishes "..– it asks about the correlation of two endogenous variables driven by common factors".

[240] Baldwin (2011) highlights that "regionalism is a threat to the WTO's role as a rule writer, not as a tariff cutter".

[241] Other notable contributions to this political economy literature can be found in Ethier (1998, 2007) and Bagwell and Staiger (1998 and 2002). A discussion of these is omitted for brevity but they place greater emphasis on the importance of controlling terms of trade in the government's objective function.

towards the outcome that is most favourable to their economic activity. Governments weigh these contributions against consumer welfare gains, identified through changes in tariff revenue and consumer surplus, and then make a decision on whether to engage in a trade agreement or not[242].

Grossman and Helpman's (1995) paper, and the literature that it inspires, uses a framework in which the decision to sign a trade agreement is made on the basis of the characteristics of two negotiating partners only. However Baldwin (1993 and 1997) suggests that the process of FTA formation may also be driven by neighbouring regionalism[243]. In his *domino theory of regionalism*, countries that are left out of neighbouring agreements are adversely affected by trade diversion which leads to losses in export market shares. These affect the internal political economy forces in favour of participating in an excluded FTA, or indeed a new FTA with other excluded members[244]. The main insight is that engaging in an FTA is not just a product of bilateral characteristics, but also one where third country effects matter. As markets get bigger, through regionalism, the costs of being left out of a preferential area increase as do the benefits from being inside.

Dominoes are then reinforced by a *juggernaut* effect. Tariff reforms carry with them a feedback mechanism that plays on the structure of the interest groups within a country. Once preferential liberalisation has been accomplished, inefficient import competing firms are likely to be pushed out of the market and hence their bargaining power should fall[245]. This shifts the lobbying mass further towards favouring more liberal policies which may then set off further dominoes. A similar idea is captured in Ornelas' (2005a) theoretical model. Because political contributions are commensurate to the market shares of domestic firms, as these fall from opening the

[242] This theoretical framework implicitly includes the impact of trade policy on the decisions to engage in an agreement (through trade creation and trade diversion and the corresponding impacts on consumer surplus, producer surplus and tariff revenue).
[243] It incorporates Bhagwati's third interest group.
[244] Originally, Baldwin's (1993) paper sought to understand the drivers of EU enlargement and hence the impact of being left out of the EU was the subject of interest, however the domino theory of regionalism can be applied in more contexts than enlargement. In fact the formation of EFTA can be seen as an attempt to balance the negative impact of being left out of the EEC. Empirical support for the domino theory of regionalism can be found in Mansfield and Reinhardt (2003), Egger and Larch (2008) and Baldwin and Jaimovich (2010).
[245] Although some small and well established lobbies can retain an inordinate amount of power as seen in the EU with the Common Agricultural Policy.

market to increased competition from FTA partners, so too does the weight of this factor in the governments objective function. This tilts the balance of the government's objective function further towards a stance that favours an optimisation of consumer surplus through liberalisation.

3.3.2.1. Political Economy Dynamics and the Changing Nature of Trade

Looking at the role of the changing nature of trade in this process requires identifying how the interest groups which shape the political economy forces are affected by the rise in vertically specialised trade. High or growing degrees of VS should manifest a high or growing presence of firms engaged in both import and export markets relative to import competing firms. In turn, these firms should be inclined to lobby in favour of more liberal policies which would afford them access to cheaper intermediate inputs (Manger 2009). Owing to the reciprocal nature of FTAs, these firms would also stand to gain from a preferential access into new export markets hence reinforcing this lobbying mass.

The previously highlighted changes in the characteristics of new regional partners (Figure 3.5) suggest that shifts in the political economy forces may already be taking place. The changing nature of trade, with the spread of vertical specialisation, may be closing the gap between good politics and good economics. The delocalisation of a segment of production, rather than an entire industry, may be more politically palatable. Hence if industries thrive as a result of liberalisation, through access to cheaper intermediates, then a new source of juggernaut effects, reinforcing liberalisation, may also arise at a cheaper political cost. With vertical specialisation, rather than having competing trade, one might be in the presence of complementary trade (Samuelson, 2001 and Bas and Strauss-Kahn, 2011)[246]. This implies that the Grossman and Helpman (1995) model need not see the reduction in prices caused by the formation of an FTA as an attack on producer surplus, but rather as a positive factor that contributes to the reduction in the costs of production. If this increases the profits of firms, and by extensions of the model, the political contributions, then liberalisation is likely to become a more favoured outcome for governments.

[246] Samuelson's (2001) neat numerical example exposes the gains from complementary trade. When a country uses the products of another, produced under a greater comparative advantage, then specialisation and trade gives rise to important reductions in production costs. These act as technological 'shocks' that push the PPF outwards.

This implies that countries that exhibit greater degrees of *global* vertical specialisation should be more inclined towards favouring liberalisation and hence possibly FTAs. Moreover, because the presence of a bilateral production link between two countries should be indicative of a stronger interest, by both parties, in the successful conclusion of an agreement, then one could also expect higher levels of *bilateral* VS to be associated with a higher likelihood of an FTA.

3.3.2.2. Regulatory Frameworks and FTAs

Although the changing nature of trade is expected to lead to further liberalisation, the type of liberalisation that will be supported remains unclear. On the one hand, multilateral (unilateral) liberalisation guarantees a wider access to cheaper sources of intermediate products. But on the other hand, such liberalisation may struggle to open markets for the associated exported product and also fall short in delivering desirable harmonised regulatory frameworks that may be needed in the presence of more complex economic transactions. Nunn (2007) makes an interesting link between trade and regulatory frameworks in the presence of 'relationship-specific' economic activity. He argues that internationally sequenced modes of production, or the customisation of inputs, tend to require relationship specific investment. The lack of appropriate regulatory structures that promote contract enforcement may lead to underinvestment that raises the costs of producing both intermediate and final products. He then argues that appropriate regulatory structures can deliver comparative advantages in the production of output.

If common cross-border provisions are needed to guarantee a smooth functioning of value chains (Nunn, 2007; and Antras and Staiger, 2011), then bilateral agreements may turn out to be more feasible and hence preferable[247]. This reasoning is in line with the theoretical model of Antras and Staiger (2011) which looks at *offshoring* and FTAs in the presence of incomplete contract. It identifies a hold-up problem, associated with market failures, that leads to an inefficient level of economic activity (offshoring) between countries. Their model suggests that flows of vertically specialised trade could be curtailed by the lack of appropriate regulatory frameworks

[247] and more feasible as it may be easier to negotiate 'deeper' provisions between smaller cohorts of countries.

or enforcement mechanism[248]. They argue that "As the prevalence of offshoring rises, effective trade agreements and the institutions that support them will have to evolve, [...], towards a collection of more-individualized agreements that can better reflect member-specific idiosyncratic needs" (Antras and Staiger 2011:p4). This suggests that there might, in principle, be a link between regulatory frameworks and the demand for FTAs. 'Good' regulations can promote the contestability of markets and ensure tighter controls in the enforceability of contracts hence reducing the incidence of hold-ups in trade. If appropriate enforcement mechanisms are needed for buyers and sellers to conduct their business, then good institutions, or indeed governance mechanisms, could play a trade enhancing role.

Regulatory frameworks are then likely to become increasingly important in mediating international economic activity. This is because modern international production sequences demand greater coordinating efforts. As production is 'chopped' across many different origins, the incidence of a failure of one segment of production along a value chain rises. This may jeopardise the functioning of the entire value chain. Hence an appropriate regulatory framework that enforces contractual obligations and allows for private sector dispute settlement may provide some of the necessary conditions for the spread of this type of international production[249]. The work of Orefice and Rocha (2011) corroborates a link between the regulatory environment and intermediate goods trade. They suggest that this type of trade not only motivates the conclusion of 'deeper' agreements but is also positively affected by the presence of deeper provisions. This implies that countries may seek to engage in deeper FTAs in an effort to bolster value chain activity through regulatory reform and hence that current measures of governance may affect the desirability of engaging in new trade agreements.

3.3.2.3. THE SPREAD OF PRODUCTION AND INTERDEPENDENCE

In Baldwin's (1993) domino theory of regionalism, third country FTAs cause trade diversion which negatively impacts on domestic firms through a loss in export market shares. This incites domestic firms to lobby harder for further bilateral

[248] Antras and Staiger (2011:p2) argue that "trade policies which encourage input trade volume can substitute for the more standard contractual safeguards available in domestic transactions and can thereby help bring countries closer to the efficiency frontier".
[249] It may also facilitate the enforceability of private international law.

liberalisation in an effort to retain these markets or to gain access to new export markets. A similar form of interdependence may also arise from the spread of production.

Neighbouring regionalism may jeopardise the location of a domestic segment of production within an international value chain. This may, in turn, bring about lobbying incentives towards joining new or expanding FTAs. If Mexico is currently exporting intermediate inputs to Korea, then a China-Korea agreement may threaten Mexico's link with Korea. This agreement may lead to 'source-switching' where Korea begins importing intermediates from China rather than from Mexico. This implies that Mexico's support for an FTA with Korea may be affected by Korea's patterns of regionalism and influenced through value chain activity.

3.3.3. Testable Hypotheses

The analysis presented in this section suggests the presence of three channels through which the changing nature of trade can impact the desirability of engaging in an FTA. These give rise to three testable hypotheses. The first is that greater degrees of vertical specialisation should lead to a higher likelihood of a trade agreement being concluded. The second is that the spread of production should give rise to interdependence effects which affect the probability that countries engage in new trade agreements. The third then suggests that regulatory quality should affect the desirability of engaging in an FTA. If the changing nature of trade is shaping new agreements, then the inclusion of variables that capture these factors should serve explain new patterns of regionalism.

3.4. New Determinants For New FTAs

This section details the data used in looking at the new determinants of new FTAs. A different indicator is associated to each new channel through which the changing nature of trade has been identified to impact on the formation of FTAs. Hence changes in political economy conditions are identified through measures of vertically specialised trade; the role of regulatory frameworks is captured through indicators of governance; and interdependence effects are calculated using a vertically specialised weighted measure of neighbouring agreements. In the empirical section, a unidirectional unit of observation is used instead of one that identifies dyadic observations. The choice of such a unit of observation does not alter the results obtained and is favoured because it facilitates the interpretation of these. In particular, using unidirectional observations allows one to focus on both dyadic characteristics as well as individual country observations, such as the degree of vertically specialised trade of a country, without altering the results of the estimation[250].

In looking at the changing determinants of FTAs two separate samples of countries will be used. A larger sample, of 140 countries for the period 1960 to 2006, will be called upon to ascertain how the 'traditional' determinants of FTAs change across the different waves of regionalism. However, in looking at how the changing nature of trade affects the formation of new trade agreements a smaller sample is used due to constraints in the calculation of measures of vertically specialised trade. Although this reduced sample is composed of 39 countries, for the period 1995-2008, it still captures 80% of world trade in 2008[251]. It is the same sample that was used in the previous essays of this thesis.

3.4.1. Traditional determinants of FTAs and Vertical Specialisation

The theoretical findings of the early models of Krugman (1991a and 1991b), Frankel et al. (1995) and Frankel (1997) did not receive a more formal empirical treatment until Baier and Bergstrand (2004) - henceforth BB2004. Using a qualitative choice model they find that the likelihood of an FTA is higher between partners; that are close in distance but remote from the rest of the world; that share a greater similarity in their GDPs; and that are more dissimilar in their factor endowments with respect to each other but more similar with respect to the rest of the world. These '*traditional*' determinants of FTAs have been embraced by the empirical literature

[250] Using dyadic observations complicates the identification of whether results are being driven by reporter or partner characteristics.

[251] This is the same sample that was used in the previous essays of this thesis to which the reader is referred to for information on the computation of the VS indicator and the description of the gravity variables. There are then 1482 observations per year and 714 agreements in place by 2008 when considering unidirectional observations.

and constitute the benchmark model for investigating the formation of FTAs[252]. The implicit idea behind these models is that trade enhancing characteristics, or the potential thereof, should help predict what countries will find it desirable to engage in an agreement.

Regionalism derives its name from the fact that preferential partners tend to be neighbouring countries. BB2004 capture this by introducing two distance based measures into their FTA formation equation. These serve the purpose of capturing trade costs in the spirit of the theoretical models of Krugman (1991a, 1991b) and Frankel et al. (1995). Higher transport costs are associated with lower trading volumes and hence a lower likelihood of an FTA being formed. BB2004 use the natural logarithm of the inverse of distance between two countries suggesting that 'NATURAL' trading partners, i.e. those that are closer, will be more likely to engage in an agreement. The second distance based indicator is a measure of *remoteness* (REMOTE) which identifies the distance between a country and its closest trading partners:

$$REMOTE = CONT_{i,j} \cdot \left\{ \frac{\left[\ln \left(\sum_{k=1,k\neq j}^{N} \frac{Distance_{ik}}{N-1} \right) + \ln \left(\sum_{k=1,k\neq i}^{N} \frac{Distance_{jk}}{N-1} \right) \right]}{2} \right\} \tag{3.1}$$

CONT is a dummy variable that is equal to 1 when countries are located in the same continent. REMOTE then identifies the simple average of country i's distance from all trading partners except j that are located in the same continent. The intuition behind this measure is that a pair of countries, with more remote third country partners, is expected to trade more with each other because of the presence of higher trade costs with respect to other trading alternatives. Hence Australia and New Zealand's trade is not only a product of the distance between these, but also the distance with respect to the closest third country partners. The remoteness measure is reminiscent of the 'multilateral resistance' term introduced in Anderson and Van Wincoop (2003). Even though it is calculated in terms of distance rather than price, it

[252] See Egger and Larch (2008), Baldwin and Jaimovich (2010) and Baier et al (2010) for further justifications of using Baier and Bergstrand's (2004) model as a starting point for the analysis of the formation of FTAs.

serves capture a similar concept[253]. The variable is expected to have a positive coefficient capturing the fact that the welfare gains from an FTA between two countries should be increasing as these are more remote from the rest of the world (Hypothesis 2 in BB2004)[254].

The other measures introduced in BB2004's 'traditional' determinants of FTAs are the economic characteristics that were discussed in section 3.2. Countries which are larger, in terms of their economic mass are more likely to engage in FTAs. Hence a measure of the sum of the log of their GDP's (RGDP) is expected to yield a positive coefficient. However, countries that are more dissimilar in this economic mass, identified through the absolute difference in the log of their GDPs (RGDPsim), are expected to be less likely to engage in an FTA[255]. BB2004 used measures of capital labour ratios to control for the fact that agreements between partners with larger differences in these ratios are more likely to deliver higher welfare gains (as predicted by traditional H-O models of trade). However Egger and Larch (2008) – Hereafter EL2008 - suggest that per capita GDPs can be used to capture these differences[256]. They include the absolute difference in the logs of the per capita GDPs (DGDPcap) and the square of these (SQDGDPcap), to capture non-linearities in this term, in their FTA formation equation. The expected sign of the coefficient of the former is positive whereas the latter is expected to have a negative coefficient (capturing these non-linearities)[257]. A final measure of the difference in the per capita GDPs of countries with respect to the rest of the world (DGDPcapROW) is added in an effort to account for BB2004's notion that the probability of two countries engaging in an FTA is diminishing as the K-L ratios with respect to the world rise. This measure is computed using the following equation obtained from EL2008:

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[253] Remembering that prices are rising in distances due to trade costs.

[254] The measure of REMOTENESS also bears similarities with measures of interdependence used in Baier et al. (2010).

[255] BB2004 suggest that this arises from the fact that welfare gains, from an FTA, increase with similarity in the economic mass of the countries involved.

[256] This is very convenient as K-L ratio data is notoriously hard to come by. Egger and Larch (2008) note that the correlation coefficient of the capital-labour ratios used in Baier and Bergstrand (2004) and real GDP per capita is high (0.975). Bergstrand et al. (2010) also use this measure to proxy for differences in capital-labour ratios in their analysis of the timing of FTAs.

[257] Nevertheless the estimated coefficient of this indicator is expected to behave differently across the different waves of regionalism.

$$\text{DGDPcapROW} = 0.5\left\{\left|\ln\left(\frac{\sum_{k,t\neq it}\text{GDP}_{k,t}}{\sum_{k,t\neq it}\text{pop}_{k,t}}\right) - \ln\left(\frac{\text{GDP}_{i,t}}{\text{pop}_{it}}\right)\right| + \left|\ln\left(\frac{\sum_{k,t\neq it}\text{GDP}_{k,t}}{\sum_{k,t\neq jt}\text{pop}_{k,t}}\right) - \ln\left(\frac{\text{GDP}_{j,t}}{\text{pop}_{jt}}\right)\right|\right\} \quad (3.2)$$

The idea that has permeated the discussion on the determinants of FTAs is that the degree of vertical specialisation should play a positive role in the formation of new agreements. This is because measures of vertically specialised trade can help identify changing political economy conditions. Several measures will be used for this purpose. The first is a fully bilateral measure of the value of imported intermediates that are part of a bilateral value chain (lnintimps_BVSbil). It captures the value of the components imported from a particular partner that are then used to produce exports to that very same partner[258]. This measure is calculated using the OECD IO tables and trade data from COMTRADE. A discussion on how this measure is obtained, what it represents and the assumptions needed for its calculation can be found in earlier essays of this thesis. One important point worth recalling is that these measures are computed rather than observed and hence they serve as proxy measures of bilateral value chain activity.

A measure of intermediate goods trade, where intermediates are identified using the BEC nomenclature (lnintimps_BEC), will also be introduced in the estimations. This is to compare the results of this essay to the findings of the previous one which saw different effects of an FTA on trade contingent on the use of imported intermediates. Furthermore, this also facilitates a comparison against Orefice and Rocha's (2011) results. Finally, a measure of the global degree of vertical specialisation of a country, VSWLD, will be used. It is calculated from the equations presented in the first essay of this thesis and represents the Hummels et al. (2001) indicator. VSWLD captures the degree of global vertical specialisation, it is the share of total intermediate imports used, irrespective of their precedence, to produce total exports to all partners. It represents the international backward linkages of countries and is invariant across partners. It is used to identify the internal structure of the political economy forces within a country. Higher degrees of VSWLD should imply the presence of a greater

[258] This was the dependent variable in the previous essay of this thesis.

amount of vertically specialised industries within a country and hence a greater lobbying mass in favour of liberalisation.

3.4.2. Governance Structures

The presence of 'appropriate' governance structures within a country can, in principle, facilitate the flow of goods and ideas and is often associated with a more liberal trade stance (see Mansfield et al. 2000, 2002 and Mansfield et al. 2008)[259].The link arises through more democratic governments placing a greater value on the well-being of its citizens and hence conducting a more liberal trade policy in an effort to bolster their consumer surplus[260]. However another link between governance and FTAs can arise from the recent theoretical literature on incomplete contracts and trade (Antras, 2003; Ornelas and Turner, 2008; and Antras and Staiger 2011). Antras and Staiger's (2011) hold-ups occur when firms trade less than they normally would due to the existence of uncertainties about the quality of the counterparts they are engaging in a deal with. The possibility that these renege on their contractual obligations leads to an inefficient amount of economic activity taking place between countries. However, if such uncertainties can be reduced by the presence of appropriate governance mechanisms, then it is possible that these mitigate hold-up problems[261]. This may then suggest that countries with better institutions, or governance structures, should not only trade more, but also be more willing to engage in trade agreements[262].

However, the link between governance mechanisms and the formation of FTAs is likely to be rather complicated. Although, a priori, better governance structures are expected to be associated with a higher likelihood of an FTA, countries may also wish to engage in FTAs in an effort to redress shortfalls in regulatory quality. Hence lower measures, within certain acceptable levels, may provide countries with the

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[259] It is noted that within this category of determinants should lie the role of multilateral negotiations in the formation of new trade agreements as suggested by Mansfield and Reinhardt (2003). These are omitted in this essay. A mitigating factor is that the period under investigation only includes one round of negotiations unlike that used in Mansfield and Reinhardt (2003).

[260] In the spirit of Grossman and Helpman's (1995) model.

[261] See Antras (2003) for a similar argument for normal trade in the presence of incomplete contracts.

[262] The introduction of these measures at this stage of the analysis and not in prior essays may raise concerns. In particular, if these are indeed determinants of vertically specialised trade, then they should be included in a gravity model (essay 2). However, recalling that the gravity model presented in essay 2 used controls for country-year effects, and that these measures have this structure then the gravity model presented in the previous essay effectively already controls for governance measures.

opportunity of addressing shortfalls in governance through an FTA. An example of this arises from the Eastern European enlargement where it is often argued that a large share of the benefits from enlargement arose from binding regulatory frameworks to the provisions of the *acquis communautaire*. EU countries may have found it desirable to sign deeper agreements with Eastern European countries in an effort to bolster their regulatory provisions so as to engage in a wider fragmentation of production with these countries.

In an effort to capture the role of regulatory structures in the formation of FTAs, measures from the World Bank's Worldwide Governance Indicators will be introduced into an FTA formation equation[263]. These are harmonised by country and year and range from -2.5 to 2.5. Higher values are associated with better governance structures[264]. Each indicator captures a different facet of governance:

- *Voice and Accountability (Voice_acc)*: Captures freedom of speech, association and free media. This measure is the perceptions of the extent to which a country's citizens are able to participate in selecting their government.
- *Political Stability (Pol_stab)*: measures the perceptions of the likelihood that a government will be destabilised or overthrown by unconstitutional or violent means.
- *Government Effectiveness (Gov_eff)*: captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.
- *Rule of Law (Rol):* captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.
- *Control of Corruption (ctr_corr):* captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand

[263] See http://info.worldbank.org/governance/wgi/resources.htm for a description of the database.
[264] The definitions are directly transcribed from the database documents. Missing values in the dataset are manually imputed as averages of the year before and after the missing value. This occurs for 1995, 1997, 1999 and 2001.

forms of corruption, as well as "capture" of the state by elites and private interests.

- *Regulatory Quality (Reg_qual):* captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.

As shown in Table 3.1, the measures of governance are highly correlated and hence their use, in the empirical section, needs to be approached with care. Introducing all measures into one single specification will cause multicollinearity which will lead to problems in the interpretation of the resulting coefficients[265].

Table 3.1: Correlation Coefficient of Governance Measures

	Ctr_corr	Gov_eff	Pol_stab	RoL	Voice_acc	reg_qual
Ctr_corr	1					
Gov_eff	0.965	1				
Pol_stab	0.774	0.779	1			
RoL	0.958	0.954	0.805	1		
Voice_acc	0.851	0.847	0.792	0.870	1	
reg_qual	0.896	0.904	0.764	0.908	0.832	1

In the empirical section, variations of these measures will be used to capture different links between regulatory frameworks and FTAs. First, the value of these will be introduced into an FTA formation model with the expectation that higher measures be associated with a higher likelihood of an FTA being formed. However, looking at dyadic characteristics, such as the minimum, the maximum, and the difference in these measures will also be instructive. If hold-ups are important, and can be mitigated by appropriate governance structures, then one could expect that the minimum governance measure, in a dyadic relationship, provides the binding condition for there to be an agreement. This is because the degree of the hold-up is likely to depend on the characteristics of the weakest member in a dyadic observation. This minimum measure may also help identify if countries are signing trade agreements in view of redressing shortfalls in regulatory frameworks as earlier suggested. However disentangling which effect dominates will be complicated. Wider differences in governance measures should also be associated with lower

[265] Two solutions present themselves; first, introduce these in individual models and determine which is most significant; or second, transform the data using principle component analysis (PCA).Several attempts were made at using PCA but it was decided to stick with individual measures.

likelihoods of engaging in a trade agreement through similar channels. Both these stories would be consistent with Antras and Staiger's (2011) work[266].

Although these measures are expected to be determinants of FTAs, a word of caution, in their interpretation is advised. These are collated from many different sources and represent the sentiment, or perceptions, of the inhabitants of a country rather than being direct observations of the actual quality of governance. Furthermore, in interpreting the marginal effects, the truncation of these measures will need to be considered as will what constitutes a 'relevant' change in these[267].

3.4.3. Interdependence Effects

The importance of interdependence effects in the formation of FTAs, as predicted by Baldwin's (1993) domino theory of regionalism, has recently been established. Egger and Larch (2008) were first to give this hypothesis an empirical backing. They showed that third party agreements play a positive role on the probability that countries engage in an agreement. Their empirical approach relies on a spatial econometric model in which a distance weighted FTA lag is introduced into Baier and Bergstrand's (2004) original FTA formation model. Baldwin and Jaimovich (2010) then take a similar approach but propose a measure of FTA 'contagion' that is obtained from a weighted spatial lag that uses exports as weights rather than the distances used in Egger and Larch (2008). Both suggest that 'other' FTAs affect the probability of a country pair engaging in one of their own.

Baier et al. (2010) opt for a more traditional approach in looking at interdependence effects (rather than the aforementioned spatial models)[268]. They argue that

[266] The interactions between FTAs and measures of governance are likely to be complex and might also give rise to reverse causality. Better governance may lead to the formation of FTAs and FTAs may lead to reforms that increase governance. Orefice and Rocha (2011) touch upon this issue through their analysis of the role that intermediate goods trade plays as a determinant of the *depth* of FTAs. They also highlight how the depth of an agreement positively affects the degree of intermediate goods trade between countries.

[267] When calculating marginal effects one needs to evaluate these at a certain point in the data. Commonly averages are chosen and deviations from these show the marginal effects. However it is hard to ascertain what a change from 0.7 to 1.7 implies, or if this constitutes a real world change in these variable, and hence hard to grasp the marginal effects of these variables on the formation of FTAs. Hence the signs of these are likely to be more revealing.

[268] The method that they propose relies on calculating 'multilateral indexes' which lends itself to a simpler estimation procedure than the spatial techniques used in Egger and Larch (2008) and Baldwin and Jaimovich (2010). The nature of these indicators is not dissimilar to the multilateral resistance

interdependence can be subsumed into *Own FTA* and *Other FTA* effects[269]. The first type of interdependence captures changes in the incentives of countries to form new FTAs which are commensurate on the amount of FTAs they currently hold[270]. The second captures a similar effect to that investigated in the spatial models, namely the role of third country regionalism on FTA formation[271].

Own-FTA effects can be captured using a variable that identifies the sum of a country's existing FTAs with other countries (Baier et al. 2010). This variable is likely to capture two different effects. First, the costs of negotiating an additional FTA should be decreasing in the number of FTAs a country has already signed and hence this measure should have a positive impact on the probability of signing an additional agreement by capturing lower negotiating costs[272]. Secondly, a larger count of FTAs should also manifest the presence of political economy forces that are more inclined towards liberalisation[273]. This is akin to capturing Baldwin's juggernaut effect where more liberal policies reduce the lobby powers of import competing firms and increase those of firms who favour liberalisation. However, in capturing these political economy forces, it is also possible that this measure is correlated with others that serve the same purpose such as the earlier explained VSWLD and hence the inclusion of these measures in the same estimation need be approached with caution[274].

The other source of interdependence arises from domino forces or 'other FTAs'. Baldwin and Jaimovich's (2010) – henceforth BJ2010 – 'contagion' index can be used to capture such interdependence. The main idea here is that countries that are left out of expanding agreements can lose export shares in these as a result of trade

terms introduced by Anderson and Van Wincoop (2003). Baier et al (2010:p8 footnote 7) explain the problems associated with estimating spatial econometric models and provide compelling arguments in favour of simpler estimation methods.

[269] Baier et al. (2010) attempt to discern which one of these is most important in driving FTA formation.

[270] This idea is derived from the literature on *tariff-complementarity* (Bagwell and Staiger 1997, 1999 and Ornelas 2005).

[271] Derived from models of *competitive liberalisation* (Baldwin 1993 and Bergsten 1996).

[272] This may capture a learning by doing element of negotiations.

[273] It is also possible that there are diminishing returns to this variable so a squared term can be added. If countries have signed many FTAs, the returns to an additional FTA should fall as the chances are that FTAs have already been signed with the most important trading partners.

[274] This captures the total degree of global vertical specialisation and was expected to yield positive coefficients through similar political economy channels.

diversion. This then induces them to sign trade agreements in an effort to re-direct their trade flows. BJ2010 create their contagion indicator using the following equation:

$$wexpFTA = \sum_{k,t \neq it,jt} \delta_{i,k,t} \, FTA_{j,k,t} \tag{3.3}$$

Where $\delta_{i,k,t}$ is the share of exports of country i to all partners (k) except j and FTA is equal to one for each agreement that country j has with partner's that are not country i. The measure captures the importance of country j's preferential partners weighted by country i's exports to these. It is expected to have a positive influence on the likelihood of signing an FTA (BJ2010).

Similar forms of contagion may also arise from vertically specialised modes of production. Being excluded from an expanding agreement can jeopardise a domestic industry's position within an international value chain. Hence third country regionalism can also lead to interdependence effects through its effects on value chain activity. In an effort to capture this, a VS contagion index (wbvsFTA) is created through a similar measure. The only difference arises from the use of a new share parameter. It identifies the importance of country j's preferential partners for country i captured through the share that these markets occupy in country i's bilateral value chain activity:

$$wbvsFTA = \sum_{k,t \neq it,jt} \frac{\text{intexps\_bvs}_{i,k,t}}{\sum_{k,t \neq it,jt} \text{intexps\_bvs}_{i,k,t}} \, FTA_{j,k,t} \tag{3.4}$$

The inclusion of these contagion measures raise issues of endogeneity because trade shares are likely to be affected by changes in preferential status (BJ2010). To control for this issue, the above shares are calculated for the first year in the sample (1995) when no agreements are identified. This implies that these contagion measures only vary through country's participation in FTAs.

Table 3.2 provides a summary of the indicators that will be used in the empirical section. It identifies; the name of the variables; a description of what these capture;

the expected sign on the impact of the probability of the formation of a new FTA; and the source from which the measures are calculated/derived[275].

Table 3.2: Summary of Independent Variables for FTA formation model

Variable	Description	expected sign	Source
NATURAL	Inverse of the natural logarithm of the distance between two countries	(+) BB 2004 and EL 2008	Calculated using CEPII
REMOTE	Distance between a country and its closest neighbouring partners (except j). Calculated using equation 3.1	(+) BB 2004 and EL 2008	Calculated using CEPII
RGDP	Sum of the log of the GDP of countries i and j.	(+) BB 2004 and EL 2008	Calculated using WDI
RGDPsim	$RGDPsim = log\left\{1 - \left[\frac{RGDP_{it}}{RGDP_{it} + RGDP_{jt}}\right]^2 - \left[\frac{RGDP_{jt}}{RGDP_{it} + RGDP_{jt}}\right]^2\right\}$	(+) BB 2004 and EL 2008	Calculated using WDI
DGDPcap	Absolute difference in the log of the per capita GDP's of i and j.	(+) BB 2004 and EL 2008	Calculated using WDI
SQDGDPcap	Square of DGDPcap	(-) BB 2004 and EL 2008	Calculated using WDI
DGDPcapROW	Differences in the per capita GDP's of country i and j with respect to the rest of the world. Equation 3.2.	(-) BB 2004 and EL 2008	Calculated using WDI
Governance measures	Voice_acc, Rol, Pol_stab, Gov_eff, Reg_qual, Ctr_corr	(+)AS 2011	WGI
MinGov*	MinGov* is the minimum measure of the above governance indicators in a dyadic observation.	(+) AS 2011	WGI
MaxGov*	MaxGov* is the maximum measure of the governance indicators in a dyadic observation.	(+)AS 2011	WGI
DiffGov*	DiffGov* is the absolute difference between the reporter and partner measures of governance.	(-)AS 2011	WGI
IMPORTS	Natural logarithm of imports	(+) Magee (2003)	COMTRADE
INTIMPS_BEC	Natural logarithm of intermediate imports used for any purpose in the economy. Identified by way of the BEC nomenclature	(+) Orefice and Rocha (2011)	COMTRADE
INTIMPS_BVS	Natural logarithm of the intermediate imports that are part of a fully bilateral value chain. See essay 1 for calculations and essay 2 for a wider discussion.	(+)	# COMTRADE and OECD STAN database
VSWLD	Degree of global vertical specialisation. Captures the structure of trade by reporting the share of total intermediate imports (irrespective of origin) that are part of a value chain, as a proportion of total exports	(+)	# COMTRADE and OECD STAN database
countFTA	Sum of FTAs a country has in a given year	(+)	Calculated using CEPII
wexpFTA	Measure of contagion with export weights in 1995. See equation (3.3). Identifies the importance of country j's preferential partners in country i's exports	(+) BJ2010	Calculated using CEPII + Comtrade
wbvsFTA	Measure of contagion with VS weights from 1995. See equation (3.4). Identifies the importance of country j's preferential partners in country i's exports of intermediate goods used in bilateral value chain activity.	(+)	Calculated using CEPII + OECD STAN + Comtrade

[275] A summary table of the descriptive statistics for these variables can be found in the Appendix A3.2.

See the first essay of this thesis for a discussion on the calculation of bilateral indicators of vertical specialisation.

3.5. EMPIRICAL FRAMEWORK

In capturing the impact of vertical specialisation on the probability that two countries engage in an FTA one will be confronted with two separate issues of *endogeneity*. The first arises from *unobserved heterogeneity* whereas the second is caused by *simultaneity*[276]. Unobserved heterogeneity occurs because of the presence of unobserved variables (to the econometrician) simultaneously affecting both the probability of countries engaging in an FTA and also the levels of vertical specialisation between these[277]. These unobserved parameters are captured by the error term (which will no longer exhibit its desired i.i.d. properties) and cause biases in the estimation of the coefficients of interest. Baier et al. (2007:p26) remark that "the inclusion of bilateral trade as a RHS variable [..] is likely to result in inconsistent coefficient estimates"[278]. Simultaneity is also likely to be problematic. It occurs through the impact that FTAs have on current trade flows. Mitigating this bias can be done through the use of pre-agreement rather than current trade flows, however providing controls for unobserved heterogeneity may be more complicated. Understanding the nature of these biases is crucial in providing solutions to the problems they cause in the estimation.

The previous essay of this thesis suggested that there was indeed cause for concern about the presence of endogeneity. It showed that current levels of vertically specialised trade were affected by the presence of future trade agreements (see Table 2.5) and hence that countries with characteristics associated with higher levels of vertically specialised trade appeared to be selecting into FTAs[279]. If these characteristics are unobserved, then biases in the estimation of an FTA formation equation will appear[280]. These biases can be dealt with using cross-sectional and

[276] see previous essay for a justification of the positive impact of FTAs on vertically specialised trade.
[277] This assumption is the same as the one made in the previous essay of this thesis.
[278] The presence of unobserved heterogeneity in these estimations was confirmed in the second essay of this thesis where it was found that unobserved variables drove levels of trade and also the desirability of engaging in an FTA.
[279] This, in part, motivated the hypothesis of this essay.
[280] In the previous essay, once appropriate controls were used through a set of selected FE, it was shown that current trade flows were unaffected by future trade agreements which then supported the

panel data techniques and this section discusses the merits and pitfalls of these approaches in estimating an FTA formation model using trade based measures of vertical specialisation.

3.5.1. Cross-sectional Models

The traditional empirical framework used to capture the determinants of FTAs is the binary response model. The probability of a positive outcome (FTA=1), conditional on a set of covariates (x), is determined by the function P(FTA=1|x)= G(xβ). G(.) represents the cumulative density function (cdf) that ensures that predicted values lie within the unit interval and β identifies a set of coefficients. A positive outcome is occurs when FTA= 1[FTA*>0] where FTA* is a latent unobserved variable that captures the minimum utility that each country is likely to obtain from signing an agreement (i.e. FTA* = min(ΔUi,ΔUj)). This empirical approach to the formation of FTAs, first proposed by Baier and Bergstrand (2004), is valid provided that strictly exogenous explanatory variables are used. In this respect, BB2004 rely on distance and income measures which should satisfy this criterion[281]. However the introduction of measures of vertical specialisation raises concerns related to unobserved heterogeneity. The following 'true' model of FTA formation can help elucidate the nature of the problem:

$$FTA_{i,j} = X_{i,j}\beta + \upsilon_{i,j}$$

$$\upsilon_{i,j} = q_{i,j} + \varepsilon_{i,j} \tag{3.5}$$

The probability of two countries (i,j) engaging in an FTA is determined by; a set of covariates $X_{i,j}$ which include the degree of VS between these; and an error term that is composed of an unobserved element ($q_{i,j}$) and an iid normally distributed error term ($\varepsilon_{i,j}$). Because the unobserved element is likely to be correlated with both the probability that two countries form an FTA (dependent variable) and the levels of VS between these, the model cannot be estimated using traditional techniques because biases in the coefficients of interest will arise. Estimating the probability model then

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notion that the impact that the FTA dummy variable was capturing was the impact of an FTA on VS rather than any other unobserved factor.

281 It can be argued that income is not exogenous as it can be affected by FTAs, but taking lagged values should resolve these issues.

requires using a method that generates exogenous variation in the independent VS variable.

This can be achieved, in cross-sectional models, either through an Instrumental Variable (IV) approach or a first difference (FD) estimator. Magee (2003) opts for the former by treating trade flows and FTAs as endogenous processes. Instrumenting for each in a first step equation, he uses the predicted values thus obtained to estimate their impact on each other in a second step. Looking at the role of VS on the probability that two countries engage in an agreement can be achieved through a similar two-step procedure:

$$VS_{i,j} = Z_{i,j}\beta + u_{i,j} \tag{3.6}$$

$$FTA_{i,j} = X_{i,j}\beta + \widehat{VS}_{i,j}\delta + \upsilon_{i,j} \tag{3.7}$$

A first step gravity model for vertically specialised trade (3.6) is estimated using a set of valid instruments and the predicted values of this first-step, $\widehat{VS}_{i,j}$, are introduced in a second step FTA formation equation (3.7)[282]. In the first step, Z, identifies a set of explanatory variables that include instruments that meet the necessary validity criteria. The first one is that the fitted values from the first step must be uncorrelated with the unobserved element of the error term $\upsilon_{i,j}$ in (3.7) so that COV($\widehat{VS}_{i,j}$, $\upsilon_{i,j}$)=0. Because this term ($\upsilon_{i,j}$) is unobserved, it is hard to determine whether this condition is met in these types of models. The second validity test requires the instruments to be as correlated as possible with the measure of VS[283]. Proving the validity of instruments tends to be complicated and often boils down to providing a convincing argument[284]. Baier and Bergstrand (2007) argue that valid instruments, in this type of estimation, are notoriously hard to come by[285]. Hence alternative methods for estimating FTA formation equations will need to be pursued.

[282] The use of a gravity model to estimate intermediate imports is justified in the previous essay of this thesis.
[283] This condition should be met by virtue of the first step.
[284] There is no direct test which guarantees the validity of the instruments used.
[285] They suggest that the instruments used in Magee's (2003) paper do not meet these validity criteria.

One such alternative approach is to estimate these models using a first difference (FD) estimator. If the 'true' model of FTA formation follows equation (3.5), and one can draw on two time periods (T=2), then it is possible to apply a first difference approach to eliminate the problematic unobserved parameter ($q_{i,j}$) so that the following model is estimated:

$$\Delta FTA_{i,j} = \alpha_0 + (X_{i,j,1} - X_{i,j,0})\beta + (VS_{i,j,1} - VS_{i,j,0})\delta + (q_{i,j,1} - q_{i,j,0}) + (\varepsilon_{i,j,1} - \varepsilon_{i,j,0}) \tag{3.8}$$

The dependent variable takes the value 1 when a country 'switches' into an agreement from period 0 to period 1 and thus identifies new agreements within the sample[286]. The α_0 constant captures the time trend in the data (i.e. the difference in the intercept in period 0 and period 1). By virtue of the assumed time invariant nature of the unobservable variable, the term ($q_{i,j,1}$- $q_{i,j,0}$) in the above expression will be equal to zero and hence disappear from the estimation. If $\delta > 0$ then this implies a positive effect of the *change* in VS on the probability that a country *switches* into an agreement. The above model can be estimated using non-linear probability models (probit or logit) to make sure that the predicted values lie within the unit interval, however if the source for unobserved heterogeneity arises from factors that change in time, then such a specification may not resolve the endogeneity problem and also deliver biased estimates.

In estimating this model one should also bear in mind that the period during which the differences are taken is going to be important. If one takes differences between the first period and the last period of the sample then the FD model might remain biased due to simultaneity. If flows of vertically specialised trade are positively affected by FTAs, then changes in flows will be endogenous to the presence of an FTA. This suggests that pre agreement changes in flows should be used to predict future changes in FTA status.

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[286] This approach could be problematic if there are instances of switching out of agreements because the dFTA dependent variable would take on negative values. This is not the case in the context of the dataset used in this essay. Furthermore it is actually a very convenient way of looking at the role of the independent variables in the formation of NEW agreements as it eliminates all those agreements that are time invariant.

3.5.2. *PANEL DATA APPROACHES*

Panel data settings generally provide convenient solutions for dealing with unobserved heterogeneity as shown in the previous essay. Using an informed choice of FE can often eradicate the biases that this condition afflicts on the coefficients of interest. However the binary nature of the FTA dependent variable requires using non-linear estimation techniques which introduce complications in the estimation procedure on account of the 'incidental parameters problem' (see Wooldridge, 2002 Chapter 15 p 484; and Greene, 2010 Chapter 9)[287]. Binary dependent variable models may yield severe biases when using the FE estimator. The alternative of using a random effects (RE) model is also unsatisfactory because of the implicit assumption of no correlation between the unobserved effects and the regressors. If the underlying hypothesis posits that the nature of the endogeneity problem arises from the unobservables driving *both* the level of VS and also the incentives to form a trade agreement, then the RE model assumption is generally, but as we shall see, not always, inadequate. Although there is no widely accepted method for estimating binary models with FE using panel data, several 'fixes' have been proposed in the literature.

The first is similar to the IV approach that was earlier presented (Equations 3.6 and 3.7) but it is applied in the context of a panel estimation. Manger (2009) looks at the impact of vertical intra industry trade[288] on the probability of two countries engaging in an FTA using such a two step procedure[289]. The first step consists of estimating a gravity model and the second step uses the predicted values of this first step to look at an FTA formation equation. One can apply this method to look at the role of VS in

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[287] Honore (2002:p166) says that the incidental parameter's problem "will typically, but not always lead to inconsistent estimation of all the parameters of the model. The problem arises when T is small. The estimates of the unobserved effect become inconsistent (even when one increases N). This inconsistency then causes biases in the estimated coefficients".

[288] The indicator of vertical intra-industry trade identifies the overlap between imports and exports at a certain level of aggregation (6-digits in this instance). Manger (2009) follows the traditional literature and identifies vertical flows when the difference in the unit values of the export and import flows is above a certain threshold.

[289] Manger (2009) underlines that the changing nature of the partners that are involved in new FTAs arises from evolving features in the typology of trade which are captured by this indicator. The proliferation of FTAs between countries of different levels of development is then motivated by changes in the political coalitions that support liberalisation manifested by the rise in vertical intra-industry trade (VIIT). Manger essentially proposes a similar conceptual link between VIIT and FTAs as is made here between VS and FTAs. However, in his empirical strategy he makes no distinction between VIIT in intermediate or in final goods. It is then possible that his results are capturing different incentives to form trade agreements than those that are the concern of this essay.

the formation of FTAs[290]. The idea here is that using predicted values of VS rather than actual values means that the unexplained part of this variable, that is likely to be correlated with the unobservables, is removed and hence exogenous variation in the VS measure has been accomplished. This implies that it can be introduced into a second step FTA formation equation[291].

Wooldridge (2002) proposes a different solution for estimating binary models with fixed effects. He suggests that a Mundlak-Chamberlain approach can be applied[292]. This can be accomplished by estimating an RE model with added observation averaged independent variables which act as pseudo-fixed-effects[293]. Consider a variant of equation (3.5) that incorporates a time dimension and where the VS term enters through the set of explanatory variables, $X_{i,j,t}$, and is correlated with the time invariant term $q_{i,j}$:

$$FTA_{i,j,t} = X_{i,j,t}\beta + q_{i,j} + \varepsilon_{i,j,t} \tag{3.9}$$

It is possible to condition the structure of $q_{i,j}$ using observation averages so that:

$$q_{i,j} = \phi + \overline{X}_{i,j,t}\xi + b_{i,j} \tag{3.10}$$

The unobserved component of the FTA equation, $q_{i,j}$, is conditioned as a function of $\overline{X}_{i,j,t}$, which identifies the average values of the regressors over time and an error term $b_{i,j}$ that is assumed to be uncorrelated with $\overline{X}_{i,j,t}$. Wooldridge (2002) argues that "Adding [$\overline{X}_{i,j,t}$] as a set of controls for unobserved heterogeneity is very intuitive: we are estimating the effect of changing [$X_{i,j,t}$] but holding the time average fixed".

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290 Manger (2010) argues that such an approach requires undertaking a panel bootstrap so as to address the incorrect estimation of the standard errors. Additionally he suggests that this corrects for time dependence in short panels and the presence of slow moving variables (p.16). However he argues that inference in these models is likely to be 'more conservative' (p.17).

291 However, because there is no STATA routine for such an estimation, one has to pay particular care in how the standard errors are treated. Manger (2009) suggest a bootstrap method.

292 See Greene (2011) and Imbens and Wooldridge (2007) for a more detailed discussion of this methodology.

293 Wooldridge (2002) attributes this method to Chamberlain (1980) and calls it Chamberlain's random effects probit model.

3.6. RESULTS

The objective of this essay is to investigate how and if the changing nature of trade affects the formation of FTAs. Three new channels through which this might occur have been identified. One is through changes in the political economy dynamics of liberalisation. Another is through a larger role for institutional participation captured by way of governance measures; the last is through the emergence of interdependence effects arising from the spread of production across national borders. Before turning to each of these, a closer analysis of how the traditional determinants of FTAs fare in explaining the participation of countries across the different waves of regionalism is warranted. If the changing nature of trade is important, then one might expect changes in the coefficients of the traditional determinants of FTAs. Furthermore, if there are new reasons for engaging in new FTAs then one might also expect that these traditional determinants show a diminishing explanatory power in predicting the countries involved in the different waves or regionalism. Once the need for looking at new determinants of FTAs has been established, a more focused analysis of the new determinants of new agreements signed between 1995 and 2008 will be carried out on a subsample of countries using, first, cross-sectional models and then panel techniques[294].

3.6.1. CHANGES IN THE TRADITIONAL DETERMINANTS OF FTAS

The preliminary evidence presented in section 3.2 pointed to perceivable differences in the characteristics of new preferential partners with respect to earlier waves. It suggested that the countries involved in the latest wave of regionalism tended to be less distant and shared lower similarities in their capital-labour ratios (as proxied by GDP per capita) than during earlier waves. If there are changes in the determining features of FTAs across the different waves, then one should be able to capture these by re-estimating the traditional FTA formation equations (BB2004). To this end, the

[294] Data constraints in the calculation of right hand side variables force a considerable reduction in the temporal and country coverage of the sample when looking at the new determinants of new agreements. The resulting sub-sample is the same that was used in the previous essay of this thesis and is described at greater lengths in sections 3.4 of this essay and section 2.6.1.3 of the previous essay.

following cross-sectional logit model is estimated across the different waves of regionalism[295]:

$$FTAx_{i,j} = \beta_0 + \beta_1 NATURAL_{i,j} + \beta_2 REMOTE_{i,j} + \beta_3 RGDP_{i,j} + \beta_4 DRGDP_{i,j} + \beta_5 DGDPcap_{i,j} + \beta_6 SQDGDPcap_{i,j} + \beta_7 DGDPcapROW_{i,j} + \epsilon_{i,j} \tag{3.11}$$

The results from these estimations, for a sample of 140 countries, are presented in Table 3.3. The dependent variable in the first column is equal to one if an FTA has been concluded by the year 2006 so that this estimation captures the traditional determinants of *any* agreement as in BB2004. The final three columns of the table show the results of estimating equation (3.11) for different dependent variables that capture the formation of new agreements during each identified wave of regionalism. Hence for Column (2) the dependent variable is equal to one *only* if a new agreement is signed during the identified lapse of the wave (i.e. 1958-1985). The dependent variable in column (3) is then equal to one if a dyad signed a new agreement during the second wave and so forth[296]. A different base year is used for each estimation so that; the first wave uses 1970's economic characteristics; the second wave has a base year of 1985; and the third wave is investigated using the characteristics of countries in 1995[297].

Column (1) confirms the results obtained by BB2004 and EL2008[298]. It shows that the probability of two countries engaging in an FTA is increasing in the degree of proximity between these (NATURAL) and remoteness (REMOTE) with respect to third countries. The combined economic mass (RGDP) and the similarity in GDP's (RGDPsim) also have a positive impact on the likelihood of an FTA as do larger

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[295] A logit is chosen for comparability across results in subsequent sections. Initially a probit model was also run but it seemed to fare worse in predicting successful FTAs than the logit.

[296] If a country signs an agreement during the first identified wave of regionalism, it is removed from the sample in subsequent estimations. In looking at the determinants of new agreements, an issue arises concerning the treatment of existing agreements. This is discussed at length in the Appendix A3.3.

[297] As a robustness check this table is also estimated using 1970's data. BB2004 used a baseline year of 1960 to avoid issues of endogeneity arising from the possible impact of FTAs on GDP. Their sample is also smaller and included 57 countries with a dependent variable that was equal to one if a country was part of an agreement in 1996. Robustness checks show that the results are relatively insensitive to the use of different base years.

[298] Although it is noted that a lower predictive power is obtained in this sample than that of BB2004. They focused on agreements in 1996 so this fact may give further support to the changing determinants of FTAs during the new wave of regionalism.

differences in capital-labour ratios (DGDPcap). This last variable enters the specification non-linearly as seen by the significance of the square of this term (SQDGDPcap). A comparison of the coefficient estimates across the different waves gives econometric support to the stylised facts observed in section 3.2. The changing role of distance appears to be captured by changes in the coefficient estimates of the distance based variables. In particular, the insignificance of the REMOTE measure in the final column may be pointing to differences in the geographic spread of new preferential partners during the latest wave of regionalism, or in other words to the emergence of more distant agreements[299]. In addition, the increase in the coefficient estimates of the DGDPCAP measure seen for the latest wave also lends itself to the notion that new preferential partners are increasingly more dissimilar in their capital-labour ratios.

Another revealing result lies in the decline in the predictive powers of the estimations across the different waves. Whereas the independent variables explain 43% of the full sample variance, they only explain 31% of the variance during the latest wave of regionalism[300]. Hence, although these determinants remain important, their predictive powers fall considerably in explaining the latest wave of regionalism. This is also highlighted when using another measure of 'goodness-of-fit' that tracks the percentage of correctly predicted FTAs conditional on the outcome (BB2004)[301]. Here the full sample model successfully predicts 43% of the agreements that are in place throughout the entire sample (column 1). However this predictive power is reduced to 11% for new agreements signed during the third wave (i.e. 91 of the 831 agreements)[302]. These results make a case for considering the waves of regionalism

[299] This may be capturing the 'hump' that appeared in Figure 3.3.
[300] Bearing in mind that the pseudo_r2 is calculated as 1 minus the ratio of the log likelihood value for the estimated model and that predicted by a model with just an intercept (like in BB2004).
[301] It is assumed that predicted PTA membership occurs when the predicted response probability (p(FTA)) is above 0.5 as in BB2004 and EL2008. The focus is placed on 'true positives' (i.e. correctly predicting an FTA when there is one) because correctly predicting the presence of no FTA in a sample such as this one with little incidence of FTAs is easier. In fact, if the model had no predictive powers whatsoever and predicted no FTAs, it would still correctly predict over 96% of the observations.
[302] Another striking feature is that the determinants of the first and last wave of regionalism share more similarities with each other than with the determinants of the second wave. Whilst it would be interesting to pursue what drives these results, it is, at present, beyond the scope of this essay.

independently and may be suggestive of changes in the determinants of new FTAs[303]. This is the focus of the remainder of this study.

Table 3.3: Determinants of FTAs across the different waves of regionalism – Full Sample

VARIABLES	Expected Signs	(1) FTA in 2006 (1970 values)	(2) FTA: **first wave** 1960-1984 (1970 values)	(3) FTA: **Second wave** 1985-1995 (1985 values)	(4) FTA: **Third wave** 1995-2006 (1995 values)
NATURAL	(+)	1.936***	1.399***	1.662***	1.749***
		(0.0578)	(0.0714)	(0.0708)	(0.0648)
REMOTE	(+)	0.0573***	0.134***	0.249***	-0.00542
		(0.00726)	(0.0183)	(0.0179)	(0.00907)
RGDP	(+)	0.219***	0.212***	0.218***	0.251***
		(0.0111)	(0.0223)	(0.0153)	(0.0140)
RGDPsim	(+)	0.114***	-0.0730	0.400***	0.145***
		(0.0257)	(0.0446)	(0.0508)	(0.0311)
DGDPCAP	(+)	0.441***	-0.385*	0.706***	1.012***
		(0.131)	(0.230)	(0.210)	(0.136)
SQDGDPCAP	(-)	-0.223***	-0.0183	-0.369***	-0.263***
		(0.0443)	(0.0737)	(0.0720)	(0.0330)
DGDPcapROW	(-)	-0.638***	-0.0943	0.413***	-0.555***
		(0.0733)	(0.107)	(0.0809)	(0.0765)
Constant		10.93***	3.394***	4.326***	7.186***
		(0.541)	(0.695)	(0.665)	(0.580)
Observations		19,460	19,460	18,957	18,455
r2_p		0.439	0.385	0.496	0.308
Correctly Predicted p(FTA)=FTA		92.78%	98.28%	96.81%	95.23%
Correctly Predicted FTA=1*		43.29% (781 out of 1804)	15.93% (58 out of 364)	27.3% (175 out of 641)	10.95% (91 out of 831)
		97.84%	99.85%	99.24%	99.21%
Correctly predicted FTA=0		19,460	19,460	18,957	18,455

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
Values are for the different base years. Column (1): 1970; Wave 1: 1970; Wave 2: 1985; Wave 3, 1995.
*Sum of new agreements across different waves is larger than that of agreements in 2006. This reflects agreements that expired

3.6.2. *Determinants of New FTAs: Governance*

One of the hypotheses put forward in this essay is that the rising complexity of international economic transactions should lead to a greater demand for 'appropriate' regulatory frameworks. Measures of governance may help identify the scope for

[303] The results presented in Table 3.3 are robust to different specifications of the temporal coverage of the waves. In the Appendix Table A3.4 the first wave is shortened and is identified for the period 1960-1980, the second wave is then lengthened from 1981-1999 and the third wave occurs from 2000-2006. The results suggest, if anything, that the traditional determinants of FTAs are worse at predicting FTAs during this newly defined third wave. The percentage of correctly predicted FTAs falls to around 5%.

hold-ups and hence be determinants of the desirability of engaging in FTAs. A priori, countries with 'better' governance structures are expected to experience a lower incidence of hold-ups and hence larger trade volumes making the conclusion of an FTA more desirable. However, it is also possible that larger hold-ups motivate the creation of FTAs in an effort to redress these through a harmonisation of regulatory frameworks. Looking at the role of measures of governance in the formation of new FTAs is approached through the introduction of these measures into a 'traditional' FTA formation equation[304].

The first column of Table 3.4 shows the results obtained from estimating BB2004's traditional FTA formation model for a cross section of countries in the year 2008 using the reduced sample of countries[305]. This benchmarking exercise reveals that the 'traditional' determinants of FTAs fare better at predicting new FTAs in the new subsample of countries than they were seen to be in the larger sample used to produce the results reported in Table 3.3[306]. The model now successfully predicts 54% of new agreements signed. The remainder of the columns introduce the *levels* of the different governance measures. The positive sign in the coefficients of these measures gives supporting evidence to the initial hypothesis - 'better run' countries are more likely to engage in FTAs. The results also suggest that the measure that tracks regulatory quality (REG_QUAL) explains the largest amount of the variance when compared to the other measures. Recalling that this measure captures the ability of governments in formulating and implementing policies that promote private sector development reinforces the claim that regulatory frameworks are important as originally suggested.

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[304] The measures are introduced individually rather than collectively to avoid multicollinearity. A principle component analysis (PCA) derived aggregate indicator was also attempted. The analysis suggested that one factor explained 85% of the variance i.e. the eigenvalue of the first factor was above 5 whereas the remaining ones were well below 1 implying that only one factor should be retained. This suggests that not much information is added through the process of aggregating these and hence it was decided that looking into the role of these measure separately would be more informative.

[305] See section 3.4 of this essay for a short description of the countries used for this regression. Also see section 2.6.1.3 of the previous essay for a fuller description of the database.

[306] It need be noted that this subsample captures many of the new agreements signed during the latest wave and hence that an FTA event is more likely here than in the larger sample.

Table 3.4: Determinants of FTAs – Measures of Governance

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
NATURAL	0.817***	0.817***	0.863***	0.930***	0.909***	0.879***	0.923***
	(0.139)	(0.139)	(0.141)	(0.150)	(0.145)	(0.144)	(0.148)
REMOTE	0.174***	0.174***	0.180***	0.183***	0.180***	0.184***	0.189***
	(0.0311)	(0.0311)	(0.0314)	(0.0317)	(0.0319)	(0.0323)	(0.0324)
RGDP	-0.224***	-0.224***	-0.217***	-0.208***	-0.211***	-0.217***	-0.212***
	(0.0515)	(0.0514)	(0.0532)	(0.0531)	(0.0538)	(0.0544)	(0.0549)
RGDPsim	0.0786	0.0786	0.128	0.122	0.112	0.128	0.159*
	(0.0879)	(0.0892)	(0.0902)	(0.0920)	(0.0905)	(0.0914)	(0.0929)
DGDPCAP	1.344***	1.344***	1.477***	1.518***	1.468***	1.512***	1.561***
	(0.365)	(0.365)	(0.377)	(0.376)	(0.383)	(0.386)	(0.388)
SQDGDPCAP	-0.312***	-0.312***	-0.335***	-0.350***	-0.329***	-0.339***	-0.352***
	(0.116)	(0.116)	(0.123)	(0.123)	(0.127)	(0.128)	(0.129)
DGDPcapROW	-2.000***	-2.000***	-2.101***	-2.016***	-2.181***	-2.142***	-2.042***
	(0.316)	(0.317)	(0.353)	(0.360)	(0.371)	(0.371)	(0.376)
POL_STAB		-5.37e-05					
		(0.129)					
ROL			0.430***				
			(0.106)				
VOICE_ACC				0.695***			
				(0.156)			
CTR_CORR					0.470***		
					(0.0934)		
GOV_EFF						0.700***	
						(0.129)	
REG_QUAL							0.868***
							(0.124)
Constant	19.25***	19.25***	19.01***	18.76***	19.09***	18.81***	18.64***
	(2.875)	(2.875)	(2.941)	(2.956)	(2.970)	(2.988)	(3.008)
Observations	1,090	1,090	1,090	1,090	1,090	1,090	1,090
r2_p	0.350	0.350	0.364	0.369	0.369	0.371	0.384
Correctly Predicted p(FTA)=FTA	81.5%	81.5%	81.4%	81.2%	81.4%	81.7%	81.5%
Correctly Predicted FTA=1	54.0%	54.0%	54.3%	54.6%	53.4%	55.5%	55.5%
Correctly predicted FTA=0	93.2%	93.2%	92.9%	92.5%	93.3%	92.8%	92.5%

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Dyadic variations in these measures could also be important in determining FTA status. This is because, for the successful completion of an FTA, both negotiating partners need to ratify the agreement which suggests that their combined characteristics might be determining. Consistent with an interpretation of Antras and Staiger's (2011) paper would be that it is the minimum value of these measures which is binding. Or, in other words, that the degree of hold-ups is determined by the degree of regulatory quality of the weakest member in a dyadic relationship. Differences in governance measures may also be important where wider discrepancies in regulatory frameworks between countries should lead to lower levels of offshoring and hence a lower demand for FTAs.

Table 3.5 looks at the role of different dyadic measures of governance on the precision of the FTA formation equation[307]. The first panel uses the minimum value of the governance measure in a dyadic observation whilst the second and third columns show the maximum and the difference in these respectively. The results support the idea that it is the minimum measure that is most influential in determining the formation of new FTAs. This can be seen by comparing the predictive power of the models in panel 1 against those of the remaining columns of Table 3.5. Again, the measure of regulatory quality appears to act as the 'best' predictor of FTAs when compared to the other measures of governance. In this format its inclusion increases the predictive powers of the FTA formation equation to a successful prediction of 66% of new agreements. This is to be contrasted against the benchmark model that correctly predicted 54% of agreements (column 1 of Table 3.4). One other possible interpretation for the positive coefficient found in this variable is that it is low measures of regulatory quality, in a dyadic observation, that motivate countries to sign new trade agreement. Or that countries may wish to engage in FTAs so as to redress shortfalls in regulatory quality. This interpretation is consistent with the results presented, however providing full econometric evidence of this effect by isolating it from other drivers might be tricky and require further work (see Appendix A3.4 for a discussion and some attempts at incorporating non-linear effects of these measures on the likelihood of an FTA being formed[308]).

[307] The coefficients of the traditional FTA formation variables are omitted for brevity.

[308] In Appendix A3.4. the relationship between these measures and the probability of engaging in an FTA is further investigated where the results suggest that there might be a non-monotonic relationship

The results presented in the second panel then reveal that, although the maximum values of the governance measures in a dyadic relationship are significant, they add little explanatory power to the FTA formation equations. Turning then to the differences in these measures, in the final panel, shows support to the initial predictions suggesting that FTAs are less likely between countries that exhibit wide differences in governance[309].

Table 3.5: Determinants of FTAs – Measures of Governance, min, max and diff

	(1) MINS			(2) MAX			(3) DIFF		
	Coeff	Ps- R2	Pred	Coeff	Ps- R2	Pred	Coeff	P- R2	Pred
POL_STAB	-0.322** (0.151)	0.353	55.2%	0.612*** (0.218)	0.356	53.7%	0.742*** (0.164)	0.365	57.1%
ROL	1.126*** (0.167)	0.398	62.0%	0.787*** (0.175)	0.366	51.5%	-0.761*** (0.165)	0.367	58.3%
VOICE_ACC	1.774*** (0.375)	0.413	62.6%	1.591*** (0.322)	0.372	50.3%	-1.195*** (0.253)	0.380	58.3%
CTR_CORR	1.897*** (0.257)	0.446	63.8%	0.493*** (0.119)	0.362	51.5%	-0.763*** (0.132)	0.373	60.1%
GOV_EFF	2.412*** (0.305)	0.450	64.4%	0.819*** (0.197)	0.362	52.8%	-1.865*** (0.231)	0.405	65.0%
REG_QUAL	2.852*** (0.368)	0.501	66.3%	1.091*** (0.236)	0.367	53.4%	-2.400*** (0.248)	0.458	65.0%

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

These results suggest that governance measures are important in determining the likelihood of a new agreement being formed and hence that their omission in subsequent estimations may lead to omitted variable biases. However, because the collective use of these introduces elements of multicollinearity, in subsequent estimations, only the measure that explains the largest variance in the probability of an FTA will be included. This is the minimum measure of regulatory quality.

3.6.3. DETERMINANTS OF NEW FTAS: VERTICAL SPECIALISATION

Table 3.6 shows the results from estimating an augmented FTA formation model using various measures of trade and vertical specialisation for the year 2008. The first column now becomes the new baseline model. It includes the traditional determinants of FTAs (BB2004) in conjunction with the minimum measure of

between governance and FTA formation. They show that very low measures of regulatory quality are associated with lower likelihoods of FTA formation, however measures in the low-to mid range are seen to be associated with higher probabilities of an FTA being formed.

[309] Table 3.5 shows that the variable POL_STAB seems to react in a way that is counter to the predictions made. It is possible that this variable captures necessary conditions needed for value chain activity. A low value of political stability may imply very little security in economic transactions and hence reduce the probability of an FTA.

regulatory quality. The three columns that follow then capture the role of various trade measures on the likelihood of countries forming a new FTA. Column (2) introduces the log of the value of total imports (IMPORTS); column (3) the log of the value of intermediate imports as identified by way of the BEC nomenclature (INT_IMPS_BEC); and column (4) the log of the value of bilateral intermediate imports that are part of a bilateral value chain (INT_IMPS__BVS)[310]. These measures are seen to enter the FTA formation equation with a positive coefficient so that they are associated with a positive impact on the likelihood of the successful conclusion of a new FTA. Comparing the coefficients of these trade measures also shows that the largest impact, in terms of the size of the coefficient, is delivered by the BEC measure of intermediate imports[311]. However, the inclusion of the bilateral measure of vertically specialised trade results in a higher prediction of successful outcomes.

In column (5), a measure of the *structure* of trade is introduced through the minVSWLD indicator. The positive coefficient on this measure suggests that countries that are more globally vertically specialised are more likely to engage in a trade agreements. This indicator serves the purpose of capturing the political economy dynamics within a country. Higher measures are associated with a larger presence of a relative lobbying mass in favour of liberalisation. The minimum value of this indicator is used to reflect the fact that *both* countries have to have a larger lobbying mass in favour of liberalisation for the successful conclusion of an agreement[312]. Column (7) then adds the measure of the value intermediate imports which are part of a bilateral value chain to this specification. Again, further support to the positive role of vertically specialised trade on the formation of new trade agreements is identified[313].

[310] This is the same measure that exhibited magnification effects in the previous essay.
[311] This is in line with Orefice and Rocha's (2011) findings.
[312] Other estimations used the value of a country's measure of world vertical specialisation rather than the minimum. A positive coefficient was found confirming the hypothesis that countries with a higher relative lobbying mass in favour of liberalisation are more likely to engage in trade agreements. However the predictive powers of the FTA formation equation were lower than when the minimum measure was used. These results are not reported but are available upon request.
[313] Interestingly, when an interaction term is added between bvs intermediates and reg quality (not shown), the trade measure loses its significance and interacted term becomes significant. This may imply that the vs measure is acting through the governance measure as originally suggested by Antras and Stagier (2011). Extensions of this thesis should focus on this issue.

Table 3.6: Determinants of FTAs – Trade Measures

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
NATURAL	1.482***	1.317***	1.304***	1.215***	1.528***	1.322***
	(0.195)	(0.217)	(0.212)	(0.218)	(0.205)	(0.231)
REMOTE	0.195***	0.184***	0.177***	0.178***	0.185***	0.173***
	(0.0359)	(0.0359)	(0.0361)	(0.0361)	(0.0396)	(0.0386)
RGDP	-0.108	-0.322***	-0.382***	-0.347***	0.0377	-0.164
	(0.0725)	(0.119)	(0.121)	(0.103)	(0.0743)	(0.110)
RGDPsim	0.451***	0.443***	0.449***	0.446***	0.293**	0.297**
	(0.125)	(0.128)	(0.128)	(0.130)	(0.129)	(0.133)
DGDPCAP	2.277***	2.245***	2.271***	2.217***	2.806***	2.708***
	(0.422)	(0.426)	(0.429)	(0.433)	(0.496)	(0.503)
SQDGDPCAP	-0.193	-0.185	-0.193	-0.178	-0.333*	-0.309*
	(0.158)	(0.158)	(0.159)	(0.160)	(0.176)	(0.176)
DGDPcapROW	-3.364***	-3.381***	-3.347***	-3.352***	-2.790***	-2.796***
	(0.693)	(0.697)	(0.698)	(0.696)	(0.668)	(0.673)
minREG_QUAL	2.852***	2.889***	2.895***	3.013***	3.285***	3.358***
	(0.368)	(0.373)	(0.371)	(0.378)	(0.381)	(0.378)
IMPORTS		0.235**				
		(0.0960)				
INT_IMPS_BEC			0.293***			
			(0.0955)			
INT_IMPS_BVS				0.184***		0.141***
				(0.0484)		(0.0519)
minVSwld					7.599***	6.920***
					(1.403)	(1.481)
Constant	17.69***	26.19***	29.04***	27.90***	5.929	15.11***
	(3.413)	(4.950)	(5.133)	(4.544)	(3.995)	(5.242)
Observations	1,090	1,090	1,090	1,090	1,090	1,090
r2_p	0.501	0.506	0.508	0.512	0.522	0.528
Correctly Pred p(FTA)=FTA	86.1%	85.6%	86.2%	86.3%	87.0%	87.8%
Correctly Predicted FTA=1	66.3%	67.5%	68.7%	69.6%	69.9%	72.1%
Correctly predicted FTA=0	94.5%	93.3%	93.7%	93.5%	94.2%	94.5%

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

The marginal effects for these estimations, evaluated at the mean, are reported in the appendix (Table A.3.7). They suggest that a 1% increase in imports leads to an increase in the likelihood of an agreement of 3.3 percentage points. The same increase in the BEC identified measure of intermediate goods trade raises this probability by 4.1 percentage points whereas a 1% increase in the measure of vertical specialisation increases the probability of an agreement by 2.5 percentage points holding all else equal at mean values.

Although the results above presented are in line with the predictions made in this essay, the estimations used have applied no controls for either simultaneity or unobserved heterogeneity and they are hence likely to be biased. In Table 3.7, an attempt to control for unobserved heterogeneity and simultaneity is made through the use of an FD estimator. It captures differences in the data between 2000 and 1995 to predict changes in FTA status by 2008[314]. This eliminates the time invariant and unobserved component of the error term that may be causing biases (see equation 3.7)[315]. Another way of putting this is that it controls for initial *levels* of trade to determine whether *changes* in trade affect the probability that a country *switches* into a trade agreement. First differences are taken with respect to the year 2000 rather than the end of the sample period to mitigate biases arising from simultaneity. These are discussed at greater lengths in the Appendix A3.5 where a robustness check, using different base years in the first differencing strategy, is provided[316]. These changes are used to predict FTA status switches taking place between 1995 and 2008.

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[314] The choice of looking at differences with respect to the year 2000 is made on the basis that it caters for sufficient variance in the independent variables and also a low enough incidence of trade agreements. Most agreements in the sample were signed after this year.

[315] This estimator only eliminates the problems associated with unobserved heterogeneity if the cause of these is time invariant.

[316] These biases arise from the positive impact of FTAs on trade flows (see previous essay of this thesis for a justification of this assertion). Using changes in trade flows between 2008 and 1995 to predict FTA formation will not deal with these biases. Changes in trade flows during this period will be affected by the presence of an FTA and hence the coefficient on the trade measures is likely to bias upwards. To avoid these biases, the estimation should be carried out using changes in trade flows *before* the conclusion of an agreement. But because the switch into an agreement happens for different countries at different periods in time, then one has to think carefully how to treat changes in trade flows between countries that have not signed an agreement. The appendix provides a fuller discussion of these issues (see section A3.5).

Table 3.7: FD Estimator – Impact of VS on the probability of an FTA (1995-2000)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
dRGDP	-0.0911	-0.288**	-0.235*	0.0912	0.269**	0.317***
	(0.112)	(0.129)	(0.126)	(0.123)	(0.115)	(0.122)
dRGDPsim	0.375**	0.439***	0.445***	0.572***	0.627***	0.679***
	(0.159)	(0.169)	(0.167)	(0.184)	(0.195)	(0.206)
dDGDPCAP	-0.713**	-0.655**	-0.635**	-0.647*	-0.659*	-0.651*
	(0.302)	(0.316)	(0.311)	(0.341)	(0.346)	(0.366)
dSQDGDPCAP	0.404***	0.406***	0.398***	0.446***	0.441***	0.464***
	(0.0773)	(0.0806)	(0.0791)	(0.0895)	(0.0890)	(0.0953)
dDGDPcapROW	-3.466***	-3.469***	-3.387***	-3.379***	-3.547***	-3.506***
	(0.383)	(0.410)	(0.399)	(0.413)	(0.433)	(0.442)
dminREG_QUAL	1.646***	1.617***	1.606***	1.727***	1.931***	1.942***
	(0.218)	(0.217)	(0.216)	(0.222)	(0.230)	(0.233)
dIMPORTS		0.332***				
		(0.0953)				
dINT_IMPS_BEC			0.215**			
			(0.0919)			
dINT_IMPS_BVS				0.326***		0.193***
				(0.0680)		(0.0657)
dminVSwld					8.489***	6.951***
					(0.885)	(0.968)
Constant	-0.643***	-0.746***	-0.717***	-0.841***	-0.983***	-1.035***
	(0.0956)	(0.0996)	(0.0997)	(0.109)	(0.109)	(0.115)
Observations	1,090	1,052	1,052	1,052	1,090	1,052
r2_p	0.130	0.131	0.126	0.157	0.202	0.196

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
d identifies differences in the independent variables from 1995 to 200

Column (1) of Table 3.7 shows that switches into FTAs are driven by changes in; the similarity of GDP; differences in per capita GDP; and changes to the minimum dyadic regulatory quality. Columns (2) and (3) see the introduction of changes in total import flows and changes in intermediate imports (identified through the BEC nomenclature) into the FTA formation estimation. These show a positive coefficient suggesting that higher changes in this type of trade are associated with a higher likelihood of switching into an FTA by 2008. The results in column (4) suggest that the probability of switching into an agreement is increasing in the growth in the value of intermediate imports that are part of a bilateral value chain (lnintimps_BVS). The introduction of this measure is also associated with a larger explanatory power.

Column (5) then highlights that increases in the degree of global vertical specialisation, or the participation in international modes of production, are also associated with a higher likelihood of switching into an FTA. This may be evidence of the shifting political economy forces that are associated with higher degrees of this measure. The final column introduces the change in the value of bilateral vertically specialised trade in conjunction with the indicator of global vertical specialisation. The results suggest that both have a positive impact on the likelihood of an FTA. The marginal effects, reporter in the Appendix Table A3.8, reveal that a 1% positive change in the growth of vertically specialised trade leads to a 9 percentage point increase in the likelihood of switching into an agreement[317].

An alternative way of controlling for unobserved heterogeneity and simultaneity is through an IV approach. This introduces exogenous variation into the trade measures. However, as anticipated, providing support for the validity of the instruments used can be complicated. Nevertheless, three instruments were identified and used to look at the impact of trade flows on the probability of an FTA being formed. The first is the minimum share of Co2 emissions over GDP. It is expected to be correlated with manufacturing activity and hence drive a measure of demand for imported inputs whilst remaining uncorrelated with the desirability of engaging in an

[317] Evaluated at mean values. It must be noted that a 1% change in the change in vertically specialised trade might be a relatively big change.

FTA[318]. The second instrument used captures the minimum density of telephone lines which should be correlated with the infrastructure of a country and hence also import demand. The final instrument is a measure of the minimum per capita expenditure on health services. The results for the IV estimation are presented in the Appendix. A3.7. A priori, the instruments are valid in the sense that they are significantly correlated with all the measures of trade flows. They also pass the Wald test of exogeneity. The results suggest that all three measures of trade play a positive role in determining the probability of a country engaging in a new FTA. However distinguishing how each measure impacts FTA formation is complex because they are all constructed using the same instruments[319].

3.6.4. Determinants of New FTAs: Interdependence Effects

This section delves deeper into the role that interdependence plays in the formation of new agreements. This is approached through the same FD estimator so that, here too, the estimated coefficients capture the impact of changes in the independent variables rather than the effects of levels. This is convenient as it is changes in the formation of neighbouring agreements which are likely to bring forth changes in the decisions to engage in FTAs as Baldwin's theory of regionalism suggests. Table 3.9 reports the results obtained from introducing various measures of interdependence into the baseline estimation shown in Column (1) of Table 3.8. The coefficients of these baseline variables are omitted for brevity[320]. The first column introduces BJ2010's contagion indicator (wexpFTA)[321]. It captures the domino effects predicted by Baldwin's (1993) original hypothesis. The results suggest that changes in export market shares, as a result of neighbouring regionalism, positively and significantly affect the probability of a new agreement being signed. The second column then looks at contagion effects occurring through vertically specialised trade (wbvsFTA) where the weights attributed to the FTA variable are measured in terms of the share of vertically specialised intermediate exports. Here too, supportive evidence is given

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[318] Although it can be argued that some new agreements have certain environmental clauses, one would be hard pressed to argue that this is a make or break condition in the formation of trade agreements (perhaps unfortunately).

[319] This implies that, in terms of the first step equation, there is little variation in the instruments used so that all three measures could be capturing the same type of variation. A more appropriate test would require identifying instruments that singularly capture variance in each measure.

[320] The marginal effects of the full table are presented in the Appendix A3.9

[321] Recall that the measure identifies country i's weighted exports to country j's FTA partners.

to the notion that contagion can arise through the interconnection of international production as this measure positively affects the probability of switching into an agreement. Looking at the differences in the results in these two columns reveals that both have a similar impact on the likelihood of an FTA but the vertically specialised measure of contagion appears to yield a larger predictive power in the FTA formation equation.

The third column introduces Baier et al.'s (2010) indicator of 'own FTA' which captures changes in the internal political economy dynamics. The original hypothesis that the probability of engaging in an FTA is increasing in the number of trade agreements already signed is confirmed. This measure captures evolving political economy dynamics in the spirit of Ornelas (2005) and Baldwin's juggernaut effect[322]. Columns (4) to (6) then show that the introduction of the measure of vertically specialised trade does not alter the results obtained from the measures of interdependence. Positive changes in vertically specialised trade remain important drivers of FTAs even when contagion effects are accounted for.

Table 3.8: Interdependence Effects (changes 1995-2000)

	(1)	(2)	(3)	(4)	(5)	(6)
dwexpFTA_o	3.965***			4.212***		
	(0.396)			(0.426)		
dwbvsFTA_o		3.700***			3.792***	
		(0.425)			(0.442)	
dcountFTA_o			0.098***			0.087***
			(0.015)			(0.015)
dINT_IMPS_BVS				0.385***	0.368***	0.302***
				(0.079)	(0.078)	(0.069)
Constant	-0.877***	-0.836***	-0.957***	-1.128***	-1.069***	-1.098***
	(0.106)	(0.105)	(0.108)	(0.126)	(0.124)	(0.118)
Observations	1090	1090	1,090	1,052	1,052	1,052
r2_p	0.207	0.216	0.166	0.238	0.244	0.184

Robust standard errors in parentheses,*** p<0.01, ** p<0.05, * p<0.1

Overall, the cross-sectional models seem to confirm the original hypotheses of this essay. The inclusion of the new identified variables increase the predictive powers of the FTA formation equations and suggest that new agreements seem to be better explained through the introduction of measures of governance, changes in vertically

[322] There is no evidence of a diminishing marginal utility (or return) to signing an extra agreement. Entering this measure squared shows a positive coefficient and is omitted in the results presented however the results with this measure are available upon request and do not substantially alter the above presented findings.

specialised trade and interdependence effects. This gives supportive evidence to the notion that changes in the incentives to form agreements might arise from changes in the typology of trade[323].

Two caveats in this analysis need be noted. First, the use of a reduced sample, both in terms of time and country coverage, may be problematic. The country coverage does not include LDCs and hence is not totally representative of world economic activity. Nevertheless, the sample captures a significant proportion of new FTAs signed. Many of these are North-North and North-South agreements but few are South-South agreements. It would also have been desirable to extend the sample in time so as to identify how the new determinants of FTAs behave during the different waves. This was not possible on account of data constraints. Governance measures are only available since the mid-90's as are harmonised indicators of vertically specialised trade[324].

3.6.5. Panel Data Approach

This section uses panel data techniques to identify the role of the changing nature of trade on the formation of new agreements. Such techniques can provide additional controls for the biases that arise from unobserved heterogeneity. However, as anticipated, estimating binary dependent variable models with fixed effects may introduce problems related to 'incidental parameters'. This implies that the desirable properties of the FE estimator may not be properly utilised[325]. Nevertheless, alternative estimation procedures that provide similar controls for endogeneity are available as discussed in the empirical section. One such alternative is the use of a Mundlak-Chamberlain approach that conditions the correlation between the unobserved variable and the independent variable. Another is an IV approach that introduces independent variation in the endogenous trade variables. These techniques are used to determine whether the hypotheses put forward in this essay hold.

[323] However it is hard to prove the validity of this statement as the indicators that are incorporated in the estimations are only available for the periods that occupy the latest wave of regionalism. A more conclusive proof of this claim would have passed through looking at the role of these variables throughout the different waves of regionalism which is unfortunately not possible.
[324] Another problem that may arise is that the anticipation of an agreement could already be causing variables to shift. In the panel specification lags will be taken to control for this.
[325] The severity of this incidental parameters problem falls as T rises and hence in a sample with 14 years the problem may not be as pronounced (Greene 2010).

The use of panel data is desirable for various reasons. First, it provides additional mechanisms through which to control for issues of endogeneity. Second, it allows for both temporal and cross-sectional variance in the regressors. Thirdly, the use of a panel setting facilitates the use of temporal lags when the impact of variables is likely to be delayed (slow-moving variable impact). This may arise for the measures of vertical specialisation and the interdependence effects.

Table 3.9 presents the results obtained from the panel data estimations of an augmented FTA formation model with the following specification.

$$\begin{aligned} FTAx_{i,j,t} = \beta_0 &+ \beta_1 NATURAL_{i,j,t} + \beta_2 REMOTE_{i,j,t} + \beta_3 RGDP_{i,j,t} + \beta_4 DRGDP_{i,j,t} \\ &+ \beta_5 DGDPcap_{i,j,t} + \beta_6 SQDGDPcap_{i,j,t} + \beta_7 DGDPcapROW_{i,j,t} \\ &+ \beta_8 minREG\_QUAL_{i,j,t} + \beta_9 lnINT\_IMPS\_BVS_{i,j,t-1} \\ &+ \beta_{10} \text{wbvsFTA}_{i,j,k,t-1} + \epsilon_{i,j} \end{aligned} \tag{3.12}$$

It introduces the quality of the regulatory framework (minREG_QUAL); the value of vertically specialised intermediate imports (lnINT_IMPS_BVS) with a one year lag; and the interdependence variable (wbvsFTA), also with a one year lag. The first column captures the coefficient estimates of the pooled linear probability model (LPM). Here no controls are introduced to mitigate the biases caused by unobserved heterogeneity. Nevertheless, the results capture the positive impact of vertically specialised trade on the probability that a country forms an FTA. It also highlights the positive role of interdependencies and regulatory frameworks in this process. The signs of the coefficients obtained are in line with the predictions of the traditional literature and the earlier observed results. The second column shows the results for a pooled logit estimation. Here too the signs of the coefficients are comparable with those earlier obtained. The third column then uses a random effect estimator. This introduces many changes in both the sign and the magnitude of the impacts. This is unsurprising because the estimator assumes that there is no correlation between the unobservables and the independent variables which is counter to the received wisdom (Baier et al. 2008).

Column 4 then runs a conditional logit (clogit) estimation that uses a group-wise pseudo fixed-effects approach. The observations are grouped by dyad and hence represent a 'within' variation which is similar to that of the FD model earlier estimated (albeit with more data points). This implies a reduction in the estimated sample which only considers countries which have witnessed changes in their FTA status. The coefficients reported appear to be in line with the predictions made throughout this essay. It supports the positive role of vertically specialised trade, governance measures and interdependence effects. However the non-linearities, originally captured by the SQDGPDCAP variable, no longer appear. One of the concerns, in interpreting the results of this estimation is that only within variation is captured for countries that change agreement and hence that the coefficient estimates are capturing the impact of changes in country characteristics only of countries that have effectively switched into an agreement[326].

In the fifth column, an instrumented measure of vertically specialised trade is introduced. This is done by running a panel data gravity model in the guise of that run in the previous essay and using the predicted values from this in a second step conditional logit model[327]. The correction of the standard errors is undertaken through a panel bootstrap with 500 replacements. The results obtained are similar to those of the preceding column however the role of vertically specialised trade appears to be significantly lower.

Column 6 introduces a Mundlak-Chamberlain approach to control for unobserved heterogeneity[328]. The results are also in line with the predictions made in the cross sectional analysis and capture the positive role that measures of governance; vertically specialised trade; and interdependence play in the formation of new agreements. However, the per capita GDP measures exhibit some strange coefficients. DGDPCAP is now negative and the other similar measures are now

[326] Even though this estimation may raise incidental parameters problems, the results obtained suggest that the 14 year span of the data may have considerably reduced the undesirable consequences of such problems.
[327] The first step estimated a model like that in equation 2.22 in the previous essay however the model is estimated without the FTA coefficient as the interest lies in predicting the amount of trade that would take place without an FTA. Very similar results emerged from running this 2 step approach with a model that uses the FTA variable in the first step. It is not entirely clear which approach is the correct method of estimation to follow.
[328] The coefficients on the regressors capturing the averages are not reported to avoid over cluttering.

insignificant. The role of the squared GDP per capita term has been reversed, implying that this term does not enter the specification non-linearly in the same way than originally predicted in Baier and Bergstrand (2004). This might arise as a direct consequence of the changing nature of trade. Differences in capital labour ratios between countries may be even more welfare enhancing in a scenario where production structures are fragmented and hence there might not be any decreasing returns to the degree of complementarity that arises between countries. Furthermore, a wider difference in K/L ratios with respect to the RoW might also make a country more attractive insofar as it could enhance the potential for further specialisation. However, a cautionary word, in the interpretation of these coefficients, deserves mention. This final estimation includes observation averaged variables (not reported) in addition to the normal variables and hence some ‘level’ effects may be overriding some of the ‘changes’ effects that are captured in the reported coefficients.

Table 3.9: Determinants of FTAs - Panel Estimations

VARIABLES		(1) OLS	(2) LOGIT	(3) RE	(4) FE	(5) FE-IV	(6) MC
NATURAL	(+)	0.0350***	0.654***	4.972***			
		(0.00418)	(0.0692)	(0.504)			
REMOTE	(+)	0.00775***	0.0991***	1.578***			
		(0.00101)	(0.0137)	(0.151)			
RGDP	(+)	0.00534***	0.320***	0.252	2.896***	2.773***	2.330***
		(0.00191)	(0.0361)	(0.225)	(0.172)	(0.166)	(0.766)
RGDPsim	(+)	0.0295***	0.809***	3.147***	3.899***	4.164***	1.226
		(0.00230)	(0.0535)	(0.531)	(0.487)	(0.325)	(0.958)
DGDPCAP	(+)	0.0677***	1.301***	0.625	2.169***	1.431***	-4.186***
		(0.00723)	(0.161)	(1.062)	(0.627)	(0.508)	(1.490)
SQDGDPCAP	(-)	-0.0119***	-0.199***	-0.194	1.139***	1.124***	0.159
		(0.00175)	(0.0584)	(0.323)	(0.275)	(0.220)	(0.564)
DGDPcapROW	(-)	-0.112***	-2.936***	-10.02***	0.791	1.933***	-0.931
		(0.00606)	(0.217)	(0.969)	(0.795)	(0.717)	(1.902)
minREG_QUAL	(+)	0.0576***	1.387***	6.748***	3.876***	2.817***	5.440***
		(0.00402)	(0.0969)	(0.748)	(0.477)	(0.398)	(1.561)
L. INT_IMPS_BVS	(+)	0.00617***	0.0687***	0.282**	1.490***	0.175***	0.633***
		(0.00108)	(0.0199)	(0.135)	(0.0873)	(0.0362)	(0.220)
L.wbvsFTA	(+)	0.656***	4.507***	16.78***			14.05***
		(0.0113)	(0.125)	(1.846)			(1.081)
Constant		0.214**	-11.54***	27.21**			23.03
		(0.0927)	(1.595)	(11.59)			(18.48)
YEAR		Y	Y	Y	N	N	N
DYAD		N	N	Y	Y	Y	Y
Observations		14,132	14,132	14,132	3,744	3,744	14,132
r2_p		0.565*	0.607	0.589	0.678	0.575	0.583
ll		-638.4	-2616	-1076	-842.8	-1112	-1007

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

3.7. CONCLUSIONS

This essay puts forward the hypothesis that changes in the typology of trade, evidenced by the rise in vertical specialisation, generate new incentives for countries to engage in new FTAs. It identifies three distinct waves of regionalism and provides some comparative static evidence that suggests that the latest wave involves countries that are more distant and that exhibit wider differences in their factor endowments than in the past. This leads to changes in the expected coefficient estimates of the 'traditional' models of FTA formation (Baier and Bergstrand, 2004). But the rise in vertically specialised trade also introduces new incentives to form new agreements and this arises through three distinct channels.

The first is through the emergence of a greater demand for appropriate regulatory frameworks. More complex modes of international production require the presence of more 'suited' regulatory frameworks so as to avoid inefficient 'hold-ups' (Antras and Staiger, 2011). This suggests that the desirability of an FTA between two countries could be tied to the prevailing quality of regulatory frameworks. Countries with better regulatory quality are seen to have a higher likelihood of signing an FTA. However, a low regulatory quality, within certain 'acceptable' levels, can also provide countries with opportunities to redress regulatory shortcomings through an FTA.

The second channel through which the changing nature of trade affects the likelihood of an FTA being formed arises from changes in the internal political economy dynamics. As countries embrace international modes of production, their dependence on cheaper foreign inputs grows and this means that tariffs are increasingly going to act as production taxes rather than protectionist measures (as the literature on effective rates of protection suggests). This re-shapes the internal political economy forces towards further support for more liberal trade policy stances in an effort to reduce the costs of intermediate products. Because vertically specialised firms are also involved in export markets, the growth in this type of trade also generates a greater demand for market access and hence for the formation of new FTAs.

The proliferation of neighbouring trade agreements also has an impact on a country's decision to engage in FTAs as Baldwin's (1993) domino theory of regionalism suggests. The third channel of influence arises from the threat of delocalisation of segments of production in other countries. If China signs a trade agreement with Korea, this might jeopardise Mexico's position within a value chain, and hence domestic political economy forces will rally in favour of a Mexico-China FTA. The changing nature of trade then introduces new forms of FTA 'contagion' (Baldwin and Jaimovich, 2010).

Some of the findings of this essay point towards directions for future research. For example, the introduction of governance measures is novel in this type of analysis, and has been shown to greatly increase the predictive powers of an FTA formation model. However, causation issues are hard to disentangle and this opens up new avenues for research. Particularly in an effort to understand how regulatory frameworks, vertical specialisation and FTAs interact. This is likely to become an issue of growing importance and one that might be pivotal in understanding how multilateral institutions and regionalism co-exist. This essay adds to Orefice and Rocha's (2011) investigations into such links.

In a related note, one caveat of this study is that it does not include measures of multilateral liberalisation as Mansfield and Reinhardt (2003) suggest should be done in such models. A mitigating factor is that the period under investigation begins just after the Uruguay round is concluded and is short enough to not have substantially changed external multilateral conditions. Furthermore, common changes in the multilateral system may be controlled for using different temporal intercepts such as those used in the FD estimations.

However, a more general issue arises from the sample used in the estimations. The analysis conducted in this essay has 'dropped' all observations for countries that belonged to an agreement before the year the sample began. This was done to focus on the creation of new agreements rather than the existence of agreements. This introduces an element of selection in the estimation that requires further thought. Although it makes sense to compare countries that have switched into an agreement against those that have not switched and are not presently in an agreement, the selection of the ‘control’ sample may require a more rigorous approach in the guise of a ‘heck-probit’ model.

Nevertheless, the empirical analysis of this essay provides important contributions to the empirical literature on FTA formation. Understanding what motivates new agreements is important in itself, but more so in view of ascertaining how the world trading system is likely to evolve. The WTO may face important challenges in maintaining its role as arbiter of international trade if it cannot reconcile the new determining features of regionalism with its system.

OVERALL CONCLUSIONS

This thesis set out to look at the links between vertically specialised trade and Free Trade Agreements. Much of the empirical literature has focused on these processes independently but little has been said about how these are linked. This is mainly because the identification and measurement of these new modes of production has been rather elusive. The first essay of this thesis aimed at resolving these issues by providing a new measure of vertical specialisation that disentangles the origin of the intermediate import flow and the destination of the corresponding export flow. In the process an indicator of bilateral vertical specialisation, which serves as a proxy measure for bilateral value chain activity, was created. This then led to the construction of a new database that tracked bilateral vertical specialisation and that enabled delving deeper into the links between vertical specialisation and new regionalism. One of the outputs of this thesis that has not been reported in the text is that this database also contains information disaggregated by sector and this will further facilitate looking at these links in future studies.

The separation of vertical specialisation into backward and forward linkages proved instructive and facilitated tracking the position of countries along the value chain, or whether countries are engaging in assembly activities or in higher value adding processes of production. The first essay highlighted the presence of a long-run path of specialisation and presented some prima facie evidence of how countries may move along this path. Although individual short-run country patterns of specialisation were found to be somewhat different from this long-run path, evidence showed that countries cluster along a clearly defined non-monotonic snake-curve of income and total vertical specialisation. They enter value chains in assembly activities but as development unfolds they start specialising in higher value adding sequences of production. These patterns of specialisation are in line with Mexico's experience where the first generation *maquiladora* assembly lines have now evolved towards the production of more sophisticated goods (Bergin et al., 2008).

Looking at the bilateral spread of these processes of production suggested that much of this specialisation is taking place along regional blocks. The US was shown to play a strong role in Mexico's evolving patterns of specialisation. In the EU, Germany was shown to be a net exporter of intermediate products which appear to enter assembly lines in Eastern Europe whilst in Asia; China emerges as a new supplier of intermediate products but remains reliant on imported components from Korea and Japan. Inter-regionally, China also enters value chain activity with the EU and the US although these production patterns seem to involve more complex sourcing strategies within East Asia and towards the EU and NAFTA.

Finding a high incidence of VS within regional blocks does not imply that FTAs cause such modes of production. Regional partners share other common characteristics, such as proximity or similarity in income, which are also likely to affect value chain activity. This suggested that one would need to look at the role of FTAs on these flows through an econometric approach that isolates the trade policy element from other characteristics that also determine vertically specialised trade. This was addressed, in the second essay of this thesis, through a theoretically derived gravity model of input trade.

The empirical strategy was devised to account for biases that arise from the endogenous formation of FTAs. Countries that sign new trade agreements exhibit, prior to the conclusion of these, higher trade flows and hence they choose their partners well (see Magee, 2003). This implies that it is important to control for the reasons behind these countries trading more in order to capture an unbiased estimate of the FTA effects. Baier and Bergstrand (2007) propose the use of country pair fixed effects (FE) to control for these biases, however this imposes restrictions on the variance of the FTA variable which implies that its coefficient captures the impact of *switching* into a trade agreement. This is problematic when using panels that cover observations across a limited amount of years and where there is a large prevalence of agreements in place before the beginning of the sample period. Hence alternative and less restrictive country-year FE were employed. In order to test whether these FE provided appropriate controls for unobserved heterogeneity, a gravity model of trade was estimated using a future FTA variable on a restricted sample. The results showed that the introduction of these controls led to an insignificant effect of a future FTA on current trade flows and hence that appropriate controls for the reasons why countries trade more prior to agreements being concluded had been provided.

The results then showed that FTAs have a positive impact on bilateral intermediate imports. However, this impact was found to be of a similar magnitude to that found for total trade. But when more targeted measures of vertical specialisation were used in the estimations, more pronounced FTA effects arose. In particular, the FTA effect was found to be 5 percentage points higher on an indicator that proxies for *international* value chain activity. This reflects that this type of trade might be more sensitive to trade policy than traditional trade flows. Moreover, when looking at the impact of FTAs on an even more targeted measure of *bilateral* value chain activity, an even larger effect arose.

This type of production is associated with a backwards and forwards movement of products across countries and hence the removal of border measures 'magnifies' the response of these flows to tariff cuts. This type of trade was also found to be more responsive to changes in trade costs and income variables than traditional trade flows giving supportive evidence to Yi's (2003) theoretical 'magnification effects'. The presence of such modes of production coupled with these magnification effects help explain why world trade has grown at a faster rate than world GDP in recent decades (Yi, 2003). The large identified role of FTAs in this process also suggests that trade policy can play an active role in promoting such modes of production which, in turn, implies that it can be an effective tool in the propagation of value chain activity.

The observation, in the second essay, that countries exhibit above average trade flows prior to signing agreements raised the question of how vertical specialisation affects the formation of new FTAs. This motivated the third essay of this thesis. The characteristics of countries engaging in the different waves of regionalism were shown to be changing. The latest wave seems to occupy countries which are more distant and which have wider differences in their factor endowments. This suggested that changes in the incentives that lead to the conclusion of FTAs might be occurring.

Three channels of influence, through which the changing nature of trade affects incentives to form new FTAs, were identified. The rise in international production leads to more complex international economic activity and transactions and this increases the possibility that failures in one segment of production jeopardise the entire functioning of the supply chain. Avoiding these failures requires incurring higher coordination costs and implementing tighter control mechanisms. Whilst some of these mechanisms can be internalised within multinational activity, others may require the involvement of institutions in setting appropriate governance structures that ensure the enforceability of contractual agreements. The recent work on 'offshoring' and FTAs of Antras and Stagier (2011) suggests that vertical specialisation, FTAs and regulatory frameworks could be linked in this fashion. The empirical evidence provided by Orefice and Rocha (2011) further substantiates that there is a link between trade in intermediate goods and demand for 'deeper' agreements. The results of this essay then find that the prevailing regulatory quality of countries is an important determinant of new FTAs. The minimum value of this measure, in a dyadic observation, explains a large part of the variance in an FTA formation model. This may indicate that countries are either engaging in an FTA so as to resolve shortfalls in regulatory quality or that it is the lowest measure in a dyadic observation that determines the extent of the 'hold-up' problem. Disentangling which dominates is hard and was left for subsequent work.

The changing nature of trade is also likely to have an effect on the internal political economy dynamics that determine the formation of FTAs (in the guise of the Grossman and Helpman (1995) and the Ornelas (2005a) theoretical models of FTA formation). This is the second channel of influence. Countries that exhibit higher and growing degrees of vertical specialisation are expected to have growing lobbies supporting liberalisation. This is because higher measures of vertical specialisation should capture a larger presence of firms engaging in international production and hence firms that would benefit from access to cheaper intermediate inputs and market access for their associated exported product. The final channel through which the changing nature of trade affects the formation of new FTAs arises from domino effects (Baldwin, 1993). The participation in international value chain activities implies a greater interdependence between FTAs. Countries are shown to engage in new agreements in an effort to consolidate or gain access to a position within a value chain as a result of neighbouring regionalism.

This thesis was constrained by the lack of IO tables to calculate indicators of vertical specialisation for a wider sample of countries. This would have been desirable so as to capture the dynamics of specialisation and in particular to tackle the question of how engaging least developed countries in these production processes can help attain development goals. However, this work can serve as a benchmark for further analysis using more flexible data approaches. Another issue that requires further empirical analysis and which was not tackled herein arises from the links between vertical specialisation and productivity growth. Although there appears to be a correlation between these processes, disentangling causality is important. If vertical specialisation leads to productivity gains and trade policy can promote this type of specialisation then a link between trade policy and economic growth emerges.

Several caveats are worth noting. First, the indicators developed remain proxy measures of vertical specialisation and can yet be refined[329]. Second, the theoretical model of input trade requires further extensions. In particular this thesis has identified different FTA effects on different types of intermediate inputs, but how these arise has not been developed theoretically. The magnification effects are an example of this. They seem important but they do not arise from the model presented. Drawing on the heterogeneous firm literature, and in particular on the recent paper by Bas and Strauss-Kahn (2011) provides further avenues for developing such a model. Finally, the links between the regulatory environment and the formation of FTAs require a more in depth analysis. The results presented in this thesis provide an important backing to the notion that the complexity of trade leads to a greater demand for regulatory frameworks as suggested by Antras and Staiger's (2011) recent paper. But it would be desirable to place more focus on how this relationship emerges and in particular on whether there is an interaction between the degrees of vertically specialised trade and the regulatory frameworks.

This thesis' aim was to contribute to the growing literature on FTAs and vertical specialisation. In the process it has identified its spread across broad regions and highlighted some features of its underlying nature. Moreover, it has isolated the impact of FTAs on these flows and shown how trade policy can play an active role in the propagation of these modes of production. Finally, this thesis has also shown how

[329] The recent paper by Johnson and Noguera (2011) provides a more precise method for calculating value added and these methods can be adapted to compute more targeted measures of bilateral value chain activity.

the changing nature of trade creates new incentives to form new agreements. These results are quite timely given the growing concerns relating to the future role of the WTO in shaping international economic activity. Indeed the recent World Trade Report (WTO, 2011) is dedicated to looking at how regionalism and multilateralism interact. Moreover, there is a new impetus, in the field of trade statistics, to establish more accurate measures that can help capture vertically specialised modes of production (see Lamy, 2010 and OECD-WTO, 2011). This thesis contributes to these debates by introducing new insights on the links between vertical specialisation and new regionalism.

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APPENDICES

APPENDIX A1

A1.1 OTHER MEASURES OF VERTICAL SPECIALISATION

This section discusses alternative measures of vertical specialisation. Particular emphasis is given to how these may serve capture the bilateral element of this phenomenon. Two types of measures arise, those that are identified through trade databases and those that require other types of data.

A1.1.1 TRADE BASED MEASURES OF VERTICAL SPECIALISATION

Trade based measures of vertical specialisation are attractive for the wide coverage they offer in terms of geography and time. They are however not without their drawbacks. Having already discussed the use of the BEC nomenclature in the main body of the text this part focuses on different indicators that may be used for the identification of vertical specialisation.

A1.1.1.1 Intra Industry Trade

It is not unreasonable to presume that the backwards and forward movement of goods within similar tariff lines may serve the purpose of capturing some form of fragmentation of production structures across international borders. This exchange of intermediate goods across industries may be captured by way of Intra-Industry Trade (IIT) indicators. Consider the automotive industry (using the HS classification); motor vehicles lie in sector HS-87 where the final assembled motor vehicles can be found in HS-8703 whilst the parts and accessories of motor vehicles fall into the category HS-8708. Although constructing an IIT indicator for sector 8703 (assembled motor vehicles) is likely to capture the simultaneous exchange of finished cars (e.g. Peugeots against Volkswagens), computing such an indicator for its 'parts and accessories' (HS-8708) may be an appropriate way of capturing vertical specialisation.

Consider product HS-870840 – which identifies 'gear boxes'. Calculating an IIT indicator at this tariff code could register the exchange of gear boxes at low levels of processing for gear boxes at higher levels of processing. The differing levels of processing can then be identified by comparing import and export unit values. Where the difference between these is above a certain threshold, one could surmise that the product exported is significantly different from the product imported hence suggesting that some form of vertical specialisation is taking place. The crux of the validity of using such a method may hinge on the choice of an appropriate level of aggregation. If the IIT indicator is computed at the 4-digit level which identifies the different parts and components (HS-8708), or indeed at the 2-digit level (HS-87), then one may be capturing simultaneous trade in intermediates that are used in the production of cars. But such an exercise may be misleading if it involves imports of a 6-digit product and exports of another (i.e. imports of radiators but exports of gear boxes). It can lead to an inaccurate identification.

In addition, even if a good choice of aggregation is made there remains certain doubt that IIT indicators properly identify the full extent of vertical specialisation. The main problem comes from the construction of the indicator which, by composition requires there to be both imports and exports of products in the same tariff lines. It is entirely possible that Germany sources all its gear boxes from Eastern Europe and does not export this product at all. In this instance, vertical specialisation is taking place, but the IIT indicator will be zero and hence one would register no vertically specialised trade taking place.

Further to this, if one considers the production of a car one need consider other materials the likes of the iron that is used to make the chassis; the plastic that is utilised for the interior; or the rubber that is used to make the tyres. All these products are located in very different HS tariff codes hence an IIT indicator may underestimate the true extent of vertical specialisation. This last point becomes clearer when one looks at I-O tables. Using these it is possible to track the share of inputs that come from the same industry and which are directly used to produce one unit of output of a given industry. This is accomplished by capturing the diagonal element of the total I-O table and dividing this by the total output of that same industry. In Table A1.1 such an exercise is demonstrated for the US. Here, it is seen that, on average, 22.1% of total inputs used in production come from the same I-O industry whilst 26.3% of imported intermediates over total imports of a given I-O sector come from the same industry. These very low values suggest that IIT indicators may be inaccurate instrument for capturing the extent of vertical specialisation[330].

Table A1.1: Diagonal Elements of IO table for the US

I-O sector	Description	share of imports from same industry in total imports	share of inputs from same industry in total inputs
1	AGRICULTURE, HUNTING, FORESTRY AND FISHING	35.2%	42.4%
2	MINING AND QUARRYING	70.9%	30.3%
3	FOOD PRODUCTS, BEVERAGES AND TOBACCO	35.9%	21.7%
4	TEXTILES, TEXTILE PRODUCTS, LEATHER AND FOOTWEAR	76.1%	49.4%
5	WOOD AND PRODUCTS OF WOOD AND CORK	79.2%	35.2%
6	PULP, PAPER, PAPER PRODUCTS, PRINTING AND PUBLISHING	67.3%	42.0%
7	COKE, REFINED PETROLEUM PRODUCTS AND NUCLEAR FUEL	3.4%	10.0%
8	CHEMICALS EXCLUDING PHARMACEUTICALS	59.9%	41.9%
9	PHARMACEUTICALS	40.3%	24.8%
10	RUBBER AND PLASTICS PRODUCTS	10.4%	10.1%
11	OTHER NON-METALLIC MINERAL PRODUCTS	39.9%	21.4%
12	IRON & STEEL	45.2%	25.7%
13	NON-FERROUS METALS	75.3%	45.1%
14	FABRICATED METAL PRODUCTS, except	10.3%	13.2%
15	MACHINERY AND EQUIPMENT, N.E.C.	34.8%	20.9%
16	OFFICE, ACCOUNTING AND COMPUTING MACHINERY	34.4%	18.3%
17	ELECTRICAL MACHINERY AND APPARATUS, NEC	24.0%	12.0%
18	RADIO, TELEVISION AND COMMUNICATION EQUIPMENT	78.0%	42.2%
19	MEDICAL, PRECISION AND OPTICAL INSTRUMENTS	13.8%	6.9%
20	MOTOR VEHICLES, TRAILERS AND SEMI-TRAILERS	46.3%	31.7%
21	BUILDING AND REPAIRING OF SHIPS AND BOATS	0.1%	0.3%
22	AIRCRAFT AND SPACECRAFT	67.6%	34.0%
23	RAILROAD EQUIPMENT AND TRANSPORT EQUIPMENT N.E.C.	14.3%	9.4%
24	MANUFACTURING NEC; RECYCLING	19.0%	4.8%
25	ELECTRICITY, GAS AND WATER SUPPLY	0.0%	18.6%
26	CONSTRUCTION	0.0%	0.1%
27	WHOLESALE AND RETAIL TRADE; REPAIRS		9.6%
28	HOTELS AND RESTAURANTS	0.0%	1.7%
29	TRANSPORT AND STORAGE	7.0%	35.7%
30	POST AND TELECOMMUNICATIONS	0.0%	29.7%
31	FINANCE, INSURANCE	1.5%	55.4%
32	REAL ESTATE ACTIVITIES	0.0%	25.0%
33	RENTING OF MACHINERY AND EQUIPMENT	0.0%	2.7%
34	COMPUTER AND RELATED ACTIVITIES	0.3%	19.4%
35	RESEARCH AND DEVELOPMENT	0.3%	1.5%
36	OTHER BUSINESS ACTIVITIES	5.8%	35.9%
37	PUBLIC ADMIN. AND DEFENCE; COMPULSORY SOCIAL SECURITY		
38	EDUCATION	0.0%	0.2%
39	HEALTH AND SOCIAL WORK	0.0%	4.2%
40	OTHER COMMUNITY, SOCIAL AND PERSONAL SERVICES	3.7%	26.8%
	Average	26.3%	22.1%
	Weighted average (by industry output)	14.2%	21.9%

330 It is important to consider that the back of the envelope calculation provided is one taking into account the direct requirements in production. Whilst one should also consider the indirect requirements (i.e. the second round effects) However, these are likely to be smaller and hence the validity of the argument is likely to remain.

A1.1.1.2 Tariff Exemption Under Special Processing Provisions

Another way that the literature has attempted to capture the extent of vertical specialisation is through special tariff provision for processing trade. The EU allows tariff exemption under a provision known as Outward Processing Trade (an equivalent provision for the US is the Offshore Assembly Provision). Under these, a tariff exemption is applied for certain goods allowing temporary export of intermediate goods for processing in a foreign country followed by re-importation under partial or complete tariff exemptions (or drawback).

In the EU, outward processing activities are mediated under the Community Customs Code[331]. Provisions exist for both outward processing and inward processing respectively known as OPX(or M) and IPX(or M). Inward processing imports, as opposed to outward processing exports as explained above, captures intermediate imports from a foreign country for home-processing with a subsequent re-export to the country of origin with tariff exemption. Processing authorisation is granted under special conditions where a particular tariff line is created for repair of goods; otherwise goods have to undergo an economic examination before authorisation is granted. The latter evaluates possible disadvantages of foreign processing on domestic processing firms. The conditions under which outward processing may be granted are also limited by type of processing and detailed annexes provide a list of possible processing activities covered. Outward processing takes place in 3 distinct phases.

- Community goods are exported temporarily to a territory outside the EC customs territory.
- Goods exported undergo processing
- The permit holder re-imports processed products

Under the community legislation there exists scope for full or partial relief of duties depending on the type of processing.

[331] COUNCIL REGULATION (EEC) No 2913/92 of 12 October 1992 establishing the Community Customs Code (OJ L 302, 19.10.1992, p. 1)

Egger and Egger (2005) analyse the evolution of OPT in the EU with respect to CEECs and other Western European countries. Their aim is to elucidate the motivation behind this type of trade by looking at 4 different models attempting to explain outsourcing. Firstly, the standard Heckscher-Ohlin model, then new trade theory models, followed by politico-economic models and then models with infrastructure as predominating determinant of processing trade. Their evidence suggests that OPT does not seem to be affected by the standard H-O framework, i.e. factor costs do not tend to influence OPT. Furthermore, they find little evidence supporting market size as guiding processing trade patterns thus arguing that new trade theory models are not well suited to deal with this type of trade. The main determinants of OPT appear to be tax savings on profits and exchange rate ratios. In contrast, Yeats (2001), evaluates processing trade as a measure of vertical specialisation and claims that using these indices to instrument for VS significantly *understates the importance* of global production sharing.

In effect, and in the context of identifying the role that FTAs may be playing with respect to vertically specialised trade, processing trade may not be useful. This is because it only covers trade movements under the presence of tariffs hence it will not afford one to look at vertical specialisation between regional partners where tariffs have been eliminated. In addition, and to the extent that tariffs may be low, firms might not apply for these types of provisions if the administrative cost is higher than the tariff faced. This is a common issue in the rules of origin literature that can be extended to OPT. In this literature the cost of compliance has been calculated at around 3-5% of the value of the product (as suggested by Evenett(2008)). However, processing trade remains an interesting indication of outsourcing as it is partially unaffected by tariff changes and hence can provide a good indication of firm incentives to source production internationally. Bearing in mind that these goods are exempt from tariffs, the growth of OPT trade will be dependent on non-tariff barrier changes and will thus significantly rely on factor price advantages for production. This may give one an ex-ante prelude to the formation of RTAs. By checking OPT flows prior to enlargements or signing RTA agreements it may be possible to determine if the latter were precursors to the signing of the agreement. However processing trade will not capture the full extent of vertical specialisation as it becomes irrelevant once a preferential trade agreement has been signed.

A1.1.1.3 Trade and Production Data

Whilst trade and production data are very different in the way that they are collected, it is possible to merge these using the ISIC nomenclature. UNIDO provides detailed information at the ISIC rev 2 and ISIC rev 3 level on industrial production which can be matched to trade data by origin and destination. This has rarely been done, however a notable exception is that provided by a World Bank working paper by Nicita and Olarreaga (2001 and 2006). They use production data from UNIDO at the ISIC rev 2 and rev 3 levels and match the corresponding trade data for a selection of industrial goods. Their tables span from 1976 till 2004 in their last revision. These can be used to grasp the co-movement of imports and output acting as a proxy for vertical specialisation (by calculating shares of imports over output). The caveats of this method remain that industrial interlinkages remain uncounted. It further requires a considerable amount of work in matching intermediate imports so as to derive an indicator of vertical specialisation. This would have to be done using the BEC nomenclature. The advantage of this approach, for econometric estimation, is that it provides a harmonised nomenclature for analysing production related variables such as wage bills, employment and investment (via gross fixed capital formation). However the data availability varies greatly by country which makes obtaining a large panel a considerable challenge.

A1.1.1.4 Vertical Intra Industry Specialisation

In an effort to exploit the extensive availability of trade data and move away from the somewhat restrictive country coverage of input output tables, Gasiorek et al. (2010) develop a trade based index of vertical specialisation named vertical intra industry specialisation (VIIS). This indicator exploits the presence of ‘parts and components’ tariff lines within broad tariff aggregates deriving a share measure of intermediate imports (identified using the BEC nomenclature) over exports by industry and country. The aggregate measure then becomes the trade weighted average of the industrial measures. The main advantage of this type of indicator is that it allows for extended analysis across developed and developing countries. In addition, it can easily be extended to consider a bilateral element of vertical specialisation thus allowing for the extension of analysis in a regional context. However, the drawbacks are that the underlying assumptions impose certain constraints requiring that imports of intermediates used in production lie within a broad aggregate industry indentified under a tariff aggregate. Furthermore it assumes that intermediate imports are being fully used to satisfy external demand and not domestic demand which in turn causes the indicators to be unbound upwards.

Despite these shortcomings, the indicator is able to capture an important aspect of vertical specialisation. The use of the BEC nomenclature seems justified (as suggested in the discussion of Table 1.1) and the coefficients in the estimations provided in Gasiorek et al (2010) follow the expected signs. The FTA variable in the estimation suggests a statistically significant relationship between the presence of an FTA and higher levels of VIIS. This relationship is stronger between N-N partners and is also shown to be negative between S-S partners where a N-S type agreement has a statistically insignificant positive coefficient. Whilst these findings are insightful and provide a supporting step for our underlying hypothesis, the estimation procedure could suffer from endogeneity between the VIIS variable and the RTA dummy. It is indeed possible that the decision to engage in an FTA is the product of increased VIIS between bilateral partners. Equally, it is conceivable that partners that engage in an RTA show higher VIIS levels. Whilst Gasiorek et al (2010) were not particularly interested in the possible interplay between vertical specialisation and regional trade agreements, their work paves the way for a more systematic analysis using I-O data.

A1.1.2 Non-Trade based Measures of Vertical Specialisation

As with the trade based measures of vertical specialisation, the non-trade based measures also have their advantages and disadvantages. These are outlined below for two such measures, FDI and VSI. The main disadvantage of these non-trade based measures is that these tend to be unavailable at the bilateral level. In addition, country and time coverage of these results in important challenges for practical implementation.

A1.1.2.1 Vertical Foreign Direct Investment

Foreign Direct Investment (FDI) flows can be a source of information in mapping vertical specialisation as they represent firm's commitments to delocalise production, partially or fully, across borders. The literature distinguishes two forms of FDI; market seeking (horizontal) and export platform seeking (vertical). The former takes place when firms decide to set-up production in another market for servicing that same market (i.e. companies recreate domestic production structures in a foreign country to gain access to that market). Vertical FDI then relates to firm incentives to source production internationally, delocalising segments of production to least cost producers in other countries. It is the latter form that captures the vertical specialisation element that we are interested in.

A firm's decision to engage in FDI hinges on choosing a production strategy that minimises production costs but maximises access to a given market. Under the presence of restrictively high trade costs (tariff, non-tariff or distance barriers) firms can engage in market seeking FDI rather than in international trade to service a given market. However as trade barriers fall, firms can prioritise minimising production costs taking advantages of factor endowment or comparative advantage differences to delocalise segments of production to where they are most efficient. Hence there appears to be an important link between FDI and trade that is mediated by trade and production costs. As market access increases by way of bilateral or multilateral negotiations firms' incentives can change and vertical FDI can be promoted.

An extensive literature review carried out by Blonigen (2005) identifies the main determinants of FDI as being exchange rates, taxes, institutions, factor endowments and trade protection. However Markusen and Maskus (2001) find that market size has a greater influence on FDI flows than do factor prices suggesting that FDI flows may be mostly market seeking (tariff-jumping or Horizontal FDI). These results may reflect the important underlying differences between the two types of FDI here exposed. The nature of FDI suggests that horizontal FDI could be larger in terms of values than vertical FDI. This is because the fixed costs of setup involved with servicing other markets in the form of *full* delocalisation of production should be larger than arms length dealings or delocalisation of *segments* of production. In the context of vertical specialisation in preferential areas, not taking account of the marked differences between types of FDI flows may be inappropriate. Flows of FDI between preferential partners could be very different in nature to those between non preferential partners. Where the former would not be market seeking as market access should be granted by virtue of the agreement. Delocalisation of production within an RTA would then generally be registered under vertical FDI. This does not preclude horizontal FDI which would occur when strong backwards and forward linkages exist in other locations across the region. However if markets are highly integrated, the costs of setting up intra-regional affiliates will not be profitable unless we assume immobility of factors of production, high transport costs and very strong backwards and forward linkages. In this context we surmise that intra RTA FDI will predominantly take the form of vertical FDI. Blomstrom and Kokko (1997) conclude that, within RTAs, "international differences in factor endowments should become stronger influences on investment location decisions". Conversely, when barriers to trade are high (outside RTA), firms gain advantage from setting up affiliates in other markets and reaping the benefits, through scale economies, of an extended entry into a market where the large fixed costs of setup can be recouped more easily. Dunning (1997) empirically demonstrates that RTA consolidation, the likes of the completion of the Single Market Programme, gave rise to an increase in intra and inter regional FDI. However, evidence showed that inter-regional FDI rose faster than intra-regional FDI. This finding provides some evidence to our hypothesis and suggests that analysis of vertical specialisation using FDI flows should distinguish between vertical and horizontal types.

Whilst FDI can be very informative in capturing firm incentives to delocalise production, the availability of data is limited. Generally data is not available bilaterally and lacks an adequate degree of disaggregation. In addition, there is little way in knowing which type of FDI flow is occurring as these are not generally recorded. The use of FDI as an indicator of vertical specialisation in econometric analysis is hence going to lead to misleading results given that the factors motivating these flows vary significantly according to the preferential status of bilateral partners.

A1.2 OECD STAN DATABASE AND METHOD OF CALCULATION

The country and time coverage of the OECD tables is detailed in the table below:

Table A1.2: OECD IO database coverage

Country	**mid 90's**	**early 00**	**mid 00**	**currency**
Argentina	1997	*	*	1000 pesos
Australia	1995/1996	*	2004/2005	Mill. AUD
Austria	1995	2000	2005	Mill. Euros
Belgium	1995	2000	2004	Mill. Euros
Brazil	1995	2000	2005	Mil. Real
Canada	1995	2000	2005	Mill. Can
Switzerland	*	2001	*	Mill. CHF
Chile	1996	*	2003	Mill CLP
China	1995	2000	2005	10,000 Yuan
Czech Rep.	*	2000	2005	Mill. CZK
Germany	1995	2000	2005	Mill. Euros
Denmark	1995	2000	2005	Mill. Kro
Spain	1995	2000	2005	Mill. Euros
Estonia	1997	2000	2005	Mill. Kroon
Finland	1995	2000	2005	Mill. Euros
France	1995	2000	2005	Mill. Euros
United Kingdom	1995	2000	2005	Mill. Pound
Greece	1995	2000	2005	Mill. Euros
Hungary	1998	2000	2005	Mill. Forint
Indonesia	1995	2000	2005	Mill. RPS
India	1993/1994	1998/1999	2003/2004	Mill. Lakhs (10 lakh = 1 million)
Ireland	1998	2000	2005	Mill. Euros
Italy	1995	*	*	Mill. Euros
Japan	1995	2000	2005	Mill. Jpy
Korea	*	2000	2005	Mill. Krw
Luxembourg	1995	2000	2005	Mill. Euros
Mexico	*	*	2003	Mill. Pesos
Netherlands	1995	2000	2005	Mill. Euros
Norway	1995	2000	2005	Mill. Krone
New Zealand	1995/1996	2002/2003	*	Mill. NZD
Poland	1995	2000	2005	Mill. PLN
Portugal	1995	2000	2005	Mill. Euros
Rumania	*	2000	2005	Mill. Ron
Russia	1995	2000	*	Mill. Rub
Slovakia	1995	2000	2005	Mill SKK
Slovenia	*	2000	2005	Mill. Euros
Sweden	1995	2000	2005	Mill. Krona
Turkey	1996	2002	*	Bill/Mill TRL
Taiwan	1996	2001	*	Mill. NT
USA	1995	2000	2005	Mill USD
South Africa	1993	2000	*	Mill. Rand

The calculation of the indicators of vertical specialisation is carried out for 39 countries using the OECD STAN database (it excludes Taiwan, Belgium and

Luxembourg). The following steps are taken to prepare the tables for a subsequent merge with the trade data obtained from COMTRADE:

- Matrices are reduced to a 25x25 square matrix that captures manufacturing trade. This requires aggregating certain manufacturing sectors and also aggregating the service sectors to one sector only.
- The base tables are then extended these so yearly tables are obtained
- These are then deflated, using country specific deflators from the WDI database, to a base year 2000 and converted into dollars using exchange rates from the Penn World Tables database. The conversion is necessary so that one can merge the IO tables with the trade data in dollars
- The trade data is also deflated, but here aggregate OECD deflators are used.
- Once the data has been fully treated, the different indicators are calculated.

In calculating indicators of vertically specialised trade an issue arises from the use of a bilateral import matrix of technical coefficients. Using the A_j^m matrix in conjunction with the domestic matrix for such a calculation will result in an alteration of the underlying technologies that lead to the production of output. This arises from the shortfall between the bilateral matrix and the aggregate matrix. Hence to keep technologies constant, the domestic intermediate matrix has to be transformed to compensate for the shortfall. The intuition behind this is relatively straight forward. If a country's technology dictates that to produce one unit of an agricultural good you need to input 0.1 units of imported intermediate industrial goods, and if you do not currently import any industrial goods from a given origin, then you need to make up for this shortfall elsewhere so as to maintain production technologies constant.

One way of dealing with this issue would be to assume some form of substitutability of goods across the I-O system that compensates for the shortfalls[332]. However, this would require computing an algebraic system with various Armington functions and introducing elasticity parameters. The system would then depend on how the substitutability of inputs is justified and technologies would no longer be Leontief. Hence a different route is taken. It assumes that, in order to satisfy demand, a reporter country needs to compensate for the shortfall in imports using alternative

[332] i.e. by using more domestic output.

sources of inputs which maintain the underlying technologies of the IO system[333]. This can be accomplished by calculating an intermediate transformation matrix, T_j, which is the sum of the domestic matrix and the difference between the total intermediate import matrix and the imported intermediate matrix from a given origin so that $T_j = D+(M-m_j)$[334]. The technical coefficient transformation matrix ($A^T{}_j$) can then be calculated by dividing each element of the T_j matrix by the output of the corresponding sector (Z_n).

Not carrying out this transformation is not overtly problematic when calculating indicators of vertically specialised trade. However, it might be a problem when looking at domestic value added versus the use of domestic intermediate products. The shortfall in trade arises because a reporting country does not import a particular commodity from a partner country. Hence say that Belgium does not import petroleum from Luxembourg. Because Belgium needs this product to produce output then it needs to make up for this shortfall in petroleum imports from Luxembourg by substituting the source of petroleum. One can assume that Belgium compensates for this shortfall either increasing its competitiveness, which might be unlikely, or that it uses inputs of this product from other sources, domestic of imported. Whether this is domestic or imported, does not affect the backward linkage between Belgium and Luxembourg, but it may affect other indicators of value added trade.

[333] An alternative would have been that the compensation arises from an increase in value added.

[334] An example is helpful. Imagine that, in order to produce a unit of output, Country A requires the total use of 0.4 units of input of which 0.3 is domestic and 0.1 is imported. Because Country A does not import this product from Country B, then the *bilateral* imported intermediate value for this product is 0. Not accounting for this implies that the sum of the domestic and the intermediate matrix is 0.3 rather than the 0.4 that is originally required. Calculating an indicator of vertical specialisation using this new matrix implies an alteration of the production technologies. Keeping these constant can be done by computing a transformation matrix that takes into account the shortfall in the import matrix so that technology is maintained at 0.4. The implication of this method is that one assumes that the shortfall is compensated through the use of more domestic inputs rather than value added.

A1.3 Testing the BVS indicator: The EU Example

Table A1.3 compares the bilateral VS calculations using the EU I-O tables' delimitation of intra and extra EU trade (Panel 1) to that calculated using the methodology presented in the first essay of this thesis with trade data extracted from Comtrade (Panel 2). Here distinction is only made on the basis of the origin of intermediate imports so that the destination of exports is held fixed towards the world. Hence the sum of BVS across destination will give the VS indicator[335]. Whilst there are differences in the numbers reported across the different panels, the underlying relation is very similar. The table shows, in the first entry, that the import content of exports to the world amounts to 30% for Austria where 20 percent (68% of the total) comes from intra EU partners and 10 percent (32% of the total) from extra-EU partners. The second panel estimates the degree of vertical specialisation of Austria at 0.36 where 68% of intermediate imports come from EU partners and the remaining 32 from non-EU partners. The table serves two purposes, firstly that of evaluating and comparing the above outlined methodology and secondly that of investigating the current degree of vertical specialisation in the EU and the regional component of this vertical specialisation. Where this is concerned, there is some prima-facie evidence of important intra-EU value chain activity, and whilst not exactly surprising given that most of these countries trade heavily with the EU it is nonetheless important to be able to assign a numerical value to this for subsequent formal testing.

The Eurostat I-O tables are more detailed than those of the OECD. They are composed of a S-U component and a further domestic and imported I-O table. The coverage in terms of sectors is extended to 59 sectors (11 more than the OECD I-O tables) identified by the CPA nomenclature (Statistical classification of Products by Activity in the European Community). As regards time coverage, there is coverage for most EU-15 countries for 1995 and 2000. The overlap between the OECD and the Eurostat tables allows one to compare 14 EU-15 countries (leaving Luxembourg out) for 1995 and 2000

[335] In compiling this table we use a reduced form imported intermediate matrix with merchandise trade values only. Furthermore, the export and import vectors are also only for merchandise trade. For comparability, this is done in both instances where we look at pure BVS derived from the I-O tables and that derived from extracted trade data.

Table A1.3: Degree of intra and extra EU-15 vertical specialisation in 2000

	2000					
	EUROSTAT (1)			Eurostat + trade data (2)		
	VS	BVS EU-15*	BVS non-EU	VS	BVS EU-15	BVS non-EU
Austria	0.301	0.205	0.096	0.361	0.247	0.113
		68.13%	***31.87%***		***68.56%***	***31.44%***
Belgium	0.440	0.325	0.114	0.482	0.341	0.141
		73.99%	***26.01%***		***70.72%***	***29.28%***
Denmark	0.277	0.196	0.080	0.271	0.195	0.076
		70.97%	***29.03%***		***71.86%***	***28.14%***
Finland	0.296	0.145	0.151	0.270	0.137	0.133
		48.98%	***51.02%***		***50.61%***	***49.39%***
France	0.219	0.129	0.090	0.210	0.123	0.086
		58.76%	***41.24%***		***58.82%***	***41.18%***
Germany	0.269	0.142	0.127	0.235	0.112	0.123
		52.64%	***47.36%***		***47.62%***	***52.38%***
Ireland	0.337			0.325	0.154	0.171
					47.40%	***52.67%***
Italy	0.249			0.240	0.138	0.103
					57.24%	***42.76%***
Netherlands	0.398	0.206	0.192	0.303	0.151	0.152
		51.73%	***48.27%***		***49.90%***	***50.10%***
Portugal (1999)	0.388	0.304	0.084	0.377	0.296	0.082
		78.35%	***21.65%***		***78.32%***	***21.68%***
Spain**	0.263	0.176	0.087	0.277	0.196	0.081
		67.00%	***33.00%***		***70.72%***	***29.28%***
Sweden	0.301			0.279	0.175	0.104
					62.79%	***37.21%***
UK (1995)	0.236	0.135	0.100	0.235	0.126	0.108
		57.35%	***42.60%***		***53.88%***	***46.12%***

Source: Own calculations from Eurostat I-O tables. Trade data from Comtrade
*exchange rates taken from Penn World Tables
** values in tables are in € 1995 hence ECUs exchange rate from average daily ECU exchange to Dollar

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A1.4 AGGREGATE BACKWARD AND FORWARD LINKAGES BY COUNTRY

Table A1.4: Backward Linkages by Country 1995 and 2005

Country	1995	2005	Δ	Country	1995	2005	Δ
Argentina	0.133	0.283	0.150	**Ireland**	0.291	0.361	0.070
Australia	0.192	0.213	0.021	**Israel**	0.375	0.515	0.140
Austria	0.292	0.360	0.068	**Italy**	0.215	0.329	0.114
Brazil	0.153	0.113	-0.041	**Japan**	0.091	0.287	0.197
Canada	0.292	0.338	0.046	**Korea**	0.244	0.392	0.149
Switzerland	0.148	0.270	0.122	**Mexico**	0.239	0.375	0.135
Chile	0.250	0.260	0.010	**Netherlands**	0.306	0.353	0.047
China	0.128	0.242	0.114	**Norway**	0.278	0.268	-0.009
Czech Rep	0.343	0.504	0.162	**New Zealand**	0.231	0.208	-0.023
Germany	0.174	0.278	0.104	**Poland**	0.245	0.361	0.117
Denmark	0.243	0.318	0.076	**Portugal**	0.401	0.452	0.051
Spain	0.247	0.372	0.124	**Romania**	0.213	0.161	-0.052
Estonia	0.405	0.528	0.122	**Russia***	0.069	0.093	0.024
Finland	0.293	0.403	0.110	**Slovakia**	0.386	0.521	0.134
France	0.177	0.299	0.122	**Slovenia**	0.292	0.421	0.129
UK	0.218	0.243	0.025	**Sweden**	0.248	0.347	0.099
Greece	0.239	0.248	0.009	**USA**	0.115	0.188	0.073
Hungary	0.346	0.530	0.184	**South Africa**	0.227	0.272	0.045
Indonesia	0.406	0.181	-0.225	**World**	0.168	0.279	0.112
India	0.229	0.296	0.067				

Source: Own Calculations using OECD STAN database and Comtrade
*Russia values are 1996 rather than 1995

Table A1.5: Forward Linkages by Country 1995 and 2005

Country	1995	2005	Δ	Country	1995	2005	Δ
Argentina	0.110	0.181	0.071	**Ireland**	0.197	0.356	0.160
Australia	0.181	0.500	0.318	**Israel**	0.119	0.210	0.091
Austria	0.205	0.319	0.113	**Italy**	0.160	0.265	0.105
Brazil	0.157	0.302	0.144	**Japan**	0.124	0.208	0.083
Canada	0.128	0.234	0.106	**Korea**	0.099	0.214	0.116
Switzerland	0.216	0.333	0.117	**Mexico**	0.135	0.233	0.098
Chile	0.183	0.488	0.305	**Netherlands**	0.168	0.300	0.132
China	0.125	0.234	0.110	**Norway**	0.338	0.587	0.249
Czech Rep	0.228	0.307	0.079	**New Zealand**	0.097	0.145	0.048
Germany	0.196	0.295	0.100	**Poland**	0.213	0.296	0.083
Denmark	0.168	0.357	0.189	**Portugal**	0.180	0.343	0.162
Spain	0.190	0.294	0.104	**Romania**	0.169	0.306	0.137
Estonia	0.198	0.449	0.251	**Russia***	0.284	0.587	0.302
Finland	0.215	0.378	0.164	**Slovakia**	0.322	0.405	0.084
France	0.167	0.269	0.102	**Slovenia**	0.181	0.255	0.074
UK	0.193	0.348	0.155	**Sweden**	0.234	0.345	0.112
Greece	0.154	0.246	0.092	**Turkey**	0.145	0.245	0.100
Hungary	0.222	0.290	0.068	**USA**	0.191	0.289	0.098
Indonesia	0.150	0.435	0.285	**South Africa**	0.190	0.427	0.237
India	0.122	0.211	0.089	**World**	0.168	0.279	0.112

Source: Own Calculations using OECD STAN database and Comtrade.
* Russia value for 1995 is 1996 data

A1.5 Total Vertical Specialisation by Country

Table A1.6: Total Vertical Specialisation by Country in 2005

Country	VS-B	VS-F	diff	VS-T	Country	VS-B	VS-F	diff	VS-T
Argentina	0.283	0.181	-0.102	0.413	**Ireland**	0.361	0.356	-0.005	0.589
Australia	0.213	0.500	0.286	0.606	**Israel**	0.515	0.210	-0.306	0.617
Austria	0.360	0.319	-0.041	0.564	**Italy**	0.329	0.265	-0.064	0.507
Brazil	0.113	0.302	0.189	0.380	**Japan**	0.287	0.208	-0.079	0.435
Canada	0.338	0.234	-0.104	0.493	**Korea**	0.392	0.214	-0.178	0.523
Switzerland	0.270	0.333	0.063	0.513	**Mexico**	0.375	0.233	-0.141	0.521
Chile	0.260	0.488	0.228	0.621	**Netherlands**	0.353	0.300	-0.053	0.547
China	0.242	0.234	-0.008	0.420	**Norway**	0.268	0.587	0.319	0.698
Czech Rep	0.504	0.307	-0.198	0.657	**New Zealand**	0.208	0.145	-0.063	0.323
Germany	0.278	0.295	0.017	0.491	**Poland**	0.361	0.296	-0.065	0.550
Denmark	0.318	0.357	0.038	0.561	**Portugal**	0.452	0.343	-0.109	0.639
Spain	0.372	0.294	-0.078	0.556	**Romania**	0.161	0.306	0.145	0.417
Estonia	0.528	0.449	-0.079	0.740	**Russia**	0.093	0.587	0.493	0.625
Finland	0.403	0.378	-0.025	0.629	**Slovakia**	0.521	0.405	-0.115	0.715
France	0.299	0.269	-0.030	0.488	**Slovenia**	0.421	0.255	-0.166	0.569
UK	0.243	0.348	0.105	0.507	**Sweden**	0.347	0.345	-0.001	0.572
Greece	0.248	0.246	-0.002	0.433	**Turkey**		0.245		
Hungary	0.530	0.290	-0.239	0.666	**USA**	0.188	0.289	0.101	0.423
Indonesia	0.181	0.435	0.254	0.538	**South Africa**	0.272	0.427	0.155	0.583
India	0.296	0.211	-0.085	0.444	**World**				

Table A1.7: Linkages and per capita GDP regressions

	(1)	(2)	(3)
	backwards	forwards	total
VARIABLES	vsb	vsf	vst
gdpcap_o	1.56e-05***	-8.50e-06***	4.58e-05***
	(2.06e-06)	(1.71e-06)	(5.53e-06)
gdpcap_o2	-3.48e-10***	2.45e-10***	-2.20e-09***
	(0)	(0)	(2.72e-10)
gdpcap_o3			0***
			(0)
Constant	0.147***	0.307***	0.212***
	(0.0192)	(0.0160)	(0.0310)
Observations	468	468	467
R-squared	0.111	0.103	0.150

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

A1.6 AGGREGATE SECTORAL VERTICAL SPECIALISATION

Capturing the sectoral linkages across bilateral partners requires a little more thought. The first step is to use the principles that led to the derivation of equation (1.4) to obtain a matrix of imported intermediates from a given partner that are used to produce exports. This is done by changing the export term from an *nx1* vector in equation (1.4) to a diagonalised *nxn* export matrix[336].

$$SBVS_{n,i,j} = \frac{A^{m}_{i,j}\left[I - A^{T}_{i,j}\right]^{-1} X_{n,i,j}}{X_{n,j,tot}}$$

(A1.1)

The product of this equation, $SBVS_{n,i,j}$, is an *nxn* matrix containing the value of vertically specialised trade (i.e. the value of imported intermediates used in the production of exports) from a given partner to another[337]. To construct the sectoral backward linkage one then takes the column sums of this new matrix and divides these, element-by-element, by a vector of exports to a given partner. This then produces an indicator that captures the share of intermediate imports from all sectors from a partner that are used to produce exports for a given sector to a partner[338]. An illustrative example is helpful here. The sectoral backward linkage of the US with respect to Mexico in the car industry is the amount of imported intermediates used from all sectors in Mexico to produce car exports to a given partner.

$$SBVS - B_{n,i,j} = \frac{\sum_{ncol} \mathrm{SBVSn,i,j}}{X_{n,j}}$$

(A1.2)

The sectoral forward linkage on the other hand is calculated by taking the *row* sums of the new SBVS matrix and dividing these, element by element, by total exports for

336 This methodology has been previously used by Cardaso et al (2008). The diagonalisation of the matrix follows the simple principle of the identity matrix, it allows exports to be 'fed into' the VS share matrix (i.e. $A^{M}(I-A^{D})^{-1}$ thus providing an nxn matrix of vertically specialised trade).

337 For simplicity, we assume that i=j

338 If instead of the column sum, one takes the row sum of the imported intermediate matrix, then the interpretation of the indicator is different, it then becomes the share of intermediate imports from a given sector and partner that are used to produce total exports.

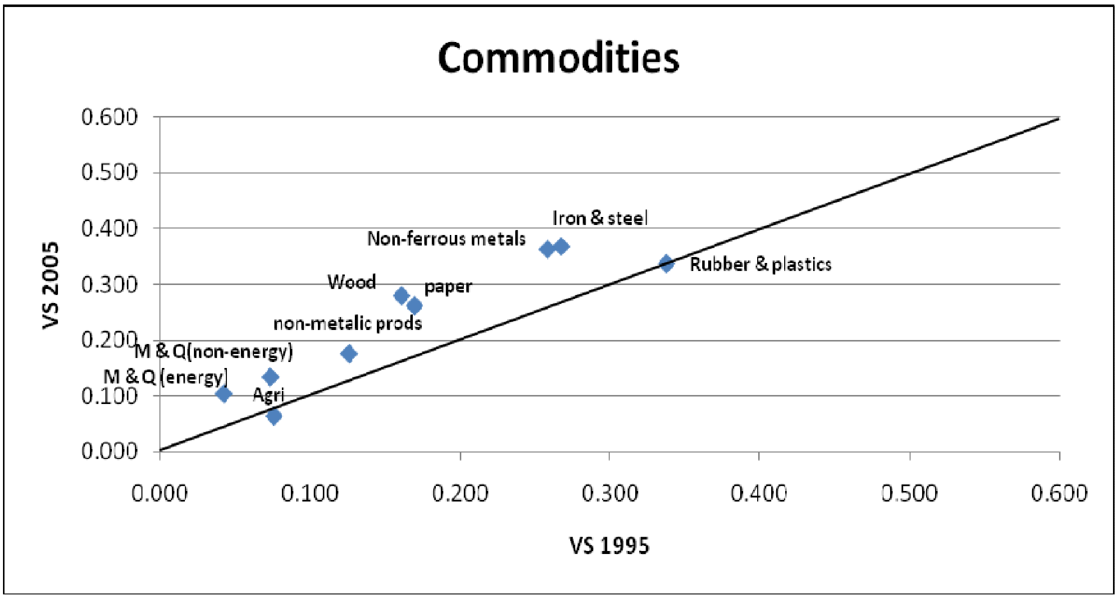
each sector. The indicator then captures the amount of imported intermediates from a particular sector that another country uses in producing all exports to a partner. Taking the car industry example, the US' forward linkage with Mexico is the amount of intermediate car exports of the US to Mexico that then go into producing Mexican exports (i.e. all sectors) to a given partner:

$$SVS - F_{n,n,i,j} = \frac{\sum_{nrow} SBVS_{j,i}}{X_{n,j}} \tag{A1.3}$$

Being able to distinguish forward and backward linkages across sectors and across partners allows one to more accurately track value chain activity and a country's position in the production sequence. Where the aggregate measures provides a good indication of how the whole economy is moving, the disaggregate measures will more finely capture where these moves are happening. The sectoral extension also facilitates future econometric analysis where industry specific effects may be controlled for.

In order to shed light on possible sectoral specific trends in vertical specialisation a similar exercise as that carried out in the body of the text for aggregate VS is undertaken however it tracks OECDX sectoral VS-B (VSI) aggregates in time. This is important as VS could be a sector specific phenomenon and hence mostly present in countries that engage in some types of economic activities. It also affords the chance of looking at broad differences across broad sectoral divisions such as commodities, manufactures and services. Figure A1.1 maps the sectoral VSI for commodities in 1995 and in 2005 in the horizontal and vertical axes respectively. The figure depicts a noticeable increase in the VSI for all sectors except the 'Agriculture' and 'Rubber & Plastics' sectors. Despite this increase, and with the exception of ferrous and non ferrous metals, most commodities remain low in the VSI spectrum. This is unsurprising as exports of raw materials will tend to have very low levels foreign content. However, the machinery used for their extraction might largely be foreign sourced.

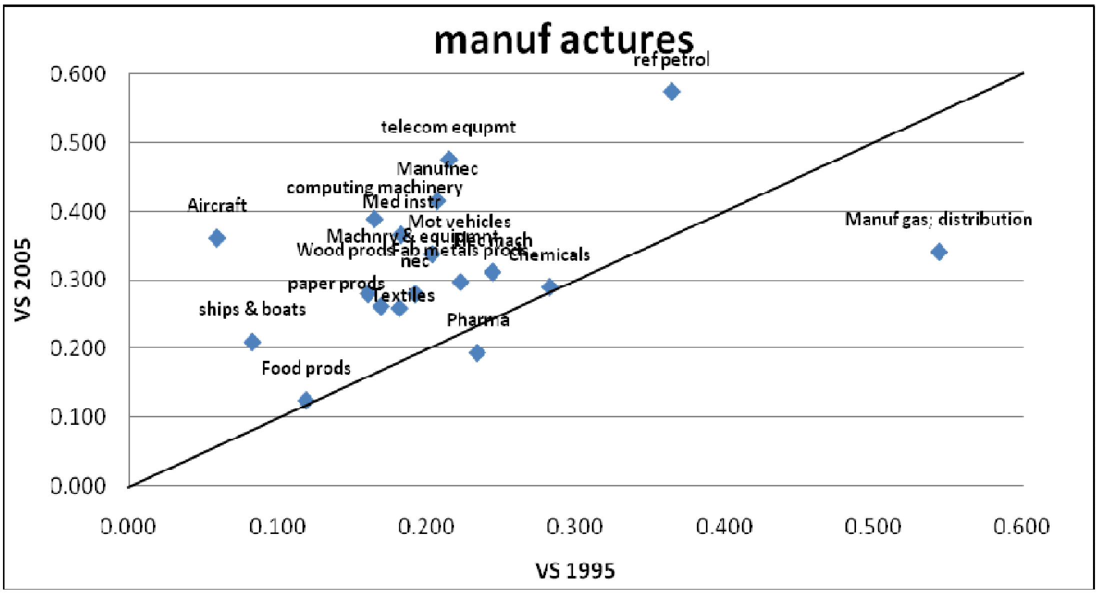
Figure A1.1: Sectoral Vertical Specialisation for OECDX aggregate: Commodities



Source: Own Calculations from OECD I-O STAN database

Manufacturing sectors are considered in Figure A1.2. A higher and more dramatic increase in VS in time emerges. Refined petroleum is the 'top-performer' showing the highest degree of foreign value added (going from just below 0.4 in 1995 to around 0.58 in 2005). It is however important to note that there might be a price effect here where the price of raw imported materials may have risen at a faster pace than the price of the finished refined petrol. Noteworthy is the near doubling in VS of sectors such as 'Telecoms equipment', 'Motor Vehicles', 'Computing Machinery' and 'Aircrafts'. Where these sectors may be considered as high-skill intensive, the important rise in VSI may point to either productivity gains or to changes in employment patterns towards non-OECDX countries. Perhaps a little surprising are the entries for 'Pharmaceuticals' and 'Chemicals' which lie very close to the 45 degree line and where one could expect increases in VSI from new technologies and increases in foreign skills. However, the values for these sectors are to be interpreted with caution as the construct of the OECD tables means that these sectors are interchanged for some countries in the sample. Overall, and in comparison to the commodities sectors, there seems to be much higher levels and increases in VS in time for manufactures.

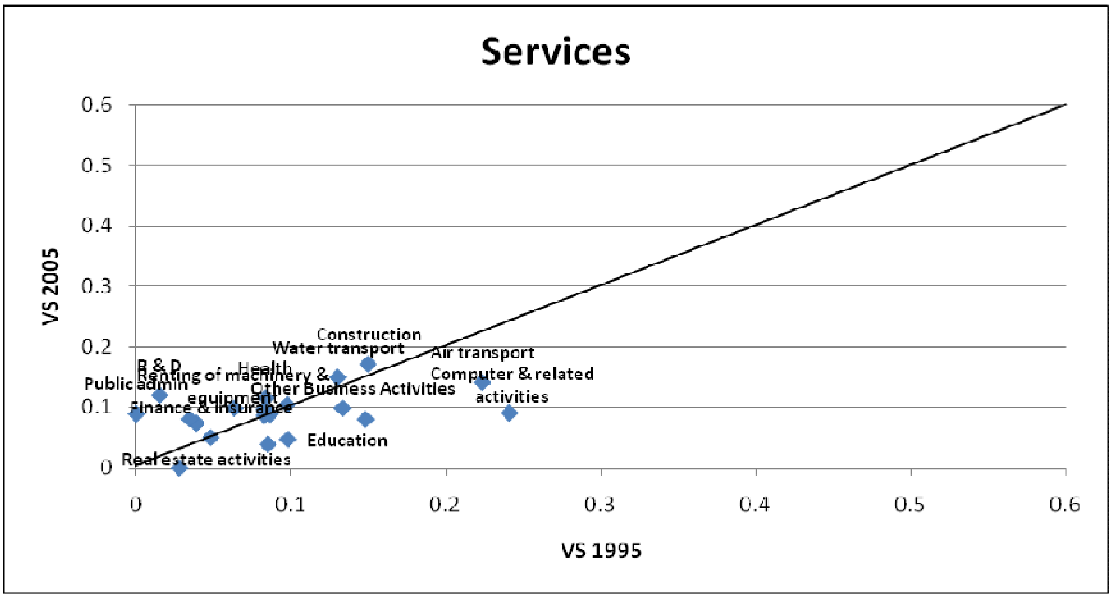
Figure A1.2: Sectoral Vertical Specialisation for OECDX aggregate: Manufactures



Source: Own Calculations from OECD I-O STAN database

Figure A1.3 then considers the service category where one perceives not only lower levels of VS, but also smaller and sometimes negative changes in time. Whilst one might have expected sectors like 'Computer and related activities' to experience important increases in vertical specialisation these have gone down considerably. It is however important to note that these aggregate sectoral measures can hide important country effects, hence outsourcing computer related activities to India will be watered down in this aggregate measure. This in turn then supports the development of a bilateral measure so that one can grasp how sectors and countries are responding to this new wave of globalisation. Other financial and business sectors have also remained relatively unchanged in time but 'R&D' arises as an important 'climber' where VSI has more than quadrupled in a decade.

Figure A1.3: Sectoral Vertical Specialisation for OECDX aggregate: Services

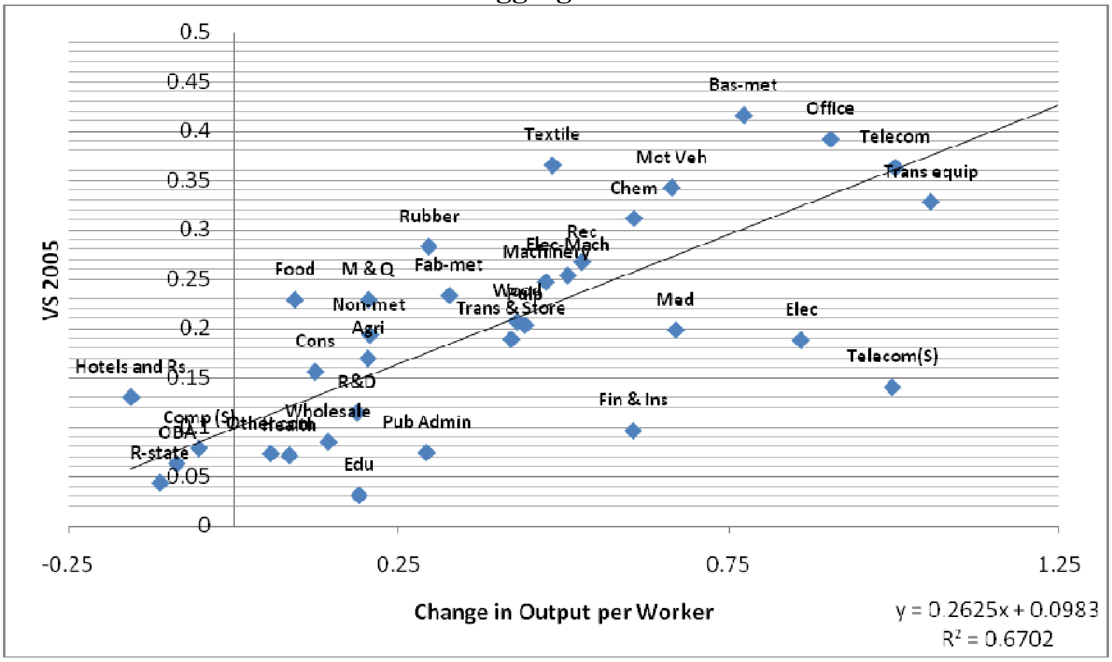


Source: Own Calculations from OECD I-O STAN database

On aggregate the above figures suggest that the increase in vertical specialisation is mostly a goods trade phenomenon (manufacturing and commodities). The service sectors seem to exhibit lower levels of vertical specialisation which have remained largely unchanged in time (or at least have not witnessed the increases seen in the other broad sectors). Overall there seems to be important interplay between domestic and foreign value added which varies considerably across industries and is more prevalent in the non-service sectors of the economy.

A correlation between global output per worker and the degree of sectoral vertical specialisation also emerges as seen in Figure A1.4 below:

Figure A1.4: Sectoral VS and changes in Output per worker for OECDX aggregate



Source: Own Calculations from OECD I-O STAN database

APPENDIX A2

A2.1. NET/GROSS FLOWS

To illustrate the circumstances under which the net/gross distinction may be problematic, two separate scenarios are considered. In the first, the distinction between these flows is of a 'measurement error' nature whereas in the second, a net flow is a proportion of the gross flow.

Measurement error case

Imagine that the theoretical models suggest that the empirical analysis should be done on the basis of net trade flows. Consider then a true model of intermediate goods trade taking the following form[339]:

$$M_{ij}{}^* = X_{ij}\beta + u_{ij} \tag{A2.1}$$

The net amount of intermediate goods trade M* is determined by a set of typical gravity covariates X and an independent and normally distributed error term u_{ij} exhibiting the typical properties. If gross trade in intermediates, as recorded by trade statistics, has the form $M_{ij} = M_{ij}{}^* + v_{ij}$. The model estimated becomes:

$$M_{ij} = X_{ij}\beta + v_{ij} + u_{ij} \tag{A2.2}$$

This provides little complications if the error term v_{ij} is assumed to be independent. However there are two probable violations of this independence. The first is that there is a likely correlation of the unobserved component v_{ij} with the independent variables in X. Not netting out the value added of any preceding stage of production implies that the observed gross measure can contain imports from country i itself. If this value added is determined by characteristics that also determine the amount of trade between two countries, then estimating this equation using OLS will provide biased coefficients. To the extent that the amount of value added can be a function of factor endowments or economies of scale which also serve to determine trade then

[339] A priori this is equally applicable to an estimation of total trade.

the independence assumption may be violated. One can think of the error term v_{ij} as containing previous imports in a sequenced production hence also determined by similar covariates that determine M*. Capturing net flows, or where trade is only in final goods without international value added that is double counted, makes this error redundant, but given the perceived fragmentation of production across international borders the “measurement error” could have consequences on gravity type estimations. The second source of violation of independence transpires through the possible correlation between the terms v_{ij} and u_{ij}. If there are unobservables that determine imports, and which are uncorrelated with the covariates in X for simplicity, and that are captured in the term u_{ij} but also in v_{ij}, then biased coefficients will also arise in estimation (unobserved heterogeneity). The violation of this independence is likely because unobservables such as institutional arrangements, legal ties or other such deep integration issues are likely to determine both the amount of intermediate goods trade AND the levels of value added done at each stage of an international production sequence. The importance of the first type of complication will be an increasing function of the degree of fragmentation between two countries whilst that of the second will increase with the degree of integration across two countries. One can circumvent the first complication by using an approach that identifies net trade flows, or international value added rather that gross flows whereas the second will be discussed in more depth below where we look at unobserved heterogeneity.

The case where net flows are in proportion to gross flows

Consider now a similar setting where the theoretical model suggests that it is on the basis of net trade flows that the estimation is to be undertaken so that A2.1 continues to be the ‘true model’. If net flows are a share of gross flows so that

$$M_{ij}^* = (a_i)\, M_{ij} \tag{A2.3}$$

and the model is estimated on the basis of gross flows rather than net flows then one would need to estimate the following:

$$M_{ij} = (1/a_i)X_{ij}\beta + u_{ij} \tag{A2.4}$$

This implies that the coefficients will be biased by $(1/a_i)$. Hence if theory tells us that the true model is to be estimated through net flows rather than gross, then biases will arise in the estimated coefficients. Hence if the net flows are half of the gross flows, the estimated coefficients will be double what they ought to be. It is important to note that these biases can also be controlled for through fixed effects or through a logarithmic transformation of the data.

A2.2: THE MODEL

To obtain the demand for varieties from a particular country one minimises the cost function with respect to the production function so that the Lagrangian becomes:

$$L = \sum_{M} n_j \varphi_j p_{i,j}(x) x_{l,j} + \lambda \left[Y - A_i \left(\sum_{M} n_j^{\frac{1}{\sigma}} \varphi_{l,j}^{\frac{1}{\sigma}} x_{l,j}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \right]$$

(A2.5)

The partial derivatives for goods from location i and j are obtained so that

$$\frac{n_j \varphi_j p_j(x)}{n_i \varphi_i p_i(x)} = \frac{n_j^{\frac{1}{\sigma}} \varphi_j^{\frac{1}{\sigma}} x_j^{-\frac{1}{\sigma}}}{n_i^{\frac{1}{\sigma}} \varphi_i^{\frac{1}{\sigma}} x_i^{-\frac{1}{\sigma}}}$$

(A2.6)

Hence

$$\frac{n_j^{-1} \varphi_j^{-1} x_j}{n_i^{-1} \varphi_i^{-1} x_i} = \left(\frac{n_j \varphi_j p_j(x)}{n_i \varphi_i p_i(x)} \right)^{-\sigma}$$

(A2.7)

Singling out x_j

$$x_j = n_j^{1-\sigma} \varphi_j^{1-\sigma} p_j(x)^{-\sigma} n_i^{\sigma-1} \varphi_i^{\sigma-1} p_i(x)^{\sigma} x_i$$

(A2.8)

Multiplying this expression by $n_j \varphi_j p_j$ gives us:

$$n_j \varphi_j p_j(x) x_j = n_j^{2-\sigma} \varphi_j^{2-\sigma} p_j(x)^{1-\sigma} n_i^{\sigma-1} \varphi_i^{\sigma-1} p_i(x)^{\sigma} x_i$$

(A2.9)

Summing up across origins:

$$C_i = \sum_{M} n_j \varphi_j p_j(x) x_j$$

$$= \sum_{M} \left(n_j^{2-\sigma} \varphi_j^{2-\sigma} p_j(x)^{1-\sigma} \right) n_i^{\sigma-1} \varphi_i^{\sigma-1} p_i(x)^{\sigma} x_i$$

(A2.10)

Inverting this gives the demand for a particular variety from country j

$$x_{i,j} = \frac{n_j^{1-\sigma}\varphi_j^{1-\sigma}p_{i,j}(x)^{-\sigma}}{\left[\sum_M (n_j{}^{2-\sigma}\ \varphi_j{}^{2-\sigma}p_j(x)^{1-\sigma})\right]}C_i$$

(A2.11)

To determine the minimum cost function to obtain a unit of X_i one should substitute this expression into the production function which is recalled to be:

$$X_i = A_i\left[\sum_M n_j{}^{\frac{1}{\sigma}}\ \varphi_j{}^{\frac{1}{\sigma}}x_{l,j}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}$$

(A2.12)

So that:

$$x_{l,j}^{\alpha} = \frac{n_j^{(1-\sigma)\alpha}\varphi_j^{(1-\sigma)\alpha}p_{i,j}(x)^{1-\sigma}}{\left[\sum_M (n_j{}^{2-\sigma}\ \varphi_j{}^{2-\sigma}p_j(x)^{1-\sigma})\right]^{\alpha}}C_i{}^{\alpha}$$

(A2.13)

Where

$$\alpha = \left(\frac{\sigma-1}{\sigma}\right)$$

(A2.14)

Then

$$n_j{}^{\frac{1}{\sigma}}\ \varphi_j{}^{\frac{1}{\sigma}}x_{l,j}^{\frac{\sigma-1}{\sigma}} = \frac{n_j^{2-\sigma}\varphi_j^{2-\sigma}p_{i,j}(x)^{1-\sigma}}{\left[\sum_M (n_j{}^{2-\sigma}\ \varphi_j{}^{2-\sigma}p_j(x)^{1-\sigma})\right]^{\alpha}}C_i{}^{\alpha}$$

(A2.15)

And summing across countries so that

$$\sum_M n_j^{\frac{1}{\sigma}} \varphi_j^{\frac{1}{\sigma}} x_{l,j}^{\frac{\sigma-1}{\sigma}} = \left[\sum_M (n_j{}^{2-\sigma} \varphi_j{}^{2-\sigma} p_j(x)^{1-\sigma})\right]^{1-\alpha} C_i{}^{\alpha}$$

(A2.16)

Therefore

$$X_i = A_i \left[\sum_M n_j^{\frac{1}{\sigma}} \varphi_j^{\frac{1}{\sigma}} x_{l,j}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} = A_i \left[\sum_M (n_j{}^{2-\sigma} \varphi_j{}^{2-\sigma} p_j(x)^{1-\sigma})\right]^{\frac{1}{\sigma-1}} C_i$$

(A2.17)

This is the minimum cost function that is required to obtain a unit of X_i.

A similar model can be obtained without having to rely on technological differences so that if technology is fixed by country and not by the desirability of the product one can use the following production function:

$$X_i = A_i \left[\varphi_j^{\frac{1}{\sigma}} \sum_M n_j^{\frac{1}{\sigma}} x_{l,j}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}$$

(A2.18)

The cost/revenue function the becomes:

$$C_i = R_i = \sum_M n_j p_j a_j \tau_{i,j} x_{l,j}$$

(A2.19)

Yielding an input demand function:

$$V_{i,j} = \frac{n_j^{2-\sigma}(a_j p_j \tau_{i,j})^{1-\sigma}}{\left[\sum_M n_j^{2-\sigma}(a_j p_j \tau_{i,j})^{1-\sigma}\right]} C_i$$

(A2.20)

And a minimum cost function:

$$A_i \left[\sum_M ({n_j}^{2-\sigma}\; p_j(x)^{1-\sigma}) \right]^{\frac{1}{\sigma-1}} C_i$$

(A2.21)

Here it is easier to see how a greater availability of intermediate products reduces the cost of producing a unit of X_i although this only happens when the elasticity of substitution is above 2.

A2.3: Database

A2.3.1. The Vertical Specialisation Indicators

The Input-Output database of the OECD is used to construct the different measures of vertical specialisation (using equation 2.1). The database contains information for 42 countries at various intervals in time. See Table A1.2 for country and year coverage of the OECD IO table database.

The calculation of the indicators of vertical specialisation is carried out for 39 of these countries (excluding Taiwan, Belgium and Luxembourg) in the following steps:

- We reduce all the matrices to a 25x25 square matrix that captures manufacturing trade. This requires aggregating certain manufacturing sectors and also aggregating the service sectors to one sector only.
- The base tables are then extended these so that we can obtain a yearly tables
- These are then deflated, using country specific deflators from the WDI database, to a base year 2000 and converted into dollars using exchange rates from the Penn World Tables database. The conversion is necessary so that we can merge the IO tables with the trade data in dollars
- The trade data is also deflated, but here we use an aggregate OECD deflator.
- Once the data has been fully treated, we use equation 1 to calculate the difference indicators BVS, VS1 and TVS.

The use of I-O tables for this type of analysis needs to be accompanied by some cautionary words, some to do with the OECD database and others of general consideration when using I-O tables. Firstly, given that the OECD tables are based on countries voluntary submission, the harmonisation of these requires applying various transformations which may reduce their individual precision at the benefit of the collective harmonisation. For example, countries use different collection methods and sectoral classifications hence harmonisation is sometimes difficult[340]. Some report Supply-Use tables at purchasing prices rather than basic prices and

[340] Adding to this, sometimes there are holes in the I-O tables which are filled using varying estimation techniques. This means that for some sectors, missing values are not recorded but are estimated.

transformations need be implemented to remove VAT and other types of subsidies. Secondly, the compilation of I-O tables is costly and is thus carried out across large time intervals. They provide a ‘snapshot’ of economic activity in a given year making the extension of these to obtain a panel highly reliant on restrictive assumptions. Extrapolating I-O tables can be done by a ‘double deflation’ methodology or alternatively require assuming constancy of technical and interdependence coefficients over time. For the purpose of our analysis we choose the latter technique but we need to understand how variation in technology may arise. UN (1999) puts forward that variation in technological coefficients can arise as a result of three circumstances: Firstly through changes in technology, secondly through changes in relative prices, and thirdly through imperfect data. The first is impossible to control for as the only information that we possess is based on the technology present in the base year of the I-O table. The second can be dealt with by using deflators to produce tables in constant price values given a base year whilst the third is also beyond our control. Choosing this methodology for extending the I-O tables is hence not without implications. First, we are constraining technological changes in the sample to three base years for which we have base I-O tables. This means that variation in our linkage indicators between these base years only occurs via variations in export and import values. We however have reason to believe that whilst this is a limiting factor, annual variation in technologies is small. Vaccara (1986) suggests that technical coefficients vary annually in the region of 2% and UN (1999) also suggest that changes are fairly gradual[341]. Second, and a more general limiting factor of I-O analysis, is that technology is assumed to be linear (Leontief). This implies that intermediate imports are required in fixed proportions to output or alternatively that there is no substitution between inputs used to produce output.

A2.3.2 The Gravity variables

Most of the gravity variables are obtained from the CEPII database. As many of these are time invariant they are easily extended, however country specific time varying variables are drawn from other sources (see below). We use the FTA variable from the CEPII dataset to identify the presence or absence of a trade

[341] However, the variations in Vaccara (1986) are calculated during the 50’s and 60’s. There is reason to believe that the 90’s saw much higher variation through the introduction of new Information Technology such as the internet.

agreement between country pairs. It is however only available till 2006 and hence needs to be extended to incorporate years 2007 and 2008. We do this by imputing the values using the WTO RTA database (http://www.wto.org/english/tratop_e/region_e/summary_e.xls). In the process of this imputation we also correct several inconsistencies in this variable given that the following agreements do not feature:

NOR-KOR (2006): (Through EFTA)
CHE-KOR (2006): (Through EFTA)
JPN-MEX (2005):
IDN-CHN (2003): (Through ASEAN)
CHL-CHN (2006)

Added Agreements:
JPN-IDN (2008)
CHL-JPN (2007)

The GDP, per capita GDP and Population data is extracted from the WDI webpage. All trade data is downloaded using WITS from the COMTRADE database.

Agreements covered:

Table A2.1: Agreements in Sample in 2008

ARG-BRA	BRA-ARG	CHE-SWE	CHL-USA	DEU-CHE	DNK-ESP	ESP-GBR	EST-ISR	FIN-NOR	FRA-SVK	GBR-ZAF	HUN-CZE	IRL-DNK	ISR-FRA
ARG-CHL	BRA-CHL	CHE-TUR	CHN-CHL	DEU-CHL	DNK-EST	ESP-GRC	EST-ITA	FIN-POL	FRA-SVN	GRC-AUT	HUN-DEU	IRL-ESP	ISR-GBR
AUS-NZL	CAN-CHL	CHL-ARG	CHN-IDN	DEU-CZE	DNK-FIN	ESP-HUN	EST-MEX	FIN-PRT	FRA-SWE	GRC-CHE	HUN-DNK	IRL-EST	ISR-GRC
AUS-USA	CAN-ISR	CHL-AUT	CZE-AUT	DEU-DNK	DNK-FRA	ESP-IRL	EST-NLD	FIN-ROM	FRA-TUR	GRC-CHL	HUN-ESP	IRL-FIN	ISR-HUN
AUT-CHE	CAN-MEX	CHL-BRA	CZE-CHE	DEU-ESP	DNK-GBR	ESP-ISR	EST-NOR	FIN-SVK	FRA-ZAF	GRC-CZE	HUN-EST	IRL-FRA	ISR-IRL
AUT-CHL	CAN-USA	CHL-CAN	CZE-CHL	DEU-EST	DNK-GRC	ESP-ITA	EST-POL	FIN-SVN	GBR-AUT	GRC-DEU	HUN-FIN	IRL-GBR	ISR-ITA
AUT-CZE	CHE-AUT	CHL-CHE	CZE-DEU	DEU-FIN	DNK-HUN	ESP-MEX	EST-PRT	FIN-SWE	GBR-CHE	GRC-DNK	HUN-FRA	IRL-GRC	ISR-MEX
AUT-DEU	CHE-CHL	CHL-CHN	CZE-DNK	DEU-FRA	DNK-IRL	ESP-NLD	EST-ROM	FIN-TUR	GBR-CHL	GRC-ESP	HUN-GBR	IRL-HUN	ISR-NLD
AUT-DNK	CHE-CZE	CHL-CZE	CZE-ESP	DEU-GBR	DNK-ISR	ESP-NOR	EST-SVK	FIN-ZAF	GBR-CZE	GRC-EST	HUN-GRC	IRL-ISR	ISR-NOR
AUT-ESP	CHE-DEU	CHL-DEU	CZE-EST	DEU-GRC	DNK-ITA	ESP-POL	EST-SVN	FRA-AUT	GBR-DEU	GRC-FIN	HUN-IRL	IRL-ITA	ISR-POL
AUT-EST	CHE-DNK	CHL-DNK	CZE-FIN	DEU-HUN	DNK-MEX	ESP-PRT	EST-SWE	FRA-CHE	GBR-DNK	GRC-FRA	HUN-ISR	IRL-MEX	ISR-PRT
AUT-FIN	CHE-ESP	CHL-ESP	CZE-FRA	DEU-IRL	DNK-NLD	ESP-ROM	EST-TUR	FRA-CHL	GBR-ESP	GRC-GBR	HUN-ITA	IRL-NLD	ISR-ROM
AUT-FRA	CHE-EST	CHL-EST	CZE-GBR	DEU-ISR	DNK-NOR	ESP-SVK	EST-ZAF	FRA-CZE	GBR-EST	GRC-HUN	HUN-MEX	IRL-NOR	ISR-SVK
AUT-GBR	CHE-FIN	CHL-FIN	CZE-GRC	DEU-ITA	DNK-POL	ESP-SVN	FIN-AUT	FRA-DEU	GBR-FIN	GRC-IRL	HUN-NLD	IRL-POL	ISR-SVN
AUT-GRC	CHE-FRA	CHL-FRA	CZE-HUN	DEU-MEX	DNK-PRT	ESP-SWE	FIN-CHE	FRA-DNK	GBR-FRA	GRC-ISR	HUN-NOR	IRL-PRT	ISR-SWE
AUT-HUN	CHE-GBR	CHL-GBR	CZE-IRL	DEU-NLD	DNK-ROM	ESP-TUR	FIN-CHL	FRA-ESP	GBR-GRC	GRC-ITA	HUN-POL	IRL-ROM	ISR-TUR
AUT-IRL	CHE-GRC	CHL-GRC	CZE-ISR	DEU-NOR	DNK-SVK	ESP-ZAF	FIN-CZE	FRA-EST	GBR-HUN	GRC-MEX	HUN-PRT	IRL-SVK	ISR-USA
AUT-ISR	CHE-HUN	CHL-HUN	CZE-ITA	DEU-POL	DNK-SVN	EST-AUT	FIN-DEU	FRA-FIN	GBR-IRL	GRC-NLD	HUN-ROM	IRL-SVN	ITA-AUT
AUT-ITA	CHE-IRL	CHL-IRL	CZE-MEX	DEU-PRT	DNK-SWE	EST-CHE	FIN-DNK	FRA-GBR	GBR-ISR	GRC-NOR	HUN-SVK	IRL-SWE	ITA-CHE
AUT-MEX	CHE-ISR	CHL-ITA	CZE-NLD	DEU-ROM	DNK-TUR	EST-CHL	FIN-ESP	FRA-GRC	GBR-ITA	GRC-POL	HUN-SVN	IRL-TUR	ITA-CHL
AUT-NLD	CHE-ITA	CHL-JPN	CZE-NOR	DEU-SVK	DNK-ZAF	EST-CZE	FIN-EST	FRA-HUN	GBR-MEX	GRC-PRT	HUN-SWE	IRL-ZAF	ITA-CZE
AUT-NOR	CHE-KOR	CHL-KOR	CZE-POL	DEU-SVN	ESP-AUT	EST-DEU	FIN-FRA	FRA-IRL	GBR-NLD	GRC-ROM	HUN-TUR	ISR-AUT	ITA-DEU
AUT-POL	CHE-MEX	CHL-MEX	CZE-PRT	DEU-SWE	ESP-CHE	EST-DNK	FIN-GBR	FRA-ISR	GBR-NOR	GRC-SVK	HUN-ZAF	ISR-CAN	ITA-DNK
AUT-PRT	CHE-NLD	CHL-NLD	CZE-ROM	DEU-TUR	ESP-CHL	EST-ESP	FIN-GRC	FRA-ITA	GBR-POL	GRC-SVN	IDN-CHN	ISR-CHE	ITA-ESP
AUT-ROM	CHE-NOR	CHL-NOR	CZE-SVK	DEU-ZAF	ESP-CZE	EST-FIN	FIN-HUN	FRA-MEX	GBR-PRT	GRC-SWE	IDN-JPN	ISR-CZE	ITA-EST
AUT-SVK	CHE-POL	CHL-POL	CZE-SVN	DNK-AUT	ESP-DEU	EST-FRA	FIN-IRL	FRA-NLD	GBR-ROM	GRC-TUR	IRL-AUT	ISR-DEU	ITA-FIN
AUT-SVN	CHE-PRT	CHL-PRT	CZE-SWE	DNK-CHE	ESP-DNK	EST-GBR	FIN-ISR	FRA-NOR	GBR-SVK	GRC-ZAF	IRL-CHE	ISR-DNK	ITA-FRA
AUT-SWE	CHE-ROM	CHL-SVK	CZE-TUR	DNK-CHL	ESP-EST	EST-GRC	FIN-ITA	FRA-POL	GBR-SVN	HUN-AUT	IRL-CHL	ISR-ESP	ITA-GBR
AUT-TUR	CHE-SVK	CHL-SVN	CZE-ZAF	DNK-CZE	ESP-FIN	EST-HUN	FIN-MEX	FRA-PRT	GBR-SWE	HUN-CHE	IRL-CZE	ISR-EST	ITA-GRC
AUT-ZAF	CHE-SVN	CHL-SWE	DEU-AUT	DNK-DEU	ESP-FRA	EST-IRL	FIN-NLD	FRA-ROM	GBR-TUR	HUN-CHL	IRL-DEU	ISR-FIN	ITA-HUN

Table A2.1: Agreements in Sample in 2008 (cont)

ITA-IRL	MEX-GBR	NLD-ITA	NOR-POL	POL-SVN	ROM-AUT	SVK-EST	SVN-GRC	SWE-ITA	TUR-ROM
ITA-ISR	MEX-GRC	NLD-MEX	NOR-PRT	POL-SWE	ROM-CHE	SVK-FIN	SVN-HUN	SWE-MEX	TUR-SVK
ITA-MEX	MEX-HUN	NLD-NOR	NOR-ROM	POL-TUR	ROM-CZE	SVK-FRA	SVN-IRL	SWE-NLD	TUR-SVN
ITA-NLD	MEX-IRL	NLD-POL	NOR-SVK	POL-ZAF	ROM-DEU	SVK-GBR	SVN-ISR	SWE-NOR	TUR-SWE
ITA-NOR	MEX-ISR	NLD-PRT	NOR-SVN	PRT-AUT	ROM-DNK	SVK-GRC	SVN-ITA	SWE-POL	USA-AUS
ITA-POL	MEX-ITA	NLD-ROM	NOR-SWE	PRT-CHE	ROM-ESP	SVK-HUN	SVN-MEX	SWE-PRT	USA-CAN
ITA-PRT	MEX-JPN	NLD-SVK	NOR-TUR	PRT-CHL	ROM-EST	SVK-IRL	SVN-NLD	SWE-ROM	USA-CHL
ITA-ROM	MEX-NLD	NLD-SVN	NZL-AUS	PRT-CZE	ROM-FIN	SVK-ISR	SVN-NOR	SWE-SVK	USA-ISR
ITA-SVK	MEX-NOR	NLD-SWE	POL-AUT	PRT-DEU	ROM-FRA	SVK-ITA	SVN-POL	SWE-SVN	USA-MEX
ITA-SVN	MEX-POL	NLD-TUR	POL-CHE	PRT-DNK	ROM-GBR	SVK-MEX	SVN-PRT	SWE-TUR	ZAF-AUT
ITA-SWE	MEX-PRT	NLD-ZAF	POL-CHL	PRT-ESP	ROM-GRC	SVK-NLD	SVN-ROM	SWE-ZAF	ZAF-CZE
ITA-TUR	MEX-SVK	NOR-AUT	POL-CZE	PRT-EST	ROM-HUN	SVK-NOR	SVN-SVK	TUR-AUT	ZAF-DEU
ITA-ZAF	MEX-SVN	NOR-CHE	POL-DEU	PRT-FIN	ROM-IRL	SVK-POL	SVN-SWE	TUR-CHE	ZAF-DNK
JPN-CHL	MEX-SWE	NOR-CHL	POL-DNK	PRT-FRA	ROM-ISR	SVK-PRT	SVN-TUR	TUR-CZE	ZAF-ESP
JPN-IDN	MEX-USA	NOR-CZE	POL-ESP	PRT-GBR	ROM-ITA	SVK-ROM	SVN-ZAF	TUR-DEU	ZAF-EST
JPN-MEX	NLD-AUT	NOR-DEU	POL-EST	PRT-GRC	ROM-NLD	SVK-SVN	SWE-AUT	TUR-DNK	ZAF-FIN
KOR-CHE	NLD-CHE	NOR-DNK	POL-FIN	PRT-HUN	ROM-NOR	SVK-SWE	SWE-CHE	TUR-ESP	ZAF-FRA
KOR-CHL	NLD-CHL	NOR-ESP	POL-FRA	PRT-IRL	ROM-POL	SVK-TUR	SWE-CHL	TUR-EST	ZAF-GBR
KOR-NOR	NLD-CZE	NOR-EST	POL-GBR	PRT-ISR	ROM-PRT	SVK-ZAF	SWE-CZE	TUR-FIN	ZAF-GRC
MEX-AUT	NLD-DEU	NOR-FIN	POL-GRC	PRT-ITA	ROM-SVK	SVN-AUT	SWE-DEU	TUR-FRA	ZAF-HUN
MEX-CAN	NLD-DNK	NOR-FRA	POL-HUN	PRT-MEX	ROM-SVN	SVN-CHE	SWE-DNK	TUR-GBR	ZAF-IRL
MEX-CHE	NLD-ESP	NOR-GBR	POL-IRL	PRT-NLD	ROM-SWE	SVN-CHL	SWE-ESP	TUR-GRC	ZAF-ITA
MEX-CHL	NLD-EST	NOR-GRC	POL-ISR	PRT-NOR	ROM-TUR	SVN-CZE	SWE-EST	TUR-HUN	ZAF-NLD
MEX-CZE	NLD-FIN	NOR-HUN	POL-ITA	PRT-POL	SVK-AUT	SVN-DEU	SWE-FIN	TUR-IRL	ZAF-POL
MEX-DEU	NLD-FRA	NOR-IRL	POL-MEX	PRT-ROM	SVK-CHE	SVN-DNK	SWE-FRA	TUR-ISR	ZAF-PRT
MEX-DNK	NLD-GBR	NOR-ISR	POL-NLD	PRT-SVK	SVK-CHL	SVN-ESP	SWE-GBR	TUR-ITA	ZAF-SVK
MEX-ESP	NLD-GRC	NOR-ITA	POL-NOR	PRT-SVN	SVK-CZE	SVN-EST	SWE-GRC	TUR-NLD	ZAF-SVN
MEX-EST	NLD-HUN	NOR-KOR	POL-PRT	PRT-SWE	SVK-DEU	SVN-FIN	SWE-HUN	TUR-NOR	ZAF-SWE
MEX-FIN	NLD-IRL	NOR-MEX	POL-ROM	PRT-TUR	SVK-DNK	SVN-FRA	SWE-IRL	TUR-POL	
MEX-FRA	NLD-ISR	NOR-NLD	POL-SVK	PRT-ZAF	SVK-ESP	SVN-GBR	SWE-ISR	TUR-PRT	

Table A2.2: Descriptive stats of variables

Variable		Mean	Std. Dev.	Min	Max	Observations
gdp_o	overall	8.47E+11	1.74E+12	5.68E+09	1.17E+13	N = 20748
	between		1.72E+12	8.78E+09	1.01E+13	n = 1482
	within		3.07E+11	-1.21E+12	3.24E+12	T = 14
gdpcap_o	overall	18345.4	14111.63	449.2205	65065.73	N = 20748
	between		13293.71	541.9631	48210.3	n = 1482
	within		4746.177	7363.714	57828.14	T = 14
rta	overall	0.385965	0.486834	0	1	N = 20748
	between		0.438271	0	1	n = 1482
	within		0.212241	-0.54261	1.314536	T = 14
lnimports	overall	13.02743	2.188095	0.275356	19.6913	N = 20669
	between		2.105007	4.76718	19.23532	n = 1482
	within		0.623321	8.535602	16.38206	T-bar = 13.9467
lnintimps_tot	overall	5.507109	2.168155	-7.30772	12.11262	N = 20669
	between		2.105339	-3.14625	11.7615	n = 1482
	within		0.546298	1.03493	9.235838	T-bar = 13.9467
lnintimps_bvs	overall	5.022131	2.327805	-9.13527	11.2558	N = 20669
	between		2.099616	-4.33347	10.76319	n = 1482
	within		1.021737	-2.13908	9.519779	T-bar = 13.9467
lnintimps_bvsbil	overall	-0.16405	3.735303	-19.0436	11.27024	N = 20590
	between		3.560454	-12.5373	10.70017	n = 1482
	within		1.180842	-7.98824	5.579733	T-bar = 13.8934
bvs_bil	overall	0.010385	0.027173	0	0.493401	N = 20748
	between		0.024175	3.29E-06	0.301734	n = 1482
	within		0.012422	-0.226	0.347093	T = 14
vs1_bil	overall	0.009767	0.027427	0	0.653405	N = 20748
	between		0.024767	7.51E-06	0.384454	n = 1482
	within		0.0118	-0.29576	0.278718	T = 14
tvs_bil	overall	0.01999	0.039551	0	0.662952	N = 20748
	between		0.03521	3.47E-05	0.394959	n = 1482
	within		0.018037	-0.28627	0.377034	T = 14
lndist	overall	8.351051	1.111235	4.087945	9.88258	N = 20748
	between		1.111583	4.087945	9.88258	n = 1482
	within		0	8.351051	8.351051	T = 14
fk	overall	0.24458	0.103939	0.036093	0.635668	N = 20672
	between		0.100973	0.047272	0.614871	n = 1482
	within		0.024973	0.091334	0.370834	T-bar = 13.9487
ov_o (gross output)	overall	1598452	3243938	11806.67	2.18E+07	N = 20748
	between		3137179	18741.2	1.83E+07	n = 1482
	within		829102.4	-2450593	1.01E+07	T = 14
va_o (value added)	overall	799475.6	1720307	4674.632	1.17E+07	N = 20748
	between		1667872	7456.221	9831393	n = 1482
	within		423558.3	-1401713	5726734	T = 14

A2.4. Exogeneity of the FTA variable

To test that the particular set of FE that have been used control for unobserved heterogeneity Baier and Bergstrand (2007) suggest using a future FTA variable arguing that future FTAs should not affect current trade flows. If this variable is uncorrelated with current trade flows then appropriate controls have been provided for the unobserved heterogeneity. However, given the variance of the FTA variable in the sample, it is probable that such a test will not be conclusive if carried out on the full sample. The reason is that the correlation coefficient between the FTA and an FTA+5 variable is high (0.72). This implies that even if unobserved heterogeneity has been controlled for, a test on the full sample will not capture this because the FTA+5 will be effectively acting like the FTA variable. The table below shows the results obtained from carrying out this test on the full sample. Here it is seen that the FTA+5 is significant throughout. This does not mean that the set of FE does not control for the endogenous formation of FTAs, but rather that the test is an inappropriate one owing to the correlation between the FTA and the FTA+5 variables.

Table A2.3: Exogeneity test on full sample

	(1)	(2)	(3)	(4)
Dep var: lnimports	OLS	FE1	FE2	FE3
lncombgdp	0.918***	1.024***	1.008***	1.125***
	(0.00486)	(0.0271)	(0.0497)	(0.0528)
lndist	-0.784***		-1.172***	-1.180***
	(0.0123)		(0.0476)	(0.0159)
contig	0.646***		0.336**	0.334***
	(0.0618)		(0.152)	(0.0457)
comlang_off	0.699***		0.671***	0.675***
	(0.0321)		(0.0946)	(0.0270)
fta	0.170***	0.0778***	0.0880*	0.113**
	(0.0348)	(0.0301)	(0.0469)	(0.0462)
fta+5	0.187***	0.212***	0.291***	0.257***
	(0.0314)	(0.0568)	(0.0964)	(0.0411)
lngdpcap_d	-1.285***	1.168***	1.223***	2.393***
	(0.100)	(0.206)	(0.157)	(0.895)
lngdpcap_d2	0.0673***	-0.127***	-0.130***	-0.141***
	(0.00575)	(0.0115)	(0.00906)	(0.0527)
lnfk	-0.0335	0.214***	-0.105	-0.149***
	(0.0216)	(0.0776)	(0.131)	(0.0402)
Constant	-23.19***	-41.29***	-31.27***	-46.91***
	(0.548)	(1.489)	(2.128)	(5.243)
Observations	15,143	15,143	15,143	15,143
R-squared	0.772	0.529	0.835	0.843
r2_o	.	0.493	0.859	0.811
r2_w	.	0.529	0.835	0.843
r2_b	.	0.495	0.925	0.823
Number of repart		1,090		
Number of repyear				545
Number of rep			39	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In the essay, it is suggested that the test be carried out on a subsample of countries where the FTA variable exhibits some variance. What is done is that all agreements that do not vary in the sample are removed, hence if the FTA variable was equal to 1 between a dyad throughout the entire sample, the dyad was dropped. Such a selection is indeed problematic because it is possible that common factors that are unobserved explain why countries do not engage in an FTA till the mid 90's. However this selection affords us to test whether the endogenous formation of trade agreements has been controlled for. The table bellow shows the correlation coefficient between the FTA variable and its future lags in the sumsample. Here it is patent that the correlation coefficients are lower that those reported in Table 4.

Table A2.4: Correaltion Coefficient betwee FTA and future lags in reduced sample

	rta	rtaplus3	rtaplus4	rtaplus5	rtaplus6	rtaplus7
rta	1.0000					
rtaplus3	0.6449	1.0000				
rtaplus4	0.5444	0.8442	1.0000			
rtaplus5	0.4499	0.6977	0.8265	1.0000		
rtaplus6	0.3714	0.5759	0.6822	0.8255	1.0000	
rtaplus7	0.2961	0.4591	0.5438	0.6580	0.7972	1.0000

When the test is performed on this subsample, it is shown that the FTA+5 loses significance only when the country-year FE are used which supports the hypothesis that these provide appropriate controls for unobserved heterogeneity.

The table below then carries out a robustness check on different forward lags of the FTA coefficient on the subsample of countries showing that when the interacted country-year fixed effects are used, most lags of future FTA remain insignificant.

Table A2.5. Robustness check on different FTA forward lags

VARIABLES	(1) lnimports	(2) lnimports	(3) lnimports	(4) lnimports	(5) lnimports
lncombgdp	0.816***	0.815***	0.815***	0.811***	0.815***
	(0.0829)	(0.0817)	(0.0814)	(0.0811)	(0.0816)
lndist	-1.415***	-1.416***	-1.415***	-1.414***	-1.415***
	(0.0367)	(0.0367)	(0.0365)	(0.0363)	(0.0362)
contig	0.233***	0.233***	0.233***	0.233***	0.233***
	(0.0657)	(0.0657)	(0.0656)	(0.0655)	(0.0656)
comlang_off	0.842***	0.842***	0.841***	0.841***	0.842***
	(0.0427)	(0.0427)	(0.0425)	(0.0426)	(0.0427)
lngdpcap_d2	-0.00763	-0.00763	-0.00751	-0.00624	-0.00757
	(0.00649)	(0.00650)	(0.00660)	(0.00708)	(0.00687)
lnfk	0.284***	0.285***	0.284***	0.282***	0.283***
	(0.0648)	(0.0649)	(0.0651)	(0.0647)	(0.0646)
fta	0.222***	0.225***	0.224***	0.222***	0.225***
	(0.0739)	(0.0704)	(0.0681)	(0.0677)	(0.0678)
ftaplus3	0.0134				
	(0.0816)				
ftaplus4		0.00178			
		(0.0754)			
ftaplus5			0.0183		
			(0.0777)		
ftaplus6				0.0559	
				(0.0916)	
ftaplus7					0.0385
					(0.104)
Constant	-17.10***	-17.04***	-17.11***	-17.07***	-17.11***
	(4.179)	(4.127)	(4.094)	(4.062)	(4.086)
Observations	4,550	4,550	4,550	4,550	4,550
R-squared	0.864	0.864	0.864	0.864	0.864
Number of repyear	504	504	504	504	504
r2_o	0.763	0.762	0.765	0.763	0.762
r2_w	0.864	0.864	0.864	0.864	0.864
r2_b	0.669	0.669	0.673	0.668	0.668

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The tables below shows the outcomes of the test for controls of unobserved heterogeneity when the dependent variable is intermediate goods trade. This is performed for the full sample first (Table A.4.4) and for the reduced sample (Table A.4.5). In the tables the dependent variables for the different estimations are as follows:

(1) intermediate goods identified using BEC
(2) intermediate goods identified using IO tables (total use)
(3) intermediate goods used in the production of total exports (bvs)
(4) intermediate goods used in the production of exports to the same destination as these originated from (bvsbil)

Table A2.6: Test for exogeneity of FTA coefficient in the case of intermediate goods on full sample

	(1)	(2)	(3)	(4)
lncombgdp	1.169***	1.098***	1.104***	1.925***
	(0.055)	(0.060)	(0.062)	(0.089)
lndist	-1.151***	-1.205***	-1.216***	-2.422***
	(0.018)	(0.016)	(0.017)	(0.037)
contig	0.334***	0.352***	0.298***	0.588***
	(0.048)	(0.047)	(0.045)	(0.077)
comlang_~f	0.641***	0.640***	0.671***	1.297***
	(0.026)	(0.029)	(0.032)	(0.044)
rta	0.085*	0.097**	0.121**	0.207***
	(0.049)	(0.048)	(0.051)	(0.069)
rtaplus5	0.257***	0.273***	0.324***	0.543***
	(0.044)	(0.044)	(0.050)	(0.062)
lngdpcap_d	3.086***	1.705*	1.666*	2.829*
	(0.805)	(0.941)	(0.954)	(1.574)
lngd~ap_d2	-0.182***	-0.100*	-0.098*	-0.160*
	(0.047)	(0.055)	(0.056)	(0.093)
lnfk	-0.023	-0.064	-0.161***	0.027
	(0.044)	(0.044)	(0.053)	(0.067)
_cons	-52.378***	-49.846***	-50.620***	-94.547***
	(4.963)	(5.717)	(5.883)	(8.997)
N	15136	15143	15143	15102
R-sq	0.831	0.828	0.814	0.873

Standard errors in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Table A2.7: Test for exogeneity of FTA coefficient in the case of intermediate goods on reduced sample

	(1)	(2)	(3)	(4)
lncombgdp	1.002***	0.815***	0.836***	1.244***
	(0.144)	(0.088)	(0.115)	(0.240)
lndist	-1.447***	-1.448***	-1.437***	-2.884***
	(0.031)	(0.037)	(0.038)	(0.054)
contig	0.200***	0.284***	0.221***	0.270**
	(0.067)	(0.067)	(0.072)	(0.114)
comlang_~f	0.809***	0.810***	0.880***	1.653***
	(0.045)	(0.045)	(0.051)	(0.066)
rta	0.109	0.208***	0.206***	0.415***
	(0.068)	(0.070)	(0.071)	(0.111)
rtaplus5	-0.059	0.033	0.023	0.084
	(0.092)	(0.085)	(0.089)	(0.144)
lngdpcap_d	.	.	.	.
	.	.	.	.
lngd~ap_d2	-0.003	-0.009	-0.006	0.026
	(0.007)	(0.007)	(0.010)	(0.023)
lnfk	0.452***	0.375***	0.334***	0.865***
	(0.079)	(0.068)	(0.080)	(0.118)
_cons	-27.426***	-24.035***	-25.942***	-41.992***
	(7.369)	(4.424)	(5.752)	(11.726)
N	4546	4550	4550	4536
R-sq	0.827	0.849	0.823	0.889

Standard errors in parentheses
* p<0.1, ** p<0.05, *** p<0.01

The results are similar in nature to those obtained from the total trade specification.

A2.5: Results

A2.5.1: The choice of a FE model

The use of a FE model over a RE one is preferred on conceptual grounds because it is desirable that there the unobservables are allowed to be correlated with the dependent variables. It is also justified through a Hausman Test performed on the basis of equation (20):

```
                 b = consistent under Ho and Ha; obtained from xtreg
          B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(59) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                           =     1213.52
                 Prob>chi2 =      0.0000
                 (V_b-V_B is not positive definite)
```

A2.5.2 The impact of varieties

The table below shows the results for the estimation of (2.19) and (2.20). This exercise is interesting from the perspective of understanding how varieties and preferences affect the FTA coefficient. What emerges relatively consistently is that the estimates for the FTA coefficient seem to bias upwards when these are not included. This suggest that perhaps when one does not include these important independent variables, the FTA coefficient is capturing the variety and preference effects suggesting that countries which trade more varieties and whose trading structure is preferred trade more with each other and are also likely to engage in an FTA.

Table A2.8: Impact of varieties on trade flows

	Dep var: lnimports (no variety or pref)				Dep var: lnimports (with variety and pref)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS	**FE1**	**FE 2**	**FE 3**	**OLS**	**FE1**	**FE 2**	**FE 3**
VARIABLES		(repart)	(rep. Par, year)	(repyear, paryear)		(repart)	(rep. Par, year)	(repyear, paryear)
lncombgdp	0.897***	0.488***	0.488***	0.924***	0.890***	1.014***	1.003***	1.060***
	(0.00347)	(0.0313)	(0.110)	(0.0358)	(0.00407)	(0.0244)	(0.0466)	(0.0329)
lndist	-0.776***		-1.062***	-1.063***	-0.761***		-1.063***	-1.065***
	(0.00930)		(0.0569)	(0.0178)	(0.00982)		(0.0544)	(0.0171)
contig	0.592***		0.245**	0.245***	0.576***		0.244**	0.246***
	(0.0343)		(0.111)	(0.0309)	(0.0340)		(0.111)	(0.0316)
comlang_off	0.646***		0.566***	0.566***	0.647***		0.564***	0.567***
	(0.0277)		(0.0981)	(0.0274)	(0.0274)		(0.0984)	(0.0276)
rta	0.195***	0.114***	0.242***	0.238***	0.254***	0.104***	0.234***	0.240***
	(0.0195)	(0.0361)	(0.0664)	(0.0334)	(0.0196)	(0.0322)	(0.0676)	(0.0331)
lngdpcap_d					-1.289***	1.215***	1.200***	1.187***
					(0.0841)	(0.183)	(0.145)	(0.386)
lngdpcap_d2					0.0676***	-0.129***	-0.128***	-0.0881***
					(0.00478)	(0.0102)	(0.00859)	(0.0218)
lnfk					0.0920***	0.254***	0.00318	-0.0340
					(0.0180)	(0.0663)	(0.135)	(0.0411)
Constant	-28.09***	-13.14***	-3.991	-27.45***	-21.69***	-40.39***	-31.84***	-37.84***
	(0.193)	(1.649)	(5.647)	(1.929)	(0.466)	(1.333)	(2.107)	(2.851)
Observations	20,669	20,669	20,669	20,669	20,631	20,631	20,631	20,631
R-squared	0.795	0.377	0.820	0.842	0.801	0.540	0.836	0.843
r2_o	.	0.611	0.781	0.857	.	0.388	0.867	0.809
r2_w	.	0.377	0.820	0.842	.	0.540	0.836	0.843
r2_b	.	0.641	0.713	0.897	.	0.383	0.951	0.799

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

A2.5.3. Regression with net flow of intermediate goods

The net flow of intermediate goods is constructed by removing the domestic content of imported intermediates from a particular location. This is achieved by multiplying the measure intimps_bvsbil by one minus the average share of the domestic content of intermediate imports from the originating country (VS1). The results show very similar coefficients and hence imply that 'double counting' concerns may be unfounded.

Table A2.9: Impact of an FTA on gross and net flows of intermediate goods

VARIABLES	lnintimps_bvsbil	lnnetintimps_bvsbil
lnmass	1.919***	1.920***
	(0.0420)	(0.0418)
lndist	-2.176***	-2.166***
	(0.0373)	(0.0374)
contig	0.413***	0.393***
	(0.0581)	(0.0579)
comlang_off	1.082***	1.080***
	(0.0514)	(0.0513)
lngdpcap_d	1.302**	1.287**
	(0.600)	(0.600)
lngdpcap_d2	-0.0874**	-0.0863**
	(0.0341)	(0.0340)
lnfk	0.217***	0.217***
	(0.0717)	(0.0716)
rta	0.503***	0.497***
	(0.0682)	(0.0679)
Constant	-46.45***	-46.67***
	(3.253)	(3.268)
Observations	20,590	20,590
R-squared	0.870	0.870
Number of repyear	545	545
r2_o	0.763	0.734
r2_w	0.870	0.870
r2_b	0.696	0.627

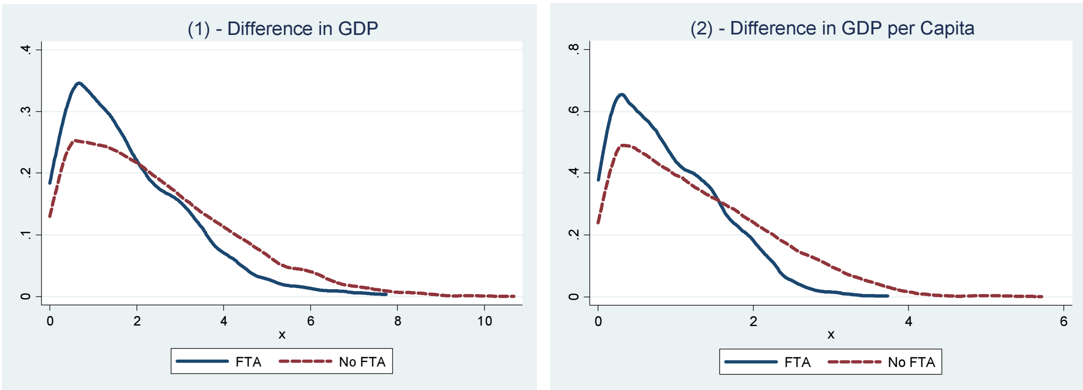
Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Appendix A3

A3.1. Characteristics of FTA partners

The figures presented in the body of the text show the characteristics of FTA partners in the year that an agreement enters into force. However Baier and Bergstrand (2004) use a baseline year of 1960 in their analysis so as to avoid any possible endogeneity arising from the correlation of trade agreements and measures of economic mass. The figure below shows that the results are qualitatively the same when this is replicated in the entire sample for the baseline year 1960.

Figure A3.1: Characteristics of FTA partners – Economic Mass and Income (1960)

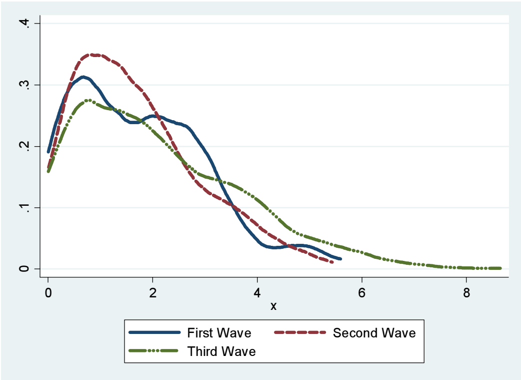


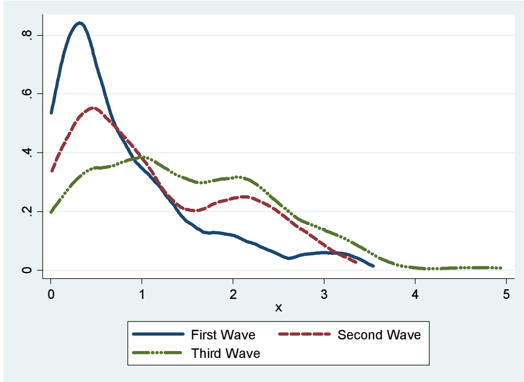
Source: Calculations from CEPII's gravity database, economic data for 1960. FTA is identified if dyad shares an agreement in 2006

Note: Difference in GDP is defined as the absolute difference in the logs of the GDPs of the dyad countries. GDP per Capita difference is also the absolute difference in the log of the GDP per capita of the dyad countries.

The analysis of the different waves of regionalism was also carried out using a baseline year of 1960. The figure below shows that using different years, such as the year of the beginning of the agreement, produces similar results.

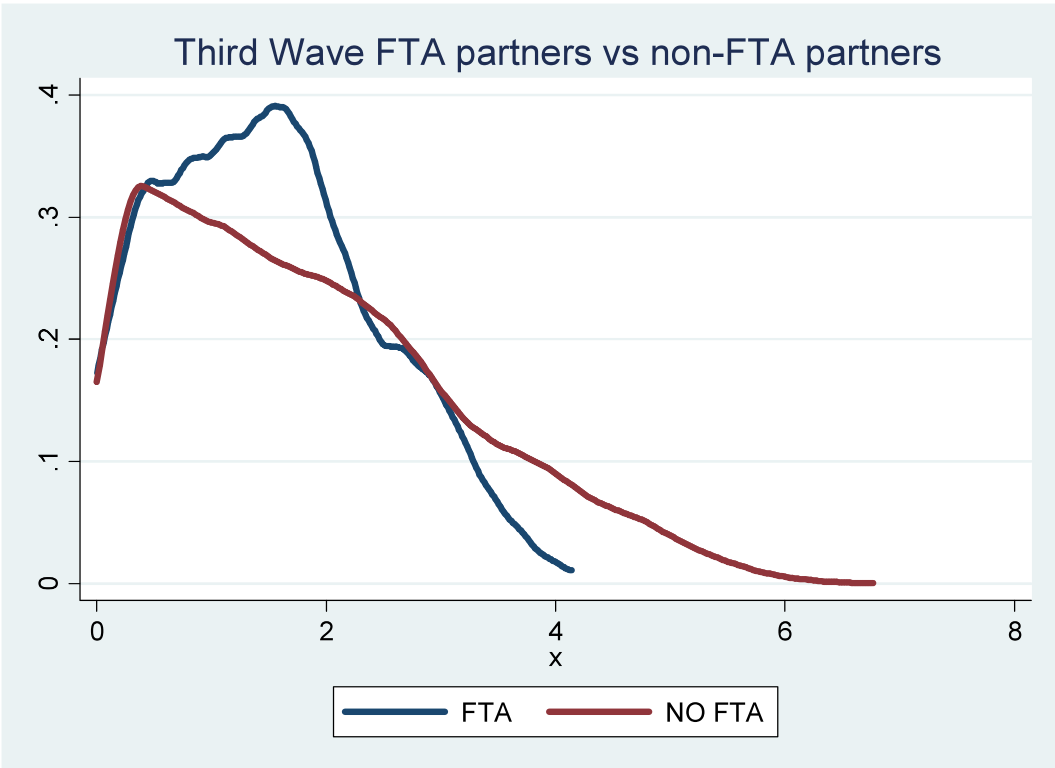
Figure A3.2: Economic mass and Income differences between FTA partners across the different waves of regionalism – values at 1960





Source: Calculations from CEPII's gravity database, data from 1960. First Wave identifies countries that signed a trade agreement between 1960 and 1984. The Second wave requires there to be a new agreement between 1985 and 1994 whilst the third captures new agreements signed between 1995 and 2006. Differences in economic mass are measures through the absolute difference in the logs of the GDPs of the dyads.

Figure A3.3: Characteristics of third wave FTA partners versus non FTA partners (2006).



Source: Calculations from CEPII's gravity database, data from 2006. Bold blue line identifies dyads that have signed an FTA during the third wave. Bold red line identifies dyads that have never signed an FTA.

A3.2: DATABASE SUMMARY STATISTICS

Table A3.1. Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
FTA	20748	0.3869289	0.4870589	0	1
newFTA	20748	0.219973	0.414238	0	1
NATURAL	20748	-8.351051	1.111235	-9.88258	-4.08795
REMOTE	20748	3.338295	4.165442	0	9.604952
RGDP	20748	52.8258	2.021133	46.16747	59.39784
RGDPsim	20748	-1.467634	0.904541	-6.77196	-0.69315
DGDPCAP	20748	1.28893	1.039722	0.00028	4.564457
SQDGDPCAP	20748	2.74231	3.832856	7.86E-08	20.83427
DGDPcapROW	20748	1.136153	0.5189738	0.008495	3.539416
minVoice_acc	20748	0.512327	0.7684196	-1.71874	1.814402
minRol	20748	0.4483433	0.8043411	-1.11595	1.939776
minPol_stab	20748	0.0872928	0.8104919	-2.03537	1.454821
minGov_eff	20748	0.5807846	0.7210308	-0.83264	2.142508
minreg_qual	20748	0.5643998	0.6559972	-1.07531	1.880103
Lnimports	20710	6.05769	2.190186	-6.583224	12.58039
Lnintimp_BEC	20710	5.587141	2.224157	-5.979344	11.96324
Lnintimp_BVS	20590	6.743704	3.724486	-19.04363	11.27024
VSWLD	20710	0.3170656	0.1371201	0.002995	0.816159
countFTA	20748	14.31637	10.3769	0	29
countFTArow	20748	7.19785	7.462788	0	29
wexpFTA	20710	-.1631003	0.3444812	0	0.984415
wbvsFTA	20710	0.6464864	0.3748953	0	0.998597

Table A3.2. Summary statistics (panel)

Variable		Mean	Std. Dev.	Min	Max	Observations
FTA	overall	0.386929	0.487059	0	1	N = 20748
	between		0.439228	0	1	n = 1482
	within		0.210776	-0.54164	1.3155	T = 14
newfta	overall	0.219973	0.414238	0	1	N = 20748
	between		0.414368	0	1	n = 1482
	within		0	0.219973	0.219973	T = 14
NATURAL	overall	-8.35105	1.111235	-9.88258	-4.08795	N = 20748
	between		1.111583	-9.88258	-4.08795	n = 1482
	within		0	-8.35105	-8.35105	T = 14
REMOTE	overall	3.338295	4.165442	0	9.604952	N = 20748
	between		4.166747	0	9.604952	n = 1482
	within		0	3.338295	3.338295	T = 14
RGDP	overall	52.8258	2.021133	46.16747	59.39784	N = 20748
	between		1.949821	46.80285	59.0728	n = 1482
	within		0.534376	51.02711	57.06868	T = 14
RGDPsim	overall	-1.46763	0.904541	-6.77196	-0.69315	N = 20748
	between		0.873368	-6.40778	-0.69474	n = 1482
	within		0.236432	-3.79728	0.633898	T = 14
DGDPCAP	overall	1.28893	1.039722	0.00028	4.564457	N = 20748
	between		0.971241	0.007903	4.488735	n = 1482
	within		0.37189	-0.99263	4.22026	T = 14
SQDGDPCAP	overall	2.74231	3.832856	7.86E-08	20.83427	N = 20748
	between		3.590383	0.000101	20.1511	n = 1482
	within		1.344624	-5.45585	17.6888	T = 14
DGDPcapRoW	overall	1.136153	0.518974	0.008495	3.539416	N = 20748
	between		0.488523	0.183032	3.098337	n = 1482
	within		0.175582	0.119586	1.844044	T = 14
minVoi_acc	overall	0.512327	0.76842	-1.71874	1.814402	N = 20748
	between		0.753621	-1.528	1.546162	n = 1482
	within		0.151259	-0.12505	0.90208	T = 14
minRol	overall	0.448343	0.804341	-1.11595	1.939776	N = 20748
	between		0.79111	-0.90716	1.863745	n = 1482
	within		0.146634	-0.20901	1.028451	T = 14
minPol_stab	overall	0.087293	0.810492	-2.03537	1.454821	N = 20748
	between		0.771615	-1.50497	1.270505	n = 1482
	within		0.248759	-0.96202	0.803981	T = 14
minGov_eff	overall	0.580785	0.721031	-0.83264	2.142508	N = 20748
	between		0.697832	-0.55685	2.011447	n = 1482
	within		0.182266	-0.03533	1.168117	T = 14
Minreg_qual	overall	0.5644	0.655997	-1.07531	1.880103	N = 20748
	between		0.614247	-0.71344	1.647874	n = 1482
	within		0.230802	-0.29259	1.61287	T = 14

lnIMPORTS	overall	6.05769	2.190186	-6.583224	12.58039	N = 20710
	between		2.116098	-1.895212	12.28444	n = 1482
	within		.5626767	-.0781112	10.10082	T-bar = 13.9744
lnINTIMPS_BEC	overall	5.587141	2.224157	-5.979344	11.96324	N = 20710
	between		2.146415	-2.159427	11.66313	n = 1482
	within		.5818033	-.8450785	10.10569	T-bar = 13.9744
lnINTIMPS_BVS	overall	-.1631003	3.724486	-12.13587	11.27024	N = 20710
	between		3.516845	-5.62951	10.70017	n = 1482
	within		1.225842	-1.08048	10.58313	T-bar = 13.9744
bvswld_o	overall	0.317066	0.13712	0.002995	0.816159	N = 20710
	between		0.093914	0.165115	0.526723	n = 1482
	within		0.100065	-0.05341	0.755386	T-bar = 13.9744
countFTA_o	overall	14.31637	10.3769	0	29	N = 20748
	between		9.367344	0	23.28571	n = 1482
	within		4.47079	-2.39792	31.03065	T = 14
wexpFTA_o	overall	.3654931	.3486506	0	.9839385	N = 20748
	between		.3236264	0	.9199914	n = 1482
	within		.1299571	-.4423418	1.018985	T-bar = 14
wexpbvsFTA_o	overall	.3875159	.4279464	0	.9999816	N = 20710
	between		.4007341	0	.9998144	n = 1482
	within		.1505021	-.5387159	1.05969	T-bar = 13.9744

A3.3: CHANGES IN THE TRADITIONAL DETERMINANTS OF FTAS

Waves of Regionalism and Treatment of Existing Agreements

Looking at the determinants of new FTAs requires thinking about how pre-existing agreements are to be treated in the estimation procedure. The traditional FTA formation models compare the characteristics of preferential partners to those of non-preferential countries to ascertain the role of the independent variables of interest on the outcome (i.e. FTA=1). However, when one wants to look at the determinants of new agreements, it is important to think carefully about the nature of the 'control' group which implies tackling the presence of pre-existing FTAs in the sample.

Consider the observations used to estimate the determinants of the latest wave of regionalism in Table 3.3 column 4. Here there are three different sub-categories of countries in the sample; one that has not signed any agreement; one that signed an agreement during an earlier wave; and one that is engaging in a new agreement during this final wave. The question is, how should one treat pre-existing agreements in the sample (the second category of countries)? Two simple options are available, either remove these or leave these in. Each option has its merits and pitfalls. First recall that the dependent variable in this estimation is equal to 1 when a country signs an agreement during the identified lapse of the wave. Also consider that the interest of the investigation is to ascertain the determining characteristics of the partners that are engaged in new FTAs. Now consider leaving countries with pre-existing agreements in the sample. This implies that one is effectively comparing the countries that engage in new regionalism against both the countries that do not engage in FTAs AND those that were already part of an FTA signed during a preceding wave. Because the latter group will have characteristics that make it desirable for them to sign an FTA as the existence of an agreement shows, then leaving these in the sample can cloud the coefficients obtained the estimation. However if one removes the observations for countries that have pre-existing agreements then one is effectively introducing an element of selection into the estimations. The dependent variable is then capturing the incidence of signing a new agreement contingent on not having signed any agreements in the past. This selection bias could be mitigated by introducing a Heckman control function that identifies the determinants of not engaging in an agreement. The Mills-ratio obtained is then introduced in subsequent FTA formation equations hence reducing the selection biases. However such a 'non-selection' model would require the identification of a variable that was correlated with not being in an agreement but uncorrelated with engaging in an agreement. It is hard to think of any variable that would satisfy this criterion.

Because it is desirable to compare countries that sign new FTAs against those that have not signed, the estimations in the text are run by removing pre-existing agreements from the sample. However it is also important to note how the results might change in a sample where pre-existing agreements are maintained. This is shown in the Table below. Here it becomes immediately obvious that the predictive powers of the FTA formation equation fall significantly. The rate of true positives is only 3% during the latest wave. This lower explanatory power of the FTA formation equations may be due to the aforementioned comparisons between countries that are signing a new agreement against those that have not signed AND those that are already in an agreement. Although a hard choice, the removal of dyads with an agreement is the preferred method of dealing with pre existing agreements as it makes more sense to compare countries that engage in new FTAs against those that do not engage in FTAs at all.

Table A3.3: Traditional FTA formation equation without removal of pre-existing agreements.

VARIABLES	(1) FTA in 2006	(2) FTA: **first wave** 1960-1985	(3) FTA: **Second wave** 1985-1995	(4) FTA: **Third wave** 1995-2006
NATURAL	1.948***	1.397***	1.302***	1.265***
	(0.0578)	(0.0713)	(0.0613)	(0.0532)
REMOTE	0.0575***	0.134***	0.249***	-0.0335***
	(0.00725)	(0.0183)	(0.0187)	(0.0102)
RGDP	0.218***	0.213***	0.122***	0.135***
	(0.0111)	(0.0224)	(0.0140)	(0.0121)
RGDPsim	0.115***	-0.0702	0.414***	0.103***
	(0.0256)	(0.0447)	(0.0513)	(0.0305)
DGDPCAP	0.434***	-0.393*	1.253***	1.097***
	(0.130)	(0.230)	(0.213)	(0.127)
SQDGDPCAP	-0.219***	-0.0155	-0.488***	-0.254***
	(0.0438)	(0.0734)	(0.0739)	(0.0312)
DGDPcapROW	-0.623***	-0.123	0.316***	-0.756***
	(0.0724)	(0.106)	(0.0827)	(0.0788)
Constant	11.03***	3.399***	2.933***	5.455***
	(0.541)	(0.695)	(0.643)	(0.553)
Observations	19,740	19,740	19,460	19,740
r2_p	0.441	0.385	0.433	0.214
Correctly Predicted p(FTA)=FTA	91.46%	96.89%	95.72%	99.63%
Correctly Predicted FTA=1*	43.29%	15.93%	11.54%	2.89%
Correctly predicted FTA=0	97.84%	99.85%	99.32%	99.63%

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
Pseudo_r2 calculated as 1 minus the ratio of the log likelihood value for estimated model and that predicted by a model with just an intercept (like in BB2004).
Values are for the different base years. Column (1): 1970; Wave 1: 1970; Wave 2: 1985; Wave 3, 1995.
*Sum of new agreements across different waves is larger than that of agreements in 2006. This reflects agreements that expired

Sensitivity of results to different specifications of the waves of regionalism

Table A3.4. provides a sensitivity check on the robustness of the economic determinants of FTAs using different years to identify the waves of regionalism. The results suggest that restricting the last wave so that it incorporates only agreements that were signed after 1999 makes a stronger case for arguing that the determinants of 21st Century Regionalism are different from the other waves (predictive powers of the model fall considerably to only predicting 5% of the agreements in place).

Table A3.4: Determinants of FTAs across the different waves of regionalism – Full Sample (1960 values) Different temporal coverage of waves

VARIABLES	(1) FTA in 2006	(2) FTA: **first wave** 1960-1980	(3) FTA: **Second wave** 1980-1999	(4) FTA: **Third wave** 1999-2006
NATURAL	1.936***	1.440***	1.823***	1.631***
	(0.0578)	(0.0729)	(0.0707)	(0.0669)
REMOTE	0.0573***	0.133***	0.203***	-0.0234**
	(0.00726)	(0.0189)	(0.0133)	(0.0100)
RGDP	0.219***	0.198***	0.254***	0.263***
	(0.0111)	(0.0230)	(0.0155)	(0.0150)
RGDPsim	0.114***	-0.0965**	0.453***	0.101***
	(0.0257)	(0.0456)	(0.0491)	(0.0332)
DGDPCAP	0.441***	-0.515**	0.432**	1.000***
	(0.131)	(0.230)	(0.206)	(0.146)
SQDGDPCAP	-0.223***	0.0344	-0.219***	-0.306***
	(0.0443)	(0.0701)	(0.0691)	(0.0365)
DGDPcapROW	-0.638***	-0.0374	0.0989	-0.522***
	(0.0733)	(0.112)	(0.0800)	(0.0813)
Constant	10.93***	3.805***	6.219***	5.860***
	(0.541)	(0.692)	(0.652)	(0.604)
Observations	19,460	19,460	18,842	18,028
r2_p	0.439	0.382	0.508	0.272
Correctly Predicted p(FTA)=FTA	92.78%	98.39%	96.48%	95.86%
Correctly Predicted FTA=1*	43.29% (781 of 1804)	14.71% (50 of 340)	37.5% (300 of 800)	4.97% (34 of 684)
Correctly predicted FTA=0	97.84%	99.87%	99.09%	99.45%

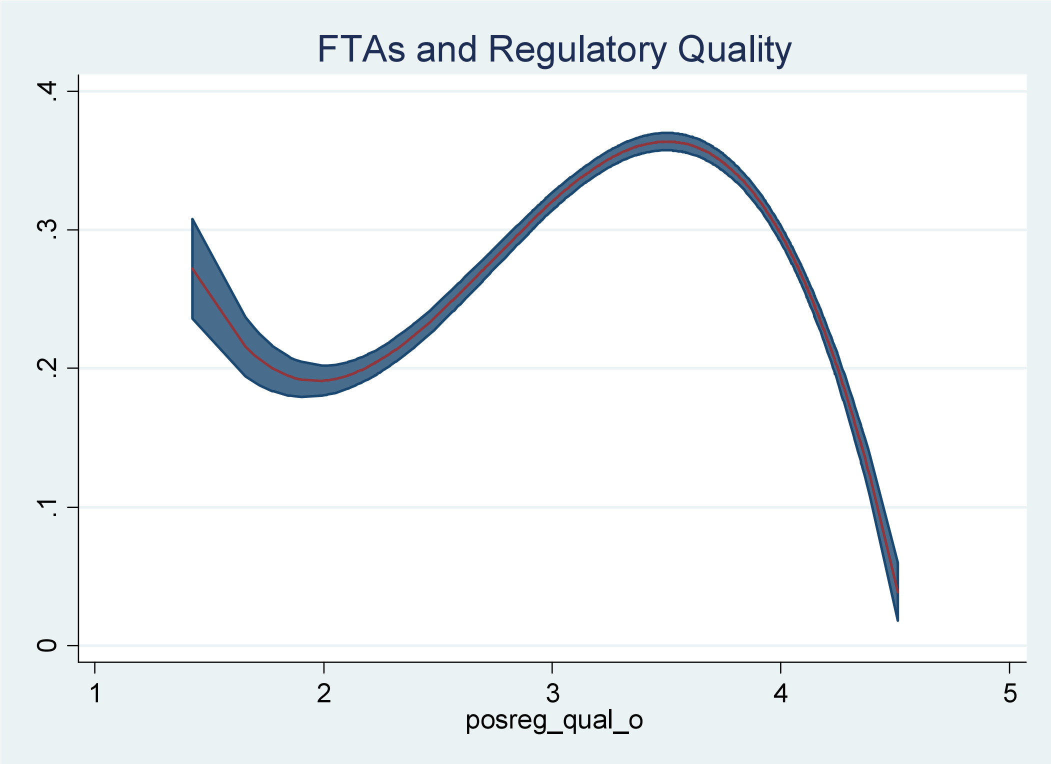
Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
Pseudo_r2 calculated as 1 minus the ratio of the log likelihood value for estimated model and that predicted by a model with just an intercept (like in BB2004).
Values are for the different base years. Column (1): 1970; Wave 1: 1970; Wave 2: 1980; Wave 3, 1999.
*Sum of new agreements across different waves is larger than that of agreements in 2006. This reflects agreements that expired

A.3.4 Determinants of FTAs – Governance Measures

It is argued, in the body of the text, that the minimum regulatory quality measure of a dyadic observation explains a greater amount of the variance in the formation of new FTAs. This could imply that countries aim to engage in FTAs to redress shortfalls in bilateral regulatory quality. It then becomes relevant to look into the degree to which measures of governance and the probability of engaging in an FTA are related. In the figure below such a relationship is plotted through a regression of the predicted values from a 'traditional' (Baier and Bergstrand 2004) FTA formation model against the regulatory quality variable observed from a dyadic observation. To allow for non-linearities, the squared and cubed terms are also introduced[342]. The shape that emerges sees the probability of engaging in an FTA, at low levels of regulatory quality, initially falling. Once a certain threshold is passed it then rises only to fall subsequently at high levels of regulatory quality. Such a relationship between these variables supports the idea that there is a non monotonic relationship between regulatory quality and FTA formation. It is also supportive of the idea that at lower levels, once a threshold has been passed, the probability of signing a trade agreement is rising so that countries may wish to engage in trade agreements to redress lower regulatory quality.

[342] This is done for all countries that do not share an agreement in 1995. The fitted values are obtained from regressing a 'traditional' FTA formation equation. The R-squared is 0.084

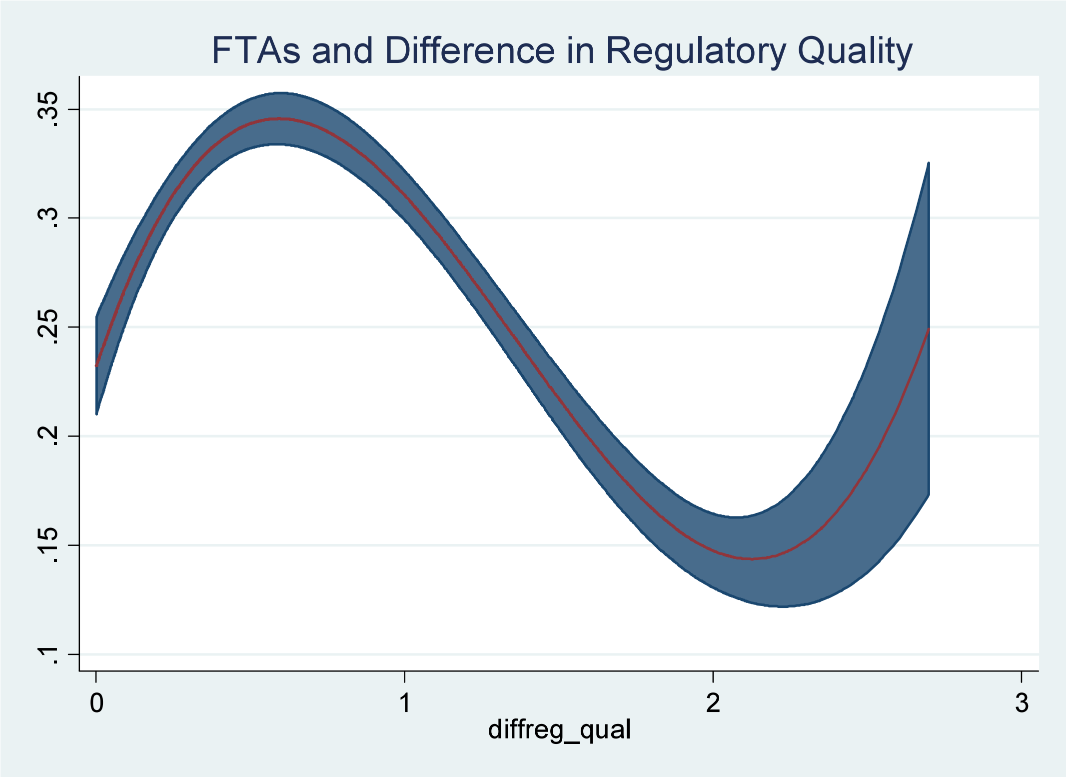
Figure A3.4: Non-monotonic relationship between regulatory quality and FTA formation.



The figure below then plots the relationship between the difference in regulatory quality and the fitted values from a traditional FTA formation model[343]. Another non-monotonic relationship also emerges. This one suggest that low differences in regulatory quality see the probability of an FTA rising, however a rising difference in regulatory quality is then associated with a falling probability of FTA formation till another threshold is reached were, at very high differences, the probability of engaging in an FTA rises. This provides further support to the story that sees countries engaging in FTAs in an effort to redress shortfalls in regulatory quality.

[343] For some reason Stata is unable to plot the values from an LPM model with 15,000 observations so the figure uses data from 2003 to 2008 for the graph. Nevertheless the data used for the estimation of the fitted values is the entire sample.

Figure A3.5: Non-monotonic relationship between difference in regulatory quality and probability of FTA



A3.5. DETERMINANTS OF FTAS – SIMULTANEITY IN USING TRADE BASED MEASURES

Using First-Differences to capture the impact of trade flows on the formation of FTAs is an adequate method of dealing with biases arising from unobserved heterogeneity provided that the source of these biases is dyadic in nature and time invariant. However dealing with simultaneity using similar specifications is a little bit more complicated.

Simultaneity biases arise from the positive impact of FTAs on trade flows (see previous essay of this thesis for a justification of this assertion). Using changes in trade flows between 2008 and 1995 to predict FTA formation will not deal with these biases because these changes will be affected by the presence of an FTA. This will lead to upward biases in the coefficients of interest. Avoiding these biases requires estimating this model using changes in trade flows *before* the conclusion of an agreement. But because the switch into an agreement happens for different countries at different periods in time, then one has to think carefully how to treat changes in trade flows between countries that have not signed an agreement.

Consider a world of three countries; Mexico, Germany and Indonesia, where the impact of trade flows on the conclusion of an FTA is addressed through a first difference model. Such an approach would control for the unobserved bilateral characteristics that cause Mexico to trade more or less with Germany or Indonesia by limiting the variance in trade flows to changes in these rather than to differences in levels. However, because the conclusion of an agreement between Mexico and Germany, in 2001, is likely to positively affect changes in trade flows, then one should use changes in trade flows before the conclusion of said agreement to eliminate simultaneity biases. So, in this instance, an appropriate estimation of the role of trade flows on the formation of new FTAs would take first differences between 2000 and 1995 and see whether Mexico's trade with Germany grew at a faster rate than Mexico's trade with Indonesia. But now imagine that Mexico had delayed signing NAFTA and only entered into an agreement with Canada in 1997. This would imply that cut off point for the FD model should no longer be the year

2000 but rather earlier so as to avoid simultaneity in the impact of this agreement on Mexican and Canadian trade.

The introduction of more agreements then further complicates things hence the choice of the cut-off point cannot be easily made. Although the incidence of simultaneity should fall with earlier cut-off points as the probability of increasing pre FTA flows increases. Table A3.5, provides a robustness check for different cut-off points to those provided in the body of the text. The first column uses first differences between values from 1997 and 1995. Column (2) and three see the cut-off point a little later in 1998 and 1999 respectively.

Table A3.5: Robustness of FD model to different cut-off points.

Variables	(1) 1997-1995	(2) 1998-1995	(3) 1999-1995
dRGDP	0.534*	0.886***	0.294**
	(0.277)	(0.223)	(0.124)
dRGDPsim	0.986***	0.603**	0.386**
	(0.312)	(0.247)	(0.180)
dDGDPCAP	-1.092***	-0.673**	-0.553*
	(0.401)	(0.288)	(0.324)
dSQDGDPCAP	0.751***	0.527***	0.417***
	(0.166)	(0.108)	(0.0869)
dDGDPcapROW	-2.836***	-3.079***	-3.035***
	(0.726)	(0.539)	(0.359)
dminreg_qual	1.972***	2.176***	1.585***
	(0.284)	(0.296)	(0.224)
dlnintimps_bvsbil_o	0.385***	0.483***	0.408***
	(0.0785)	(0.0751)	(0.0697)
Constant	-1.003***	-0.753***	-0.796***
	(0.102)	(0.105)	(0.0988)
Observations	1,074	1,074	1,076
r2_p	0.103	0.137	0.143

Robust standard errors in parentheses,*** p<0.01, ** p<0.05, * p<0.1

A3.6. MARGINAL EFFECTS FOR CROSS-SECTIONAL ESTIMATIONS

Table A3.6. Marginal Effects for results in Table 3.4, Determinants of new FTAs – Measures of Governance 2008

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
NATURAL	0.140***	0.124***	0.174***	0.231***	0.222***	0.185***	0.210***
	(0.0254)	(0.0233)	(0.0244)	(0.0287)	(0.0263)	(0.0243)	(0.0233)
REMOTE	0.0299***	0.0301***	0.0280***	0.0259***	0.0224***	0.0280***	0.0276***
	(0.00547)	(0.00546)	(0.00586)	(0.00619)	(0.00623)	(0.00610)	(0.00633)
RGDP	-0.0385***	-0.0386***	-0.0262***	-0.0193*	-0.0135	-0.0186*	-0.0153
	(0.00852)	(0.00821)	(0.00962)	(0.0100)	(0.0105)	(0.0106)	(0.0107)
RGDPsim	0.0135	0.00369	0.0438***	0.0452***	0.0446***	0.0450***	0.0638***
	(0.0150)	(0.0153)	(0.0159)	(0.0158)	(0.0154)	(0.0155)	(0.0155)
DGDPCAP	0.231***	0.230***	0.342***	0.337***	0.300***	0.319***	0.322***
	(0.0601)	(0.0579)	(0.0641)	(0.0605)	(0.0644)	(0.0634)	(0.0648)
SQDGDPCAP	-0.0535***	-0.0558***	-0.0557**	-0.0605***	-0.0225	-0.0285	-0.0272
	(0.0195)	(0.0185)	(0.0223)	(0.0222)	(0.0246)	(0.0233)	(0.0233)
DGDPcapROW	-0.343***	-0.345***	-0.464***	-0.385***	-0.590***	-0.539***	-0.476***
	(0.0535)	(0.0504)	(0.0750)	(0.0726)	(0.0883)	(0.0812)	(0.0751)
minPol_stab		-0.0538**					
		(0.0253)					
minRol			0.189***				
			(0.0256)				
minVoice_acc				0.276***			
				(0.0434)			
minctr_corr					0.292***		
					(0.0304)		
minGov_eff						0.366***	
						(0.0366)	
minreg_qual							0.403***
							(0.0390)
Observations	1,090	1,090	1,090	1,090	1,090	1,090	1,090
r2_p	0.350	0.353	0.398	0.413	0.446	0.450	0.501

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
Evaluated at the mean

Table A3.7. Marginal Effects for results in Table 3.6, Determinants of new FTAs – Trade based measures 2008

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
NATURAL	0.140***	0.210***	0.184***	0.182***	0.167***	0.215***	0.184***
	(0.0254)	(0.0233)	(0.0250)	(0.0243)	(0.0251)	(0.0242)	(0.0266)
REMOTE	0.0299***	0.0276***	0.0258***	0.0247***	0.0244***	0.0260***	0.0240***
	(0.00547)	(0.00633)	(0.00612)	(0.00609)	(0.00604)	(0.00692)	(0.00650)
RGDP	-0.0385***	-0.0153	-0.0449**	-0.0534***	-0.0477***	0.00531	-0.0228
	(0.00852)	(0.0107)	(0.0184)	(0.0190)	(0.0160)	(0.0104)	(0.0160)
RGDPsim	0.0135	0.0638***	0.0619***	0.0627***	0.0613***	0.0413**	0.0413**
	(0.0150)	(0.0155)	(0.0155)	(0.0156)	(0.0156)	(0.0167)	(0.0169)
DGDPCAP	0.231***	0.322***	0.313***	0.317***	0.305***	0.395***	0.376***
	(0.0601)	(0.0648)	(0.0644)	(0.0648)	(0.0640)	(0.0726)	(0.0721)
SQDGDPCAP	-0.0535***	-0.0272	-0.0258	-0.0270	-0.0245	-0.0469*	-0.0429*
	(0.0195)	(0.0233)	(0.0230)	(0.0232)	(0.0229)	(0.0258)	(0.0254)
DGDPcapROW	-0.343***	-0.476***	-0.472***	-0.468***	-0.461***	-0.393***	-0.388***
	(0.0535)	(0.0751)	(0.0739)	(0.0744)	(0.0722)	(0.0778)	(0.0767)
minreg_qual		0.403***	0.403***	0.404***	0.414***	0.462***	0.467***
		(0.0390)	(0.0384)	(0.0383)	(0.0385)	(0.0418)	(0.0417)
lnimports_o			0.0329**				
			(0.0143)				
lnintimps_bec_o				0.0410***			
				(0.0145)			
lnintimps_bvsbil_o					0.0253***		0.0196**
					(0.00733)		(0.00780)
minbvswld						1.070***	0.961***
						(0.207)	(0.213)
Observations	1,090	1,090	1,090	1,090	1,090	1,090	1,090
r2_p	0.350	0.501	0.506	0.508	0.512	0.522	0.528

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
Evaluated at the mean

Table A3.8. Marginal Effects for results in Table 3.7, Determinants of new FTAs – FD Estimations Trade based measures (1995-2000)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
dRGDP	-0.0623**	-0.103***	-0.104***	-0.0222	0.00612	0.0110
	(0.0296)	(0.0331)	(0.0329)	(0.0285)	(0.0292)	(0.0282)
dRGDPsim	0.148***	0.140***	0.141***	0.147***	0.161***	0.155***
	(0.0407)	(0.0396)	(0.0396)	(0.0396)	(0.0390)	(0.0395)
dDGDPCAP	-0.111*	-0.109*	-0.108*	-0.122*	-0.124*	-0.126*
	(0.0640)	(0.0635)	(0.0639)	(0.0673)	(0.0680)	(0.0688)
dSQDGDPCAP	0.0651***	0.0656***	0.0665***	0.0776***	0.0703***	0.0769***
	(0.0171)	(0.0171)	(0.0173)	(0.0187)	(0.0175)	(0.0184)
dDGDPcapROW	-0.700***	-0.704***	-0.709***	-0.699***	-0.710***	-0.699***
	(0.0766)	(0.0768)	(0.0771)	(0.0767)	(0.0760)	(0.0755)
dminreg_qual	0.255***	0.255***	0.259***	0.281***	0.289***	0.294***
	(0.0433)	(0.0430)	(0.0433)	(0.0435)	(0.0439)	(0.0439)
dlnimports_o		0.0733***				
		(0.0223)				
dlnintimps_bec_o			0.0743***			
			(0.0199)			
dlnintimps_bvsbil_o				0.0913***		0.0610***
				(0.0130)		(0.0136)
dminbvswld					1.486***	1.014***
					(0.193)	(0.223)
Observations	1,090	1,085	1,084	1,080	1,090	1,080
r2_p	0.129	0.139	0.142	0.176	0.176	0.193

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
Evaluated at the mean

Table A3.9. Marginal Effects for results in Table 3.8, Determinants of new FTAs – FD Estimations Interdependence (1995-2000)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
dRGDP	0.0133	0.0140	0.0113	0.0630**	0.0593**	0.0416
	(0.0259)	(0.0260)	(0.0240)	(0.0285)	(0.0286)	(0.0253)
dRGDPsim	0.0705**	0.0680*	0.0767**	0.108***	0.107***	0.116***
	(0.0352)	(0.0348)	(0.0338)	(0.0385)	(0.0389)	(0.0387)
dDGDPCAP	-0.171**	-0.182***	-0.162**	-0.160**	-0.173**	-0.157**
	(0.0675)	(0.0666)	(0.0645)	(0.0747)	(0.0759)	(0.0720)
dSQDGDPCAP	0.0850***	0.0886***	0.0835***	0.0947***	0.0983***	0.0942***
	(0.0168)	(0.0169)	(0.0162)	(0.0195)	(0.0198)	(0.0186)
dDGDPcapROW	-0.607***	-0.633***	-0.604***	-0.577***	-0.608***	-0.619***
	(0.0787)	(0.0789)	(0.0761)	(0.0823)	(0.0842)	(0.0852)
dminreg_qual	0.265***	0.268***	0.286***	0.293***	0.298***	0.312***
	(0.0439)	(0.0448)	(0.0428)	(0.0453)	(0.0464)	(0.0437)
dwexpFTA_o	0.777***			0.822***		
	(0.0835)			(0.0879)		
dwbvsFTA_o		0.729***			0.746***	
		(0.0919)			(0.0956)	
dcountFTA_o			0.0188***			0.0170***
			(0.00286)			(0.00306)
dlnintimps_bvsbil_o				0.0750***	0.0724***	0.0589***
				(0.0144)	(0.0145)	(0.0131)
Observations	1,090	1,090	1,090	1,052	1,052	1,052
r2_p	0.207	0.216	0.166	0.238	0.244	0.184

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
Evaluated at the mean

A3.7: Cross Sectional Instrumental Variable Estimation

Table A3.10: Instrumental Variable Approach

VARIABLES	(1) Step 1	(2) Step 2	(3) Step 1	(4) Step 2	(5) Step 1	(6) Step 2
NATURAL	0.824***	0.118	0.764***	-0.111	1.706***	-0.0824
	(0.0508)	(0.214)	(0.0478)	(0.241)	(0.0992)	(0.246)
REMOTE	0.0529***	0.0777***	0.0549***	0.0367	0.118***	0.0550*
	(0.0114)	(0.0264)	(0.0108)	(0.0336)	(0.0248)	(0.0304)
RGDP	0.984***	-0.864***	0.979***	-1.340***	1.395***	-0.796***
	(0.0210)	(0.249)	(0.0213)	(0.310)	(0.0411)	(0.198)
RGDPsim	0.0963***	0.138*	0.0726**	0.149*	0.287***	0.0835
	(0.0318)	(0.0742)	(0.0328)	(0.0833)	(0.0868)	(0.0834)
DGDPCAP	-0.0523	1.137***	-0.0786	1.068***	0.0679	1.005***
	(0.0980)	(0.253)	(0.105)	(0.281)	(0.194)	(0.272)
SQDGDPCAP	-0.0374	-0.131*	-0.0442	-0.0999	-0.165***	-0.0739
	(0.0262)	(0.0776)	(0.0281)	(0.0853)	(0.0492)	(0.0848)
DGDPcapROW	0.110	-1.415***	0.179	-1.402***	0.282	-1.405***
	(0.109)	(0.228)	(0.112)	(0.256)	(0.215)	(0.236)
minreg_qual	0.0815	1.497***	0.0974	1.687***	-0.361***	1.882***
	(0.0635)	(0.146)	(0.0707)	(0.168)	(0.128)	(0.205)
minco2pc	0.0365***		0.00681		0.0439	
	(0.0130)		(0.0139)		(0.0269)	
mintellines	-0.0198***		-0.0181***		-0.0365***	
	(0.00391)		(0.00421)		(0.00873)	
minhealthpc	-0.000130*		-0.000204***		-0.000330**	
	(6.72e-05)		(7.12e-05)		(0.000166)	
minfk	-1.426***		-0.675*		-2.323***	
	(0.373)		(0.374)		(0.732)	
lnimports_o		0.856***				
		(0.270)				
lnintimps_bec_o				1.355***		
				(0.332)		
lnintimps_bvsbil_o						0.560***
						(0.153)
Constant	-38.23***	40.88***	-39.00***	61.77***	-56.76***	40.17***
	(0.962)	(9.995)	(0.977)	(12.82)	(1.996)	(8.483)
Observations	1,090	1,090	1,090	1,090	1,090	1,090
R-squared	0.790		0.778		0.660	
Correctly Pred p(FTA)=FTA		83.21%		80.83%		81.38%
Correctly Predicted FTA=1		57.98%		60.43%		54.91%
Correctly predicted FTA=0		93.98%		89.53%		92.67%

Robust standard errors in parentheses,*** p<0.01, ** p<0.05, * p<0.1

Table A3.10. shows the results obtained from estimating the impact of the trade variables on the probability of an FTA being formed through an IV approach. The first step in each regression uses a cross sectional gravity model to create a set of predicted values that are inserted in a second step FTA formation equation. A justification for the use of a gravity model to estimate total trade and intermediate trade flows can be found in the previous essay of this thesis. The results confirm the positive effects of trade flows on the probability that a trade agreement is concluded between two countries. A priori, the Wald test is passed and hence the instruments should be valid (i.e. correlated with the trade flow measure). However determining whether the instruments are correlated of not with the unobserved component of the FTA formation equation is more complicated. It seems reasonable to presume that Co2 emissions do not currently influence the desirability of an agreement. Similarly the coverage of telephone lines or a government's expenditure on health should not influence a country's decision to engage in trade agreements. The table below shows the correlation between the instruments proposed and the new FTA measure that is the dependent variable in the estimation. It reveals that the instruments used are not statistically correlated with the outcome variable.