UNIVERSITY OF SOUTHAMPTON

FACULTY OF LAW, ARTS & SOCIAL SCIENCES

DIVISION OF ECONOMICS, SCHOOL OF SOCIAL SCIENCES

Essays on International Trade and Regional Economic Integration in East Asia

by

Xinyi Li

Thesis for the degree of Doctor of Philosophy

May 2008

To my family

UNIVERSITY OF SOUTHAMPTON

ABSTRACT

FACULTY OF LAW, ARTS & SOCIAL SCIENCES
DIVISION OF ECONOMICS, SCHOOL OF SOCIAL SCIENCES

Doctor of Philosophy

Essays on International Trade and Regional Economic Integration in East Asia

by Xinyi Li

This thesis investigates the regional economic integration in East Asia, and empirically finds out the inter-relationship amongst vertical-specialisation-based trade, business cycles synchronisations and regionalisation.

The thesis is consisted of six chapters.

The first chapter explains the motivation to study the economic integration in East Asia and provides a brief literature survey on the topic of regional economic integration. Some background information of international trade in East Asia and of the current progress of regional integration achieved in East Asia is offered in Chapter 2.

Chapter 3 looks at the correlations of external disturbances amongst countries in East Asia. A Bayoumi-Eichengreen (1992) method of Structural VAR is employed to identify the long-run external shocks. We find that the level of correlations of external shocks for our sample countries is not far behind the one for EMU countries. The external demand shocks are highly correlated amongst ASEAN countries as well as other economies in the region. Moreover, we find that Japan has strong correlations with other countries in the region in terms of supply disturbances, which reflect the vertical production linkages between Japan and the other countries.

Chapter 4 studies effects of vertical production linkages which include backward linkages from demand and forward linkages from supply, and of international spillovers on output co-movements across countries. Shea (2002) has found that production linkages positively affect industrial output co-movements within the U.S. By exploiting the international input-output table, we derive the vertical production linkages between countries. The result from our two-step estimation shows that both directions of vertical linkages together with international spillovers have positive significant effects on output co-movements across countries.

Chapter 5 looks into the regional bloc effect on vertical-specialisation-based trade. The regional trading agreement dummy is instrumented as suggested by Tenreyro and Barro (2003) to calculate the propensity of creating a trading agreement. Our gravity estimation demonstrates that either bilateral or multilateral free trade agreement significantly promotes international trade which is based on vertical production fragmentation.

The thesis concludes in Chapter 6 and also outlines the possible future work.

Contents

List of Tables

List of Figures

Acknowledgements

My great gratitude goes to my supervisors, Prof. Maurice Kugler and Prof. Akos Valentinyi. They have been extremely attentive to the development of this thesis. Their intellectual insights, consistent encouragement, great advice and patient supervision are invaluable.

I am deeply indebted to the faculty of the division for the friendly environment, strict training and kindly help that I have received. In particular, I would like to express my thanks to Prof. Sevi Rodriguez Mora, Dr. Jean-Yves Pitarakis, Dr. John Bluedorn, Dr. Carmine Ornaghi, Dr. Christian Schluter, Dr. Jan Podivinski, Dr. Maozu Lu, Dr. Jian Tong, Mr. John Aldrich, Prof. Robin Mason and Prof. Thierry Verdier for their advice and encouragement.

The support and friendship from my peers have been very much appreciated. I especially wish to thank Mr. Zhijun Zeng for inspiring me on the road of economic research. Dr. Zheng Wang, Dr. Jie Ma, Dr. Yun Zhu have given me valuable comments on my research work. I am also grateful to Corrado Giulietti, David Pinch, Edmund Rawle, Yijuan Chen, Hairong Mu, Ioannis Kingdom, Stuart Redding, Juan A. Correa, Greg Taylor, Ding Ma, Yining Chen of the NOC, and many other friends in the division.

Mrs. Gill Crumplin, Mrs. Chris Thorn and Mrs. Fatima Fauzel provided me with kind assistance to my study life in Southampton.

Last but not least, I dedicate this thesis to my parents and my sisters. Their encouragement, understanding and support are the backbone of my life!

Chapter 1

Introduction

1.1 Motivation and Literature

1.1.1 Asia's Reaction to other Regional Blocs

The world is under a new trend of regionalism since the 1990's. Regional economic integration arrangements facilitate goods, services and factors to mobile freely across borders of member countries, which will leads towards higher levels of trade, investment, welfare gains as well as better risk sharing mechanisms. Regional economic blocs with varying degrees of integration have been established in Europe, North America and South America.[1] The most conspicuous regional blocs are: the European Community after the year 1992 (EC92), the North America Free Trade Agreement (NAFTA) and the Mercado Común del Sur; the Southern Common Market (MERCOSUR). Indeed, these three regional blocs represent three different types of economic integration: North-North integration, EC92; North-South integration, NAFTA; and South-South integration, MERCOSUR.

European integration is the earliest and furthest proceeded economic area on the globe. The European Community completed its common market in 1968. After the EC enlargements for three times since 1974 and the implementation of

[1]There are some smaller regional blocs existed in Africa and amongst some Caribbean countries, such as the CFA in Africa and the ECCA in Caribbean region.

the bilateral FTA with EFTA member countries, the 1992 European Economic Area (EEA) agreement extended EC92 to the European Free Trade Association (EFTA)[2] countries, which covers countries in Western Europe. Recently, the EC signed agreements with ten Central and Eastern European countries. These European Agreements call for free trade in industrial goods. They will lead to deeper integration of the whole Europe.

Unlike EC92 which is a collection of countries with similar levels of economic development, NAFTA is a fairly obvious core-periphery pattern organisation with the U.S. in the central as the hub. In 1994, the free trade area between Canada and the U.S. (CUSFTA) extended to its south neighbour, Mexico and became NAFTA. NAFTA is the first formal regional integration agreement involving both developing and developed countries. After Mexico's entry to NAFTA, rapid increase in Mexican trade with the US became one of the most striking occurrences. Mexico has become the US's second largest trading partner, accounting for a larger share of US trade than Korea, Thailand, Singapore, Malaysia, Hong Kong and Taiwan combined.[3]

In South America, Argentina, Brazil, Paraguay and Uruguay founded the Mercado Común del Sur; the Southern Common Market (MERCOSUR) in 1991 in order to promote free trade and the fluid movement of goods, peoples, and currency. Although the development of MERCOSUR was arguably weakened by the collapse of the Argentine economy in 2001 and it has still seen internal conflicts over trade policy between its member countries, the whole community of MERCOSUR is still working towards a deeper integration. In December 2004 it signed a cooperation agreement with the Andean Community trade bloc (CAN) and they published a joint letter of intention for future negotiations towards integrating all of South America. Venezuela became a member of MERCOSUR in 2006. Bolivia, Chile, Colombia, Ecuador and Peru currently have associate member status.

One may be curious about Asia's reaction towards these trends of economic integration all over the world. What would the countries in East Asia do in face of other part of the world creating their own regional bloc to improve integration? In East Asia, accordingly, and by other reasons, the degree of intra-regional trade

[2]EFTA was established in 1960. Iceland, Norway, Switzerland and Liechtenstein currently remain members of EFTA.

[3]Romalis (2005, page 2)

is quite high which is measured either by the trade intensity index or the trade dependency index.[4]

In a summary of World Bank publications by Evans et al. (2006), evidence shows that East and South-East Asia trading bloc first emerged in the 1970's with a larger share of total world trade than North America. In the 1980's, intra-regional trade in East Asia area steadily increased together with growing trading links to the U.S. By the 1990's, the bipolar world of the 1960's evolved in a tri-polar world, with the emergence of the East Asia. This bloc accounts for a larger share of world trade than North America, and diversified its exports overtime away from the U.S.

Thus, Goto and Hamada (1994, 1995) voice that the development of a tighter economic integration link within East Asia, e.g. the EAEC[5] or the APEC, would be a natural response of Asian countries against two big trading blocs in the world, EC92 and NAFTA.

A free trade area amongst countries in the Association of South East Asian Nations (ASEAN) has been established in 2002, and negotiations of the ASEAN Free Trade Area (AFTA) expansion to other countries in the region becoming ASEAN+3 (ASEAN together with China, Japan and Korea) have been in an ongoing process. Ideas to create an Asian Currency Unit also have been proposed.

Therefore, one might ask: 1) whether or not it is beneficial for countries in East Asia to establish a closer regional integration, e.g. a common currency union; 2) what factors will affect the feasibility of creating a tighter linked integration; and 3) what the consequence will be if there is a regional integration arrangement in the region. These questions have become the objectives of the research presented in this thesis. This thesis looks into these questions from the perspective of international production linkages through trade in intermediate inputs between countries. International production linkages across countries involve externalities and finer division of labour. These international production linkages make countries on the value chain enjoy "Ricardian Gains" as well as "Smithian Gains" through deep integration which has not yet been systematically studied in the literature.

[4]It is defined as the ratio of the sum of export and import to GNP.

[5]The EAEC (East Asia Economic Caucus) is proposed in 1990 by Dr Mahathir, former Prime Minister of Malaysia.

1.1.2 A Non-Exhaustive Literature Survey on Regional Economic Integration

1.1.2.1 Trade and Regional Integration

When we talk about Regional Integration Agreement/Arrangement (RIA), traditionally three types of RIAs are distinguished. 1) A Free Trade Area/Agreement/Arrangem (FTA) is an RTA formed by removing tariffs on trade amongst member nations and leaving members with autonomy in setting their tariffs on trade with non-member countries. 2) A Customs Union (CU) applies a common tariff structure to trade with non-members. 3) A Common Market (CM) permits free movement of factors of production, as well as goods and services, between member states.[6]

Baldwin and Venables (1995) analyse the RIA's allocation effects on trade and accumulation effects on investment. Both allocation effects and accumulation effects of regional economic integration cause creation and diversion of trade and investment. It is tempting to say that an RIA brings expansion of intra-group trade and contraction of external trade, but it is not true. In a multi-good general equilibrium model, it is possible that complementarities between goods traded internally and externally of the arrangement may lead to increases in total trade. An RIA will affect growth if it changes the return on investment — in physical, human, or knowledge capital — and hence spurs accumulation. And this change in return on investment may also be caused by trade.

Krueger (1997) argues that all else equal, customs union (CU) arrangements are strictly *Pareto Superior* to free trade agreements (FTA) because an FTA cannot lead to any more trade creation than can a customs union and, when Rules Of Origins (ROOs) export any protection, an FTA leads to more trade diversion than does a customs union. For a customs union, it is generally accepted that the larger the share of trade pre-existing amongst union partners, the more likely there is to be net trade creation and the less trade diversion will normally result. Of course, if a customs union were formed amongst countries which collectively would produce goods and services at factor prices that would prevail at a full global free trade equilibrium, the welfare effects of customs union would be those of free trade. It is arguable that customs unions between developing countries are

[6]Baldwin and Venables (1995), "Handbook of International Economics", Vol. 3, Chapter 31, p.1598.

less likely to provide welfare gains than those between developing and developed.

Also, Arndt (2003) points out that production sharing based on intra-product specialisation has been shown to be welfare enhancing under conditions of free trade. At a sufficiently flat domestic-world price ratio, welfare improves relative to the Most Favoured Nation (MFN) equilibrium. The partner countries in the MFN engage in deeper economic integration, creating an economic area in which traditional preferential trade liberalisation is combined with production sharing. This is still a trade-diverting arrangement, but welfare falls by less than before. Thus, deeper integration, which includes production sharing, mitigates the negative welfare effects of narrow preferential trade liberalisation. By specialising in the components of products in which each has comparative advantage, the two countries can improve productivity. This rise in efficiency is passed through to a lower intra-area price ratio. This improvement in the country's term of trade raises welfare.

Hence, if countries which trade more in intermediates establish a free trade arrangement, this type of vertical integration will replicate the production to a global scale and shift the specialisation of each participating country to a more locational comparative advantage stage. In another word, vertical specialisation, some other economists call it "production sharing" or "production fragmentation", can create some comparative advantage for certain countries which they do not have before in the production chain by segmenting more production stages.[7]

Hanson (1996) shows that vertical trade recreates the regional production network on a global scale. Large country becomes the global industry centre and subcontract input production to its small trader partner countries, and this type of trade causes a spatial redistribution of labour in small countries. In his case study of Mexican apparel industry, he finds that there has been a substantial relocation of Mexican apparel production since its opening to trade, and NAFTA reinforces this production relocation. Border producers in Mexico have easier access to the US market which reduces the importance of distance from its industry centre to Mexico City. For a developing economy, trade liberalisation involves a transition from vertically integrated manufacturing to a specialised role of subcontracting for developed-country firms. Mexican experience of re-

[7]Jones and Kierzkowski have written several papers on production segmentation due to technology improvement creates comparative advantages for low-income countries to participate labour-incentive stage of production, e.g. assembly.

gional specialisation under NAFTA is at least as profound as those of industrial specialisations.

The term regional economic integration typically refers to reduction of regional trade barriers and investment restriction. As discussed above that regional economic integrations are beneficial to member states as long as this integration is vertical, and commodities exchanged are complementarities. A series of paper by Hummels et al. (1998, 2001) and by Yeats (1998) record this trend of vertical specialisation in production sharing across countries, which is featured by significant increase in trade in parts and components. In a two-country dynamic Richardian model, Yi (2003) finds that the more stages of production are separated across borders, the higher benefits this type of productions will have. In the same paper Yi also predicts that as the number of production across countries stages increases, the magnification effect of tariff reduction upon trade volume increases.

1.1.2.2 FDI and Vertical Regional Integration

In the short run, integration is expected to stimulate intra-regional trade and investment; in the long run, it is hoped that the combination of larger market, tougher competition, more efficient resource allocation, and various positive externalities will raise growth rates of the participating economies. As discussed in a report by Evans et al. (2006), deep integration typically harmonises regulations with regards to trade and production, and encourages investment across borders in addition to removing trading border barriers. These two policy measures generate positive externalities to productivities, which may in turn promote deeper integration. Evans et al. (2006) provide evidence to support this argument by a case study of Egyptian adoption of EU standard in their report to the Department for International Development (DFID), U.K.

More recently, vertical specialisation within a region can be regarded as a consequence of Multi-National Corporations (MNCs)' strategies of market penetrating and local advantages exploitation, which always associated with Foreign Direct Investment (FDI). MNCs implement their strategies by setting up facilities or subsidiaries in host countries to build-up their demand or supply linkages. The establishment of these facilities or subsidiaries will cause the change in inflow

and outflow of FDI.

In fact, the reduction of regional trade barriers could instead stimulate overall FDI flows among the relevant trading partners by enabling MNCs to operate more efficiently across international borders. This argument applies in particular for vertical integrated FDI, where the operations of the MNC's different affiliates are specialised according to the locational advantages of the host country, and where a predictable and liberal trade environment is a prerequisite for the international division of labour at the firm level.

Analyses of the economic impact of the European Single Market have argued that this specific integration process has led to significant efficiency benefits that will raise the participating countries' growth rates over the medium long term. In additional, it is likely that FDI will stimulate technology transfer and diffusion, both direct and through spillovers to local firms.

Studies of the impact of economic integration on intra-regional investment are much rare and generally constrained by data shortage. A similar picture is suggested in later study by Molle and Morsink (1991), based on FDI flows between EC countries during the period 1975 – 1983. The study suggests that intra-EC trade and intra-EC investment are complementary to each other, but only above a certain level of trade intensity.

Winters (1997) notes that another distinction between Spain and Portugal, on one hand, and Greece, on the other hand. Spain and Portugal benefited from significant increases in inward FDI as result of EC membership, but Greece did not, largely because the country's macroeconomic policies did not provide an attractive environment for foreign investors.

The main contribution of the presence of foreign firms presumably comes from technology transfer and technology spillovers. The Mexican economy seems to have reached a level of development and skills where local firms are able to absorb some of the new technology that is imported and used by foreign multinational firms. (see Kokko, 1994; Blomstrom et al., 1994). This spillover effect reflects the inter-sectoral productivity linkages between local producers and foreign firms(Kugler, 2006).

The experience of Mexico suggests that North-South integration may be greatly beneficial for the Southern partners, and illustrates some of the prerequisites for achieving these beneficial effects. Consequently, regional integration has been connected to significant increases in the inflows of foreign investment, in particular from countries outside the NAFTA region.

Therefore, Blomstrom and Kokko (1997) conclude from their case study on NAFTA and MERCOSUR that the most positive impact on FDI has occurred when regional integration agreements have coincided with domestic liberalisation and macroeconomic stabilisation in the member countries. Altogether, FDI and intra-regional trade contribute to the ongoing regional integration.

1.2 Description of the Thesis

1.2.1 Main Findings of the Thesis

This thesis is focused on the economic integration in East Asia, by examining factors that influence economic integration. In particular, the aspects investigated here are the relationships between regional bloc, international trade and the correlations of shocks across countries. Within the literature there is some debate about the effect of international trade on business cycles synchronisations, which has become a crucial condition for the deeper regional integration process. On one hand, economists, such as Eichengreen (1992); Kenen (1969); Krugman (1993), follow the traditional theoretical prediction that closer trade ties could result in countries becoming more specialized in the goods in which they have comparative advantages, and these countries might be more sensitive to industry-specific shocks, leading more idiosyncratic business cycles. On the other hand, empirical economists argue that tighter trade relations will induce higher synchronisation of business cycles. Frankel and Rose (1998) reveal that countries trade more with each other tend to experience more synchronised business cycles, and countries are more likely to meet the criteria of joining an Optimal Currency Area (OCA) *ex post* than *ex ante*. This school of economists believe that the dominance of Intra-Industrial Trade (IIT) in international trade makes countries become more fragile in facing demand shocks which hit all countries in trading relations.

This thesis offers a different view to study the relationship between economic co-movements and international trade by looking into the vertical production linkages across countries and the trade based on these linkages. The result of this study suggests that production linkages (including backward and forward linkages) have positive effects on the output co-movements across countries in the sample. The results are significant in statistics and in economics. Backward linkages represent for demand shocks to final products — all suppliers that supply inputs to produce final products will be affected once there is occurrence of shocks to the demand for final products. Forward linkages describe the supply shocks to intermediates output—When a supply shock happens to intermediate producers, it has effect on all the downstream producers' cost, which use this intermediate as inputs to produce. Other result of this thesis shows that controlling for other factors, a regional (bilateral or multilateral) trading bloc stimulates the vertical-specialisation-based trade. In another words, regional trading arrangements facilitate the relocation of production in the region, and liaise production network to expand from domestic level to a regional level. This finding is an indirect support to those studies on regional effect on trade, welfare and growth convergence which have already been existed in literature.

1.2.2 Structure of the thesis

Three core chapters, following after the background introduction presented in Chapter Two, represent a single theme, the link between trade integration and macroeconomic convergence. Hence, Chapter Three first explores the evolution of macroeconomic convergence, which forms the basis for the next two pieces of parallel research. Chapter Four then investigates whether the findings of Chapter Three can be explained by increased vertical integration and so complementarity between economic activity across countries in the region. Chapter Five assesses how far whether this type of integration has been stimulated by trade policy, e.g. regional free trade arrangements.

Detailed structure of the thesis is explained as followed.

Chapter Two provides some background information on the region of East Asia, illustrating that East Asia is a good sample region to study regional integration. Within the region, there exists a colourful diversity of countries in economic

development level — Japan is the most advanced economy in the region, together with emerging markets such as Korea, Malaysia and Singapore plus a group of developing countries, China, Indonesia, the Philippines and Thailand. From the previous literature on international trade and production sharing in East Asia, we have a preliminary picture that thriving East Asian countries participate in the international exchange of production, goods and services. Statistics data also offers a view of how these countries open to the world and close to each other. All the facts suggest that these East Asian countries have formed a basis to have a broad discussion on further economic integration within the region.

Chapter Three first looks at the possibility of forming a currency union amongst these East Asian countries. The concept of optimal currency area was proposed by Mundell (1961) and McKinnon (1963). It is the area that countries within the regional sharing the same currency or fixed exchange rates with each other, and the region has floating exchange rates with the rest of the world. In the complementary works by Alesina and Grilli (1992, 1993) and by Alesina and Barro (2002), it has been shown that given the transition cost and factor mobility, countries will benefit more and suffer less to give up their own discretionary monetary policy tools if shocks to these countries are highly correlated.

Inspired by the Bayoumi-Eichengreen (1992) method, a C-Model of Structural Vector Autoregression (SVAR) is employed to decompose the error terms in order to identify the long run shocks to the system. In the vector, export and national exchange rates with Special Drawing Rights (SDRs) of the International Monetary Fund (IMF) are incorporated considering all East Asian countries are fairly export-oriented economies which makes these countries open but vulnerable to shocks from outside of the economies.

Traditionally, the European Monetary Union (EMU) is used as benchmark of this study. The result of this chapter shows that correlations of shocks of demand from the external are high amongst *ASEAN5*[8] countries as at the same level as those amongst EMU countries before they formed a monetary union. This finding is consistent with the conclusion by Bayoumi et al. (1999). However, a remarkable discovery of this chapter is that all sample countries in the region have high correlations of supply shocks with Japan in addition to the fact that ASEAN5 are highly correlated with one another. This result hints a direction

[8]ASEAN5 traditionally is referred to the five countries with higher level of development in ASEAN. They are Indonesia, Malaysia, the Philippines, Singapore and Thailand.

that production linkages, which are embedded in increasing international trade, may induce more symmetric business cycles.

Chapter Four continues looking into vertical production linkages effects on shocks correlations. To my best knowledge, this is the first empirical research on the relationship between trade based on vertical production linkages and business cycles synchronisations. Shock correlations across countries are attributed to vertical production linkages in two directions — 1) upward propagation that demand shocks to final products affect all upstream input suppliers which supply inputs to produce the final product; 2) and downward propagation that productivity shocks to production in upstream sectors that is transmitted to downstream sectors which are using its product as intermediates. To describe vertical linkages across countries, this chapter adopts the measurement developed by Hummels et al. (2001). However, in this chapter this measurement is used to capture only the demand linkages which represent the backward propagation of taste shocks. Since there is a circularity problem existed in this vertical specialisation measure, in this chapter we run a regression for inter-industrial effects of foreign countries on domestic industrial production, and utilise the estimated effects to encapsulate supply linkages which corresponds to the forward transmissions of productivity shocks. Furthermore, a load of literature suggests that international trade has direct and indirect spillover effects on trading partner countries. Backus et al. (1992) predict that larger spillover across countries will result in higher co-movement of outputs. Hence, the spillover effects between countries are also estimated.

A 2-step estimation method is exploited in Chapter Four. In the first step, generic shocks and constants are first estimated in a country-by-country regression. In the second step, the residual derived from the first-step regression is used to estimate the effects of backward, forward linkages and spillovers on output co-movement in the sample countries by a recursive least square procedure. Most results of the estimation match our expectation. Backward vertical production linkages generate positive and significant effects. For those groups of countries having strong vertical linkages, all the variables in question produce expected sign and significance — vertical production linkages and the spillover from international trade positively contribute to the correlations of shocks. This result complements the finding by Frankel and Rose (1998) that demand shocks to intra-industrial trade is attributed to symmetric business cycles. This chapter

evidences that supply shocks transmitted through vertical production linkages also induce business cycles synchronisation.

Chapter Five investigates a policy-related topic whether or not regional trading bloc stimulates vertical specialization within the region. Vast body of literature on regionalism is focused on the regional effects on trade — creation or diversion, and on welfare — change in wage rates and social welfare, or on economic growth — spillovers and convergence. There are a few papers studying the production relocation and agglomeration. In addition to the previous research questions, there was not a research on the relationship between regional trading bloc and industrial production specialisation in the region.

A gravity-based framework is applied to estimate the effect of regional dummy on the sum of vertical specialisation index for each pair of countries in a panel sample. As argued in literature, the establishment of any regional bloc arrangement is not taken totally exogenous with other variables of interest in economic research. Thus, the regional bloc dummy is instrumented by predicted values from a probit regression. As shown by Wooldridge (2002), Two-Stage Least Square (2SLS) method yields a consistent estimator for this simultaneous equation model. The result from the research in this chapter demonstrates that regional trading bloc, either bilateral or multilateral, significantly promotes vertical specialisation within the region. The result confirms Arndt's argument (2003) that regional trading agreement is sustainable and welfare enhancing when the agreement is deeper integrated to production sharing across member countries. The result also suggests that less exchange rates variability leads to higher level of vertical-specialisation-based trade across borders. The finding in this chapter completes the three-fold conjecture that highly vertical integrated region will have more symmetric business cycles amongst countries in the area — vertical production linkages lead to higher synchronisations of economic shocks; countries will be beneficial to create a certain level of regional bloc arrangement; and the established regional arrangement encourages higher vertical production specialisation.

Chapter Six concludes this thesis and outlines the future work to continue.

Chapter 2

Trade, Production Sharing and Economic Integration in East Asia

East Asia is an ideal region in which to apply economic models to the study of regionalisation and globalisation, since both trends had such marked and profound effect on this part of the world. The region's economy is closely integrated with the world economy, and the growth and trade performance of the region's economic leaders continues to astound observers.

In a summary by Evans et al. (2006), evidence shows that East and South-East Asia trading bloc first emerged in the 1970's with a larger share of total world trade than North America. In the 1980's, intra-regional trade in East Asia area steadily increased together with growing trading links to the U.S. Its export share shifted towards the U.S. in the period (36.2% in the 1980's compared to 26.4% in the 1970's). It also represented a growing share of total world trade with 23% in the 1980's in contrast to 16% in the 1970's. By the 1990's, East Asia turned the bipolar trading world into a tri-polar trading world. However, the emergence of the East Asia trading bloc in a tri-polar world trading system does not signify that the world is evolving into three disparate, autarchic trading blocs. In the 1990's, inter-bloc trade was still very large in company with significant increasein intra-bloc trade.

East Asia was chosen for study because the available evidence indicates that regional production sharing is expanding at a far faster pace there than it is in either North America or Europe.

East Asia's trade in components and parts has been growing very rapidly. By 1999 its share of such trade exceeded that of Europe and North America. Moreover, intra-East Asia trade in components and parts is extremely intensive. These examples indicate that international production sharing is more pronounced in East Asia than in other parts of the world.

Ng and Yeats (2001) report the remarkable trade in parts and components in East Asia by exploiting the data collected in accordance with the Standard International Trade Classification, Revision 2 (SITC, Rev 2), which identifies the trade in parts and components under Section 7, the group of machinery and transport equipments, of this Classification system.

In spite of the problems existed in the data, the availability of SITC Revision 2 data reflect the relative importance of the East Asian countries' trade in components. For example, in 1996, the United States and Germany were (according to this source) the two largest exporters and importers of components, but Singapore, Hong Kong, Japan, Malaysia, and China were among the ten largest exporters or importers of these goods. Furthermore, the Revision 2 statistics show that recent growth rates for East Asian trade in components have exceeded corresponding rates for any other major regional group of countries. Components now constitute one-fifth of East Asian exports of manufactures.

Asian imports of components, measured as a share of all manufactures, is growing considerably faster than imports in the countries of the Organisation for Economic Co-operation and Development (OECD) Europe or North America. The value of Asian global imports of components rose more than nine-folded over the 1985 – 1996 period.

East Asian global exports of components grew at an annual rate of 15% over the 1984–1996 period — more than four points above the growth rate of all goods (10.6%). However, exports of components to other East Asian markets grew at a considerably faster than average pace (about 20.9%). As a result, the share of all parts and components exports destined for regional markets almost doubled,

rising from 25% to 46%.

Over the 1984-1996 period components recorded the fastest annual growth rate for all the major product groups in both regional (20.9%) and global exports (15%). These rates were approximately three points per year higher than those for all manufactures and five to six points higher than for all goods. In short, trade in parts and components was increasing dramatically in relative importance.

As Ng and Yeats (2001) reported, the dramatic expansion of East Asian trade in components was largely an intra-regional phenomenon that was unmatched by any other geographic groups of countries. For example, over the 1985–1996 period the share of East Asian imports of components from Europe held relatively stable in the 14% to 16% range, whilst North America's share of both imports and exports fell by 14 percentage points. The Asian group of countries appears to be the big gainer, but the table 2-1 shows that other sub-regional Asian groups (e.g. South Asia, Oceania) did not participate in the expansion (i.e. their East Asian import shares remained low and static). In contrast, the share of East Asian imports originating in other (non-Japanese) East Asian countries more than doubled, to about 32%.

A similar pattern is evident in the export statistics. The 1985–1996 shares of East Asia's components exports going to Europe remained essentially stable, whilst North America's shares experienced a sizeable decline. Within the Asian regional subgroups the relative importance of South Asia's share was low and remained virtually unchanged, while the share of East Asian exports destined for Oceania declined by more than 2 points from its 1985 level (3.8%). As with imports, it was in the other (non-Japanese) East Asian countries that regional exporters registered their greatest relative trade gains. In short, as measured by either exports or imports, the driving force behind the expansion of production sharing in East Asia come largely from the East Asian countries.

Integration from the East Asian perspective stands in sharp contrast to the EU model, particularly when it comes to governments' role in the process. The integration in the EU is largely a result of the European governments' collective policy initiatives, which are given a great deal of political weight. Similar policy initiatives are absent in East Asia (with the exception of the Association of

Table 2.1: The Origins and Destinations of East Asian Countries Trade in Parts and Components

Region	Imports			Exports		
	1985	1990	1996	1985	1990	1996
WORLD	Value of Trade in US$ million					
	17,693	63,827	165,549	33,152	89,469	178,547
	Share of Trade Destined for or Originating in					
WORLD	100.0	100.0	100.0	100.0	100.0	100.0
ASIA	43.5	59.4	58.5	31.9	41.2	49.6
Of which						
Japan	28.7	29.1	25.6	1.7	3.2	5.3
Other East Asia	14.2	29.3	32.0	24.2	34.9	41.3
South Asia	0.2	0.2	0.3	1.5	1.0	1.0
Oceania	0.5	0.6	0.6	3.8	1.9	1.5
Former Soviet Union	*n/a*	0.1	0.1	0.8	0.3	0.4
NORTH AMERICA	37.1	25.1	23.3	44.9	35.3	29.5
Of which						
United States	36.2	24.3	22.3	41.8	32.4	27.2
EUROPE	16.6	15.0	17.0	14.0	19.2	16.2
Of which						
European Union	15.5	13.8	16.0	13.1	18.3	15.3
Eastern & Other Europe	1.1	1.3	1.0	0.9	0.9	0.9
LATIN AMERICA	0.2	0.2	0.4	3.1	2.3	2.8
Of which						
Mercosur	0.1	0.1	0.2	0.8	0.6	1.1
MIDDLE EAST	0.1	0.1	0.3	4.0	1.1	1.0
AFRICA	*n/a*	*n/a*	*n/a*	1.6	0.6	0.4
Of which						
Sub-Saharan Africa	*n/a*	*n/a*	*n/a*	0.9	0.3	0.2
UNSPECIFIED COUNTRIES	2.4	0.2	0.7	0.5	0.2	0.4

Source: Ng and Yeats (2001), "Production Sharing in East Asia: Who Does What for Whom, and Why?"

East Asian nations [ASEAN]). Indeed, China, Japan, South Korea, Taiwan, and Hong Kong were not parties to any regional trade agreements before 2004. Nevertheless, the East Asian economies have attained a high degree of integration based on market forces. Apparently, governments in the region have shown willingness and flexibility in the accommodating the market's need.

Goto and Hamada (1994) voice that preconditions for a free trade area in East Asia seem to be met amongst countries in the region. They find that the degree of interdependence amongst East Asian countries through trade and factor mobilisation is substantial. Some indicators show a higher degree of interdependence amongst Asian countries than amongst the EC countries which are usually regarded as benchmark. In their following paper in 1995, they continue to show that it would be a natural response of Asian countries to create a tighter regional FTA against two other big blocs in the world, EC and NAFTA. But they point out that the U.S. would discourage this formation of FTA[9] as its natural reaction due to the negative impact on other countries out of the region, and high degree of economic dependence of East Asia with the U.S. Thus, Goto and Hamada (1995) suggest that a looser integration, e.g. APEC, would be a good roundabout way toward further integration.

Therefore, the ASEAN Free Trade Area (AFTA) has been established since the year 1992. More than 99% of the products in the intra-trade between the six advanced economies in ASEAN, comprising Brunei, Indonesia, Malaysia, the Philippines, Singapore and Thailand, have been brought down to the 0-5 percent tariff range. The new members are not far behind in this process. Vietnam has until 2006 to bring down tariff of products to no more than 5% duties, Laos and Myanmar in 2008 and Cambodia in 2010.

Moreover, ASEAN is actively seeking further integration with other countries in the region, although the proposal of EAEC is currently on hold due to the Japanese opposition. The talks on ASEAN+3 (ASEAN, plus China, Japan and Korea) have been continued. ASEAN aims to achieve a greater regional free trade area or even a tighter economic community including other three regional economic powerhouses by the year 2020. Over the years, total trade value between ASEAN and the Plus Three Countries (China, Japan and Korea) reached US$195.6 billion in 2003 compared to US$170.8 billion in 2002, marking a growth

[9]The EAEC (East Asia Economic Caucus) proposed by Dr Mahathir, the former Prime Minister of Malaysia, is putting on hold since Japan opposed to the plan.

of 14.49% in 2003.

In 2002, China signed up to ASEAN's 1976 Treaty of Amity and Co-operation, which calls for dialogue-based solutions to both political and economic disputes. Also China and ASEAN agreed to set up a free trade framework by the year 2010.

As for the relationship between Japan and ASEAN, Japan continues to be the third largest export market and the largest import source country. It may be argued that Japan might be too relative strong to be part of the Asian economic integration.[10] However, as reported in other international trade literature, Japan exports parts and components to South-East Asian countries for assembly and then re-export to final export markets, e.g. the U.S. or the European Union (EU). This participation in vertical specialisation is attributed to the future economic integration, which also it is part of the study of this thesis. In 2003, ASEAN and Japan agreed to establish a Comprehensive Economic Partnership (CEP) before the ASEAN-Japan FTA is to set up in 10 years time.

All these efforts plus the underway negotiation of bilateral trading agreement with Korea will serve as the building blocks for a possible establishment of an East Asia Free Trade Area (EAFTA) in the near future.

Having experienced the financial crisis in 1997/1998 in East Asia, as for the financial and monetary integration, countries within the region have learnt a lesson from the crisis, and now are on a road map to achieve deeper financial cooperation or integration, though so far it is not clear whether a common currency, like Euro, should be created or peg their own currencies to a major external anchor currency, e.g. US Dollars.[11]

Within the ASEAN, financial services liberalisation under the current third round of negotiations has been actively pursued with a view to conclude it by the end of 2004. On capital account liberalisation, a stocktaking exercise has been ongoing since December 2003, whilst a list of prudential policies and measures is

[10]Tachibanaki (1994)'s comments on the paper "Economic Preconditions for Asian Regional Integration" by Goto and Hamada (1994).

[11]Exchange rates of some countries in the region are de facto pegged with the US Dollars, e.g. China, Hong Kong, Malaysia and Thailand. Frankel and Wei (1995) points out there is no evidence to support a Japanese Yen Area for the region but strong evidence to support a US Dollar bloc for the region.

currently compiled and expected to be completed by June 2004.

The Asian Bond Markets Initiative and the Chiang Mai Initiative are two important steps for ASEAN countries together with China, Japan and Korea to progress to regional finance cooperation. Now the network of bilateral swap arrangements has been expanded from 12 to 16 agreements since August 2003, bringing the total size of the network of US$36.5 billion. This type of monetary coordination can be regarded as a weak form of reserve pooling. Note that most regional countries have floating currencies and apart from Indonesia, most countries have improved their external balance sheet position, so a repeat of the 1997/98 crisis is seen as unlikely. Thus the main significance of the *Chiang Mai Initiative* could be seen as a first step towards greater Asian integration.

Chapter 3

The Correlations of External Disturbances across East Asian Countries

Abstract

This Chapter looks at the evidence from correlations of external shocks to East Asian countries in order to see the possibility of forming a prospective currency union. Following the Bayoumi and Eichengreen (1992) method based on Blanchard and Quah (1989) decomposition, an SVAR is employed to investigate the shocks correlation between the countries of interest. We focus on external shocks because of the high openness of these Asian economies, and exportation as their main engine to push economic growth. Consistent with the result by Bayoumi et al. (1999), ASEAN is feasible to become a currency union. Our finding in the correlations of productivity shocks, however, suggests a close production link from Japan to these Asian countries, which contrasts with the result by Alesina et al. (2002) that there is no a clear East Asian currency area. This finding hints a possible further research on linkages from the supply side.

Keywords: Shock Correlations; SVAR
JEL Classification Code: E32, F15, F33, F42, F55

3.1 Introduction

This chapter investigates the potential benefit and cost, from the perspective of shock correlations, to create a currency union and to share monetary policies amongst East Asian countries. East Asian economies are highly open to international trade, and actively participate in international production sharing. Thus, this chapter stresses on these international linkages by looking at the correlations of external shocks that are original from the international markets, whereas previous studies in literature aimed at the generic effect of shocks. In this chapter, we run a SVAR model on exports and exchange rates to represent demand shocks and productivity shocks which are original from outside of the Asian economies. Having decomposed the error terms in the regression, we find that, in the long run, demand shocks are highly correlated in the group of ASEAN countries. We also discover a high correlation of supply shocks between Japan and its Asian trading partners. It is evidence of strong production sharing linkages across borders in the region. Therefore, from the view point of business cycles symmetry, it brings benefits to East Asian economies to develop a tighter monetary arrangement, e.g. a currency union,amongst them.

As Alesina and Barro (2002) observe, the process of globalisation, in particular the increase in international trade and in the need of price stability, contributes a lot to the incentive to study closer monetary integration. First, the growth of international trade in goods and assets should have raised the transactions benefits from common currencies, and therefore, led to a decline in the number of independent moneys. The recent episodes of financial turbulences around the world stimulate the discussions about "building new financial architectures", regional monetary arrangements have been on agenda of academia and governments. Second, the increased emphasis on price stability also attributes to this trend. The memory of the seventies and eighties exceptionally high inflation in many developing countries and double-digit inflation in several industrial economies generates consideration of irrevocably fixed exchange rate as a possible instrument to achieve stable prices level. Adopting another country's currency or maintaining a currency union seems more credible commitment devices than just simply fixing the exchange rate.

Looking around the world, there are many examples reflecting the consideration of multinational currencies. In 1999, eleven countries in West Europe (now

twelve) adopted a common single currency. Ecuador fully dollarized it economy in 2000. El Salvador legalized the use of the U.S. dollar during 2001, and dollarization is under active consideration in many other Latin American countries, including Mexico, Guatemala and Peru. Six West African states have agree to create a new common currency for the region by 2003, and eleven members of the Southern African Development Community are debating whether to adopt the dollar or to create an independent monetary union possibly anchored to the South African Rand. Six oil-producing countries (Saudi Arabia, United Arab Emirates, Bahrain, Oman, Qatar and Kuwait) have declared their intention to form a currency union by 2010.

In East Asia, the fast growth both in intra-regional and inter-regional trade draws attention to the question of the feasibility of forming a currency union amongst these East Asian countries. Despite the Asian crisis, the achievement of AFTA in early 2002, much in advance of the original deadline of 2008 shows that ASEAN countries have crossed an important milestone to abolish trade barriers and create a level of playing field for cross-border movement of goods, services and capital. Now China and ASEAN agreed to set up a free trade area by the beginning of 2010. Within the region, Japan takes a big share of the ASEAN external trade. Given the intensive trade linkages between countries in the region, it is worth looking at the benefit and cost to create a tighter monetary arrangement for the region of East Asia which can reduce international trade risks associated with exchange rate and price variability and promote free flow of factors across borders.

The rest of this chapter organises as followed: Section 3.2 reviews the theory of optimal currency area, including the definition, and its benefits and loses. Section 3.3 provides a literature review in the field. Countries' background is laid out in Section 3.4. The SVAR econometric analysis is explained in Section 3.6. Section 3.7 concludes.

3.2 Theories of Optimal Currency Areas

3.2.1 Definition

In principle, currency unions can take in either of the two forms below. Edwards and Magendzo (2003) point out the importance to differentiate the different kind of common currency unions because of their different economic performance between these two regimes in terms of independence of monetary policy, seignorage, and capacity to absorb external shocks.

First, a country, usually which is a small country, may adopt another large nation's currency as its own. When the other nation is an advanced country this monetary arrangement has come to be known by the general name of "dollarisation". Under "dollarisation" the country in question completely gives up monetary independence, and monetary policy is run by the advanced nation's central bank. Countries can "dollarise" in a unilateral fashion — in which case they will loose the revenue from seignorage, or they can sign a monetary treaty with the advanced country and share seignorage.

Under the second type of currency union, a group of countries creates a new currency that is common to the group, and a new joint central bank sets up which can engage in independent monetary policy. Under this monetary policy is run by a common currency's exchange rate may float relative to other currencies. The Eastern Caribbean Currency Area ECCA[12] and Communauté Financière d'Afrique; Franc of the African Financial Community (CFA)[13] are intermediate between the two types of unions. In these both cases, the countries have a joint currency and a joint central bank. However, the ECCA currency, Caribbean dollar, has been linked to the U.S. dollar since 1976, and before that to the British sterling pound. The CFA franc has been tied to the Franch franc from 1948 and then pegged to the Euro since 1999 (expect that the CFA franc was devalued and re-pegged for once in January 1994).

[12]ECCA includes Antigua and Barbuda; Dominica; Grenada; Montserrat; St. Kitts and Nevis; St. Lucia; St. Vincent and the Grenadines. Source: Edwards and Magendzo (2003)

[13]CFA Franc Zone is consisted of Benin; Burkina Faso; Cameroon; Central African Republic; Chad; Comoros; Congo; Cote d'Ivorie; Equatorial Guinea; Gabon; Guinea-Bissau; Mali; Niger; Senegal; Togo. Source: Edwards and Magendzo (2003)

3.2.2 Benefit and Cost

As the well-known "border effect", country borders, or in another word, national currencies, matter for trade flows. Anderson and van Wincoop (2003) find that the presence of an international border can reduce trade by 30% among industrial countries and by 44% between the U.S. and Canada. Alesina and Barro (2002) discover that under reasonable assumptions about elasticities of substitution between goods, countries that trade more with each other benefit more from adopting the same currency.

Rose and his co-authors provide a series of evidence through exploiting the gravity model for the idea that currency union like EMU will largely increase international trade. Cross-sectionally, Rose (2000) estimates countries within a currency union trade over three times than those countries adopt their own individual monies from a data pooled 186 countries from 1970 to 1990 in a five-year span. Rose also finds that currency unions are associated with trade growth is faster than non-currency unions, and the impact of a common currency is an order of magnitude larger than the effect of reducing moderate exchange rate volatility to zero but retaining separate currencies. On the time-series dimension, Glick and Rose (2002) complement the research that joining/leaving a currency union leads bilateral trade increase/decrease by about 100% in the fixed effect estimation, and other estimators obtained in their research produce even bigger effects.

Theoretically, a fixed exchange rate system, if totally credible, could achieve the same commitment benefit as a currency union. However, the recent world history shows that fixed rates are not irrevocably fixed, thus they lack full credibility. Consequently, fixed exchange rates can create instability in financial markets. To the extent that a currency union is more costly to break than a promise to maintain a fixed exchange rate, the currency union is more credible. Sharing a common currency would lead to an increase in the depth of trading relations, whilst precluding the "beggar thy neighbour" competitive devaluations that can destroy a common market.

Therefore, if countries within a group that trade more with each other will gain more from adopting the same currency. Also, smaller countries, ceteris paribus, would be more inclined to give up their currencies.

The costs of giving up monetary independence as instrument of business cycle stabilization are lower the higher the association of shocks between the client and the anchor. The more shocks are related the more policy selected by the anchor will be appropriate for the client as well. What turns out to matter is not the correlation of shocks, *per se*, but rather the variance of the client country's output expressed as a ratio to the anchor country's output. This variance depends partly on the correlation of output and partly on the individual variances of output.

The costs implied by the loss of independent monetary policy also depend on the explicit or implicit contract between the anchor and its clients. There are two cases. One is in the case of dollarisation that the anchor does not change its monetary policy regardless of the composition and experience of its clients. If the clients can compensate the anchor to motivate the selection of a policy that takes into account the clients' interest, which will reflect the shocks that they experience. Specially, it is cheaper for a client to buy accommodation from an anchor that faces shocks that are similar to those faced by the clients. The allocation of seignorage arising from the client's use of the anchor's currency can be made part of the compensation schemes.

The other case of currency union looks like clients with compensation, because the monetary policy of the union is not targeted to a specific country but rather to a weighted average of each country's shocks. The EMU is a good case in point. The ECB does not target the shocks of any particular country but rather the harmonized inflation rate across the Euroland.

In the case of developing countries, the cost of abandoning monetary policy may not be so high because stabilization policies are typically not well used when exchange rate are flexible. To the extent that monetary policy is not properly used as a stabilization device, the loss of monetary independence is not a substantial cost and may actually be a benefit.(Alesina et al., 2002)

The countries that stand to gain the most from giving up their currencies are those that have a history of high and volatile inflation. This kind of history is a symptom of a lack of internal discipline for monetary policy. Hence, to the extent that this lack of discipline tends to persist, such countries would benefit the most from the introduction of external discipline. Linkage to another currency is also more attractive if, under the link system, relative price levels between the

countries would be relatively stable.

Empirically, Edwards and Magendzo (2003) consider it important to distinguish these two kinds of regimes in the terms of independence of monetary policy, seignorage and capacity to absort external shocks. Therefore, they chose 20 strictly dollarised countries and 32 countries that are members in currency unions. Also, they create a new estimate method of "treament effects model" to investigate the growth, inflation and growth volatility directly. They revealed that both types of common currency countries have lower inflation than countries with their own currency. Dollarised countries have lower growth and higher volatility than countries with a domestic currency. Currency unions, on the other hand, have higher growth and higher volatility than countries with a domestic currency.

3.3 Literature Review

Pioneered by Mundell (1961), the classical work of OCAs compared the gains and losses from monetary unification. The study of the theory and application of OCAs has been rekindled by the possibility of monetary unification in various parts of the world. McKinnon (1963) and Kenen (1969) developed the concept of OCAs, adding important arguments to the debate. Most of literature focuses on the four inter-relationships between the candidate countries of a potential OCA. These four inter-relationships are: 1) the extent of trade, 2) the similarity of the shocks and business cycle, 3) the degree of labour mobility and 4) the system of fiscal transfer.

The classic Mundellian definition of an Optimal Currency Area is a region for which it is optimal to have its own currency and its own monetary policy for the region wide. Therefore, it must be optimal for countries in a region to relinquish their monetary policy, such that the nominal exchange rate is not required by the national government to alter the real exchange rate in the event of asymmetric shocks hitting the region. The nominal exchange rate may not be required to alter the real exchange rate if regional prices are flexible, labour and capital mobility is free, symmetric shocks hit the economies of the region, or any combination of these.

Alesina and Grilli (1992) show in a loss function that the trade-off of joining a currency union depends on the differences in the political preferences and the economic dissimilarities. The participating countries can improve welfare if the union's policy preferences are more conservative than its national preferences. Also, the larger the difference in output variances and the lower the correlation between domestic and the union's output, the higher is the potential cost of being part of a monetary union, because the union's policy might not be suitable for the national countries. To illustrate, they create a formula of economic distance to measure the economic dissimilarities according to the standard deviations and the correlation coefficients of the growth rate of outputs. They also empirically find that the countries those which may pay highest cost by giving up their own monetary independence will benefit the most from gain in credibility. In their following paper in 1993, they suggest that it is less likely to form a currency union in a multi-speed.

Alesina and Barro (2002) extend the study of gain/loss to adopt common currencies in with more general consideration, taking the compensation of policy adjustment and country size into accounts. Since the anchor countries can choose whether or not to consider the clients' interests in their discretionary monetary policy, the client countries would be better give up the seignorage income as to buy the anchor's accommodation. In this case, the country size, in term of GDP, would be of importance to the price that clients pay for policy accommodation. If the anchor country takes account of costs imposed on clients, dollorisaiton is not inflationary. Also from the perspective of minimizing the expectation of its own costs, the anchor country's reactions to its economic shock is insufficient if it considers the linking countries' interests. The difference in cost between focusing on the individual and on the union universe to the anchor country depends on the relative size of linking country, on the variance of the relative price shock and on the variance of the difference in the economic disturbances. On the contrary, from the view of clients, to adopt common currencies reduces the negative effects of relative price shocks and the economic disturbance similarity, which overall makes the choice of joining a union more favourable because of buying policy accommodation. The smaller size of anchor is, the less compensation that the linking countries must pay for the policy accommodation. Theoretically, a small size country is more preferred to be an anchor country, but it is difficult for a small size country to bear the ex-post pressure on inflation. Thus, a larger anchor country, in relation to its clients, may be more solid. Or, a common currency

union is easier to form amongst countries with nearly equal economic size.

Alesina and Barro (2002) also combine the effect of trade on the economic shock similarity. In a given size world, the trading cost effect on output per capita and consumption per capita decreases as the country size increases. Adopting a common currency facilitates trade by reducing trading cost, which has a large positive effect on a country's output and consumption. Usually, countries or regions that naturally trade a lot would particularly benefit from using a common currency. The trade volume is increasing in the size of each country. However, the correlation between the shocks of the two economies will be related to the volume of trade scaled in some manner by country size. Usually, we assume a higher volume of trade between two countries will have lower variance of relative price shocks and of economic shock differences. Thus, trading more will raise the gain from adopting common currencies. In the case of equal country size, currency unions usually are formed by adjacent countries if 1) countries gain policy commitment; or 2) trade benefit; or 3) these neighbouring countries share a high correlation of business cycle. Some countries may want to form a union even without the benefit of commitment, if the trade gains are sufficient to compensate for the loss of monetary autonomy. In this situation two or more non-committed countries may form a union, because they are too far from a committed country. That is to say, these countries will suffer from a huge relative price change if adopting the currency of committed country. In a case of different sized countries, if there is a hub-style union which is consisted of small non-committed countries and a only one big committed country in the centre, the same result will happen as the union of equal sized countries; if, however, there are four types countries in the world, which are 1) big and committed, 2) big but not committed, 3) small but committed, and 4) small and uncommitted, currency unions are not necessarily formed by countries adjacent to each other, but may be formed by countries trading the most.

3.4 Asian Story

The European experience has provoked a growing interest in the potential for regional monetary arrangement in other parts of the world. For those who advocate the benefits of regional common currencies, East Asia is the region

which has been mentioned as a potential candidate for closer monetary and exchange rate co-operation. This is because of the perceived characteristics of the countries within the region as a rapidly developing region with open, export-oriented economies and a keen interest in monetary and exchange rate stability. At a meeting in Hanoi in December 1998, ASEAN leaders endorsed a project to study the feasibility of an ASEAN common currency and exchange rate system. In May 2000, the ASEAN+3 (ASEAN: Indonesia, Malaysia, Philippines, Singapore, Thailand, Brunei, Cambodia, Laos, Myanmar and Vietnam + 3: China, Japan and Korea) launched the Chiang Mai initiative which, currently being implemented, will augment the ASEAN swap arrangement of 1977 and supplement it with bilateral swap and repurchase arrangement.

The diversity in the level of economic development amongst the ASEAN countries is quite large. Singapore, the richest country in the group, has a per capita income close to 300 times the per capita income of Myanmar, the poorest countries in the group. It is sometimes argued that such a high degree of income differentials could make it difficult to sustain a monetary union amongst these countries. However, it is important to note that the high degree of output and price co-movement following an economic shock across them matters for the adoption of a common currency. For even if the countries in a monetary union have perfect equality of per capita income, if the co-movement across countries is low, conducting a common monetary for the union as a whole is difficult. On the other hand, even if per capita income across countries in a monetary union are vastly different, but their co-movement following an economic shock is very high, conducting a common monetary policy is much less problematic. There are some populous countries in the world, i.e. China, India or the U.S., also exhibiting large intra-regional income differentials within themselves. Yet, each of these countries uses a single currency. If countries with diverse sub-regions can adopt a common currency, why not a region with diverse countries? As compromised, five more developed countries from the ASEAN (Hereafter as ASEAN 5: Indonesia, Malaysia, Philippines, Singapore and Thailand), together with China (including Hong Kong), Japan and Korea are becoming the region of our interest.

Frankel and Wei (1993) found that: 1) there are indeed intra-regional trade biases in the EC and the Western Hemisphere and perhaps in East Asia; but 2) the greatest intra-regional bias was in one of these three, but in the APEC

grouping, which includes the U.S. and Canada with the Pacific countries; and 3) the bias in the East Asia and Pacific groupings did not increase in the 1980s.

Frankel and Wei (1994) apply the gravity model with trading area dummy variable to investigate the trading bloc effect. Consistent with their paper in 1993, they find that the strongest bloc effect is the Pacific bloc which includes the U.S. and Canada along with East Asia, Australia and New Zealand. The significant gravity coefficient suggests trade the bloc effects double trade between members in the group of East Asian countries alone. Also in their currency bloc regression, there is no strong evidence to support the East Asian currency bloc. If there is any, it is more likely to be classed in a US dollar bloc. Embedded a term of exchange rate volatility in the gravity model, an instrumental estimation with the standard deviation of relative money supply as instrument for the volatility of exchange rate is employed to correct the simultaneity. They find the trading bloc effect is a bit attributed to exchange rate links.

Bayoumi and Eichengreen (1999) develop an OCA Index based on the Mundell's theory (1961) of optimal currency areas. The index is derived from the result of a cross-sectional regression covering advanced and East Asian economies that relates observed exchange rate variability to four optimal currency indicators. The independent variables are: 1) the standard deviation of the difference in growth rates across two economies; 2) the dissimilarity of the composition of trade; 3) the level of bilateral trade; and 4) the size of the two economies. The first two indicators are proxies for the costs associated with asymmetric shocks, the second two for the benefits from stabilizing exchange rate with close trading partners and across larger groupings. A smaller value of the index suggests countries are better to share currencies. They use ASEAN data for 1995, and predict that the largest ASEAN economies (Indonesia, Malaysia, Philippines and Thailand) are not far from the level of preparedness for monetary union, compared with continental Europe in 1987.

In one of their extended conference paper co-authored with Mauro (1999), a Vector of Autoregression (VAR), which includes industrial production, price level and interest rate, is run to investigate the correlations of shocks and their effects on output based on the Bayoumi and Eichengreen (1992). They derive underlying domestic aggregate supply and demand disturbances for the ASEAN 5 and the EU countries. They suggest that the aggregate supply disturbances

affecting Indonesia, Malaysia and Singapore are relatively high correlated, whilst the Philippines and Thailand experience more idiosyncratic shock. The results are similar to the European experience where shocks appear to be relatively highly correlated between Germany and France, whilst those affecting Italy and Spain are more idiosyncratic. However, their empirical results show that the speed of adjustment to shocks in the ASEAN 5 countries is much faster than in European countries, thus implying the former region has more flexible labour markets.

Alesina et al. (2002) compute the price co-movement based on the countries' price level relative to that in the U.S. and output co-movement based on countries' PPP values of GDP relative to the U.S. exchange rate under an AR(2) framework. The lower value of relative root-mean-squared error suggests a higher co-movement between countries. They can not define a clear Yen area, because, in terms of co-movements, Japan seems to be less associated with the rest of the world. They conclude that Japan is not an attractive currency anchor for Asian countries for policy commitments and trade links. Few countries exhibit a high trade-to-GDP ratio with Japan.

Frankel and Rose (2002) estimate the effect of common currency on trade and income. With the cross-sectional gravity model, they find an approximately 300% stimulus to trade from sharing a common currency, and they find no evidence that trade created amongst members of a currency union comes at the expense of a diversion of their trade away from non-members. Furthermore, they incorporate this gravity model as an instrument variable into their Instrumental Variable (IV) specification for the effect of trade on income. With or without controls, there is an almost the same positive effect of openness (proxied by ratio of trade to GDP) on real income per capita. If they include the inner product of bilateral currency union membership, partners' real GDP and the distance between them in the output equation, the result shows that the improvement of income gained from adopting a common currency is through trade stimulus only, but not through other channel, e.g. monetary credibility and stability. It is a quite straightforward three-fold effect. The currency union boosts total trade, which promotes the openness of the economy, and the openness is a significant determinate of growth.

In most East Asian counties, their nominal exchange rates are, *de facto*, pegged with the U.S. dollar. So the exchange rate viability between these coun-

tries is quite small. Figure 3.1 illustrates the nominal effective exchange rates of selected countries in East Asia. It is obvious to tell from the figure that the variability of exchange rates in Asian countries has been in a narrow range since 1990. The exchange rates have a high degree of co-fluctuation amongst countries in the ASEAN group.

Also in the East Asian countries, the inflations are quite mild across candidate countries for the prospective currency union. Table 3.1 exhibits the GDP deflators for the countries in the region over the period from 1970 to 2004. The GDP deflator is used to measure prices since it reflects the prices of output rather than the price of consumption.

One of the main benefits of common currency is that the reduction of exchange rate variability should reduce the risk and costs of cross border trade. In this respect, the greater the degree of intra-regional trade, the larger is the potential welfare gain. Table 3.2 shows the intra-regional trade as a percentage of total trade for each individual country. In the year 2004, the range of intra-regional trade share is from the lowest Japanese figure 39.43% to the highest Hong Kong's figure 64.74%. Even the '97 Asian financial crises did not reduce the trade amongst these countries. About half of the external trade of these countries take place within the region.

Inspired by Frankel and Rose (2002) empirical finding, we have carefully considered the situation in the region of ASEAN 5+3. As shown in the Table 3.3, the main export markets are similar for these eight economies. Around half of the exports from these Asian countries are to the industrial countries. It implies that these economies might face the similar external demand shocks.

Also Table 3.4 suggested, all these East Asian countries, with an exception of Japan, are fairly open to the world economy. Hong Kong and Singapore are mainly undertaking re-export, which result in their extremely high ratio of trade in good to GDP. The rest of the candidate countries still exhibit high openness to the world. It suggests that these economies have possibility to be subject to a similar external supply shocks.

Combined the fact displayed in Table 3.3 and Table 3.4, we would have a conjecture that the East Asian countries share high cross-country correlation of

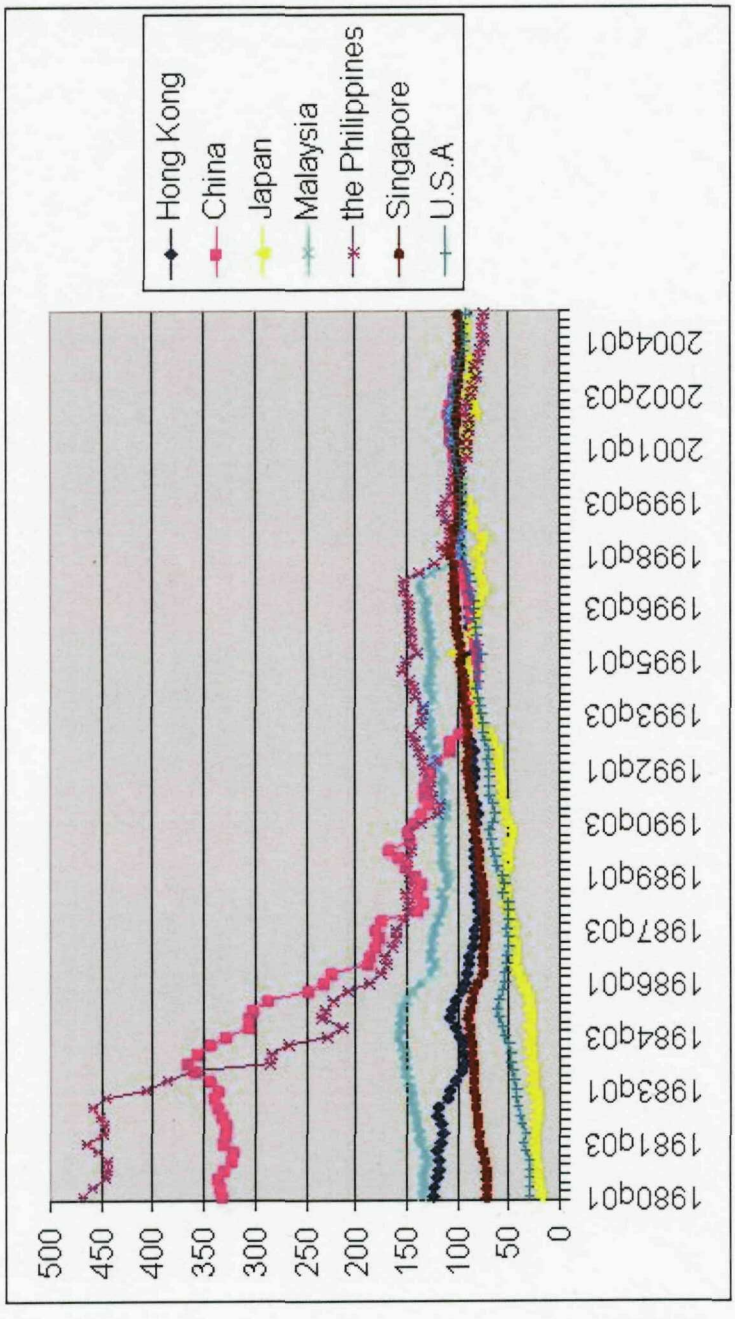

Figure 3.1: Nominal Effective Exchange Rates for Selected Economies

Table 3.1: Inflation in East Asian Economies

Country/Year	1970	1975	1980	1985	1990	1995	1997	1998	2002	2004
China	-2.64	-1.16	3.78	10.14	5.68	13.18	0.82	-2.40	-0.21	6.33
Hong Kong	8.56	4.61	15.29	5.79	9.44	2.46	5.65	0.20	-3.60	-2.82
Japan	6.46	7.18	5.44	2.31	2.41	-0.51	0.29	75.27	-1.18	-2.32
Korea	18.42	26.04	24.04	4.77	10.52	7.39	4.62	-0.09	2.82	2.65
Indonesia	13.62	11.20	30.99	4.29	7.72	9.70	12.57	5.82	5.99	7.08
Malaysia	-0.39	-3.08	6.87	-1.51	3.81	3.63	3.48	8.50	3.83	6.04
Philippines	7.86	9.32	14.25	17.63	12.97	7.55	6.22	10.46	4.52	6.11
Singapore	1.70	2.44	11.45	-1.39	4.45	2.09	0.38	-2.38	0.91	3.49
Thailand	-5.00	3.49	12.70	2.18	5.77	5.59	4.06	9.24	0.72	4.56

Source: the World Development Indicator, the World Bank, 2004

Table 3.2: Intra-Regional Trade as Percentage of Total Trade in East Asian Economies

Country/Year	1980	1985	1990	1995	1997	1998	2002	2004
China	42.43	53.16	56.73	48.90	48.73	45.17	42.72	40.50
Hong Kong	40.49	49.01	52.42	57.13	57.90	57.23	61.92	64.74
Japan	21.22	21.92	23.66	33.20	32.68	28.53	36.23	39.43
Korea	31.47	29.52	31.98	39.96	37.76	35.26	42.23	43.92
Indonesia	59.02	54.64	53.32	50.96	48.47	46.16	50.71	52.66
Malaysia	48.03	55.31	51.78	51.24	51.48	47.75	53.22	53.27
Philippines	36.09	39.81	35.09	41.94	42.22	42.17	48.14	52.27
Singapore	39.65	42.81	43.34	50.86	48.45	45.93	50.79	50.41
Thailand	38.69	42.59	44.06	45.02	45.08	41.62	46.75	49.10

Source: Direction of Trade Statistics, the IMF, 2004

Table 3.3: Export percentage to Industrial Countries in Total Trade

Country/Year	1980	1985	1990	1995	1997	1998	2002	2004
China	44.75	41.82	35.02	51.36	51.29	55.29	54.48	53.81
Hong Kong	62.32	54.34	53.06	46.78	46.38	48.43	43.50	38.84
Japan	45.94	57.99	58.55	47.67	48.21	54.25	48.20	42.14
Korea	64.91	69.87	66.92	47.41	41.63	48.05	46.61	42.05
Indonesia	77.63	75.76	70.24	59.10	55.86	53.53	52.63	50.57
Malaysia	59.66	54.73	50.57	50.22	48.35	51.88	47.25	45.11
Philippines	75.27	73.80	79.21	71.43	71.74	70.64	60.07	56.82
Singapore	40.68	46.88	49.55	42.88	42.73	47.20	38.69	38.06
Thailand	57.89	56.98	67.10	51.29	53.55	57.23	53.76	49.24

Source: Direction of Trade Statistics, the IMF, 2004

external shocks since they are highly exposed to the external demand and supply disturbances.

3.5 Econometric Methodology

3.5.1 Data

The annual data used in this chapter are obtained from the International Financial Statistics (IFS) which is developed by the International Monetary Fund (IMF). The time span of the data covers from 1960 to 2004 for most countries of interest, except for Indonesia. The exports of each country are Free On Board

Table 3.4: Trade in Goods as Percentage of GDP

Country/Year	1970	1975	1980	1985	1990	1995	2000	2003
China	5.01	9.69	20.21	22.83	32.55	40.11	43.89	60.05
Hong Kong	142.73	128.17	151.58	174.93	221.54	261.05	252.01	294.77
Japan	18.69	22.67	25.57	22.68	17.20	14.75	18.09	19.87
Korea	31.69	56.94	62.38	63.57	51.13	50.31	65.00	61.56
Indonesia	21.85	36.93	41.97	33.03	41.52	42.57	63.68	44.89
Malaysia	72.21	74.91	95.35	87.32	133.36	170.66	199.50	174.79
Philippines	34.01	40.35	43.19	32.74	47.73	61.85	101.18	94.33
Singapore	211.73	238.29	370.22	277.51	307.59	289.25	297.73	297.85
Thailand	28.35	36.87	48.58	42.06	65.75	75.78	106.73	109.36

the World Development Indicator, the World Bank, 2004

(FOB) priced and recorded in American Dollars. We tried to find the effective real exchange rate for each country that we are interested in, but almost half of these candidate countries (Hong Kong, Indonesia, Korea and Thailand) do not report this index. As compromised, we use the exchange rate between the national currencies and Special Drawing Rights (SDRs) to proxy the real exchange rate, because the value of SDRs is based on a basket of key international currencies, which reflects the world's trading and financial realities. The exchange rate between national currencies and the SDRs is recorded as the domestic price of per SDR. The value of this exchange rate decreases if the national currency appreciates, and *vice versa*.

Augment Dickey-Fuller tests are employed to test the unit root hypothesis for each series of our interest. Both series reject the null hypothesis and display the property of I(1) process. In order to conduct our estimate, a first order difference is taken for both series to reduce the I(1) process to a stationary process.

We have 45 observations in all. If too many lagged term are included, it will reduce degrees of freedom. On the other hand, if too few lags are involved, it will lead to misspecification. Hence, the *Akaike* Information Criterion (AIC) is employed to choose model that gives the lowest value of the criterion. And we find that only one lag included is the optimal choice.

3.5.2 Econometric Framework

Recent literature focuses on the trade-off to adopt common currencies by examining correlation of candidate countries' business cycle and the symmetry of shocks across potential members of the union. Frankel and Rose (1998), however, argue that there exists endogeneity in the criteria of optimal currency areas. Four de-trended variables (real GDP; industrial production; employment; or the unemployment rate) are used to measure the correlated economic activities between countries. Estimation with instrumental variables built up on the gravity model is employed to avoid a downward estimated effect of trade. Also a dummy variable as unity if two countries shared a bilateral fixed exchange rate is added in to their sensitivity test. The robust result of trade effect contrasts with the Bayoumi-Eichengreen (1992) view that the high correlation amongst European incomes is a result not of trade links, but of Europeans' decision to relinquish

monetary independence *vis-à-vis* their neighbours. They conclude that with trade boosting up, a country is more likely to satisfy the criteria for entry in a currency union *ex post*, even it does not *ex ante*.

Artis and Zhang (1995) find similar result that most European countries' incomes were more highly correlated with the U.S. during 1961 -1979, but have become more highly correlated with Germany since joining the ERM. (Of course, the U.K. is an exception.)

A VAR describes the dynamic evolution of a number of variables from their common history. The analysis of VAR can solve the endogenous problem because the VAR can mimic the data-generating process. The individual coefficients in the estimated VAR model are interpreted as impulse response function, which traces out the response of the dependent variable in the VAR system to shocks in the error terms. However, a VAR model is theoretic because it uses less prior information. With no theoretical input to the model, it is difficult to claim that its output provides much of a theoretically justified result. Then if a number of restrictions and forms of theory are imposed, it can be brought to bear to allow the analysis to proceed. Therefore, the VAR with a structure, in which a number of restrictions are involved, can identify the long run and short run shocks which affect the endogenous variables in the VAR system. Hence, there is sufficient information contained in the structural VAR model and we can meaningfully interpret these results.

The Blanchard and Quah (1989) decomposition, by using relatively uncontroversial long-run restriction, offers an opportunity to perform this analysis. The decomposition employs the traditional view of macroeconomic fluctuations where aggregate demand is downward sloping in price-output plane, and the long-run aggregate supply is vertical. The use of the classical dichotomy assumes that 1) prices are negatively related to AS shocks; 2) prices are positively related to AD shocks; 3) AS shocks permanently affect the level of real output; and 4) AD shocks only affect the level of real output temporarily.

Bayoumi and Eichengreen (1992) take this argument one stage further and assume that primitive AD shocks are related to policy choices which through fiscal and/or monetary policy affect the level of AD but not AS, which is solely related to the real economy in the form of productivity shock. This approach may be

sensible as it seems likely that for standard inter-temporal reasons, the operation of monetary policy operates through both channels of aggregate demand, e.g. identified IS and LM shocks. This would mean that any identified asymmetry in demand shocks may in fact originate from the operation of monetary policy. But it is also clearly possible that asymmetric non-policy related demand shocks from, for example, the goods or asset markets are also likely to play a role. Of course, this oversimplification may also neglect, for example, the role of fiscal policy in determining saving and capital formation of subjective discount rate and hence on aggregate supply. But Blanchard and Quah (1989) argue that as long as the effects of IS or LM shocks are relatively unimportant compared to the permanent output effects of supply shocks then the results will not be too badly distorted.

Here in this chapter, we adopt a similar approach, but take the international respects into accounts. We follow a flexible price model in open economy. If there is a world relatively demand shock for domestic products, the real exchange rate appreciate (a fall in q); if there is a relative output shock for domestic country, the real exchange rate depreciate (an increase in q). Also we have made assumptions on the countries of our interest. The East Asian countries exhibit a strong openness with the world economy, which illustrated by a high ratio of trade to GDP. Thus, we assume that the domestic productivity shock is associated with the world relative supply shock. It implies that the real exchange rate depreciate if there is a domestic demand shock for world products. The demand shock is just only transitory. It will not have the long run effect on output. It is a necessary assumption on our following estimation.

Clarida and Gali (1994) show that the nominal fluctuation in exchange rate is the main source of the volatility of real exchange rate. Given most East Asian countries *de facto* peg their currencies with U.S. dollars (illustrated in Section 3.4), we assume that it is no harm to our estimation if we ignore the monetary disturbances effects on the exchange rate.

The structural VAR methodology proposed by Blanchard and Quah (1989) is employed in this paper. Under that framework we are allowed to decompose series into temporary and permanent components, and distinguish temporary and permanent shocks to variables using VAR. When this method is applied, the theoretical restrictions have to be imposed for identification purpose.

We consider the following standard VAR model:

$$Y_t = AY_{t-1} + u_t \tag{3.1}$$

where Y_t and Y_{t-1} are $k \times 1$ vectors at time t and $t-1$, respectively; u_t also is a $k \times 1$ vector with the variance-covariance matrix Σ and represents the innovations from the equations in the VAR; A represents a $k \times k$ matrix of coefficients.

If the matrix $I - AL$ in invertible, pre-multiplication by $(I - AL)^{-1}$ allows the VAR to be rewritten as the following form:

$$Y_t = (I - AL)^{-1}u_t = (I + AL + (AL)^2 + \cdots)u_t \tag{3.2}$$

where I is a $k \times k$ identity matrix and L is the lag operator.

Furthermore, in order to analyze temporary and permanent shocks to variables, innovations need to be decomposed into uncorrelated structural shocks. We assume

$$u_t = C\varepsilon_t \tag{3.3}$$

where ε_t is a $k \times 1$ vector of white noise process and represents a $k \times 1$ vector of uncorrelated structural shocks; and C is a $k \times k$ matrix and denotes the contemporaneous coefficient matrix on u_t. And it implies that $CC' = \Sigma$, which the variance-covariance matrix of u_t. Then the VAR model could be rearranged as

$$Y_t = (I - AL)^{-1}u_t = I + AL + (AL)^2 + \cdots)C\varepsilon_t \tag{3.4}$$

In this chapter, we construct a 2×1 vector $Y_t = (\triangle ex_t, \triangle er_t)'$, where ex_t and er_t denote the logarithm of exports and exchange rates; and also ε_t is a 2×1 vector $(\varepsilon_{1t}, \varepsilon_{2t})'$, where ε_{1t} and ε_{2t} are the demand shocks and supply/productivity shocks from the external of the economies. Dickey-Fuller (Augment Dickey-Fuller) test is employed to do the unit root test for each series. Then we take the first order difference for each series to reduce both I (1) processes to stationary processes. Hence, the VAR model above can be written as following:

$$\begin{bmatrix} \triangle ex_t \\ \triangle er_t \end{bmatrix} = \sum_{i=1}^{\infty} L^i \begin{bmatrix} a_{11i} & a_{12i} \\ a_{21i} & a_{22i} \end{bmatrix} \begin{bmatrix} C_{11} & C_{12} \\ C_{21} & C_{22} \end{bmatrix} \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix} \tag{3.5}$$

Due to the fact that the composite shocks, $u_t = (u_{1t}, u_{2t})'$, have no structural interpretation in the VAR model, we need to interpret these results via estimating the shocks, $\varepsilon_t = (\varepsilon_{1t}, \varepsilon_{2t})'$. In order to identify exactly an estimated VAR, we have to impose $\frac{k(k-1)}{2}$ restrictions as well of restrictions of unity and orthogonality. Therefore one additional restriction is required in this paper. In terms of macroeconomic theory, both international demand and supply/productivity shocks have permanent effect on the level of exchange rate. While international demand shocks have only temporary effect on the level of export, and international supply/productivity shocks have permanent effect. When the restriction that the international demand has no long-run effect on the level of export is imposed, Equation 3.5 can be rewritten as:

$$\begin{aligned} &\sum_{i=1}^{\infty} L^i \begin{bmatrix} a_{11i} & a_{12i} \\ a_{21i} & a_{22i} \end{bmatrix} \begin{bmatrix} C_{11} & C_{12} \\ C_{21} & C_{22} \end{bmatrix} \\ = &\begin{bmatrix} 0 & \sum_{i=1}^{\infty} L^i a_{11i} C_{12} + \sum_{i=1}^{\infty} L^i a_{12i} C_{22} \\ \sum_{i=1}^{\infty} L^i a_{21i} C_{11} + \sum_{i=1}^{\infty} L^i a_{22i} C_{21} & \sum_{i=1}^{\infty} L^i a_{21i} C_{12} + \sum_{i=1}^{\infty} L^i a_{22i} C_{22} \end{bmatrix} \end{aligned} \tag{3.6}$$

The restriction allows not only the international demand and supply/productivity shocks to be just identified, but also this structural VAR model to be estimated.

3.6 Empirical Evidences

As discussed in the previous section, the Structural Vector Autoregression (SVAR) model allows to identify the long-run demand shocks and long-run supply/productivity shock, which are the white-noise residuals of Equation 3.5 in the SVAR framework, namely ε_{1t} and ε_{2t}. The purpose of our study is to examine shocks correlations between countries, in order to find out how close countries are linked together. Therefore, we run the SVAR regression ,and save residuals from regression as demand shocks and supply/productivity shocks for each country of interest, respectively. Then, we compute the contemporaneous correlations of shocks from saved residuals between pair of countries in question. The correlations can be regarded as shock correlations, which is our main interest of this study.

3.6.1 Correlations of International Demand Shocks

In this chapter, external demand shocks mean the disturbances on demand for candidate countries' output, e.g. exports. As illustrated in Table 3.3 of Section 3.4, approximately half of the exports from these countries destine industrial countries. Given exports' big contribution to GDP in all these East Asian countries, their real output might be affected if there is a shift in the demand from their target markets, though this international demand shocks are supposed to be transitory.

Table 3.5 shows the correlation coefficients measuring the correlation of international demand shocks across the East Asian Countries. They are the contemporaneous correlations of residual series ε_{1t} between any two countries in our sample. The most remarkable feature in the table is the international demand shocks correlations between countries in the group of ASEAN5 countries. With the lowest value 0.3 between the Philippines and Singapore and the highest value 0.76 between Malaysia and Singapore, the correlation coefficients within the group mainly lie in the range between 0.4 and 0.5. Korea also has similar scale correlations of international demand shocks with all countries of interest except with China. There is an exhibition of negative correlated international demand shocks between Japan and most countries of our question. It can be explained that Japan has a different exports structure from those of its neighbour countries. Another notable result is the high correlated international demand shocks between the two major port economies and their biggest trading partner. Hong Kong has 0.37 with China and Singapore has 0.76 with Malaysia. Malaysia and Thailand have plausible correlations with all the economies in the region.

Most pioneered work on European economic integration such as the European Monetary Union (EMU) uses shock correlations between different regions in the U.S. as benchmarks. As one argues that the U.S. is an optimal currency area indeed, without any barriers to free mobility of factors, for example capital and labour, across regions. However, countries in East Asia have not enjoyed free mobility of factors. They do have barriers of language and culture difference. Thus, we use shock correlations between countries in Euro Area as our benchmark.

Bayoumi and Eichengreen (1992) compute shock correlations between Germany and other countries in Euro Area. In their SVAR estimation, they use

Table 3.5: Correlations of External Demand Shocks between East Asian Economies

	China	Hong Kong	Japan	Korea	Indonesia	Malaysia	Philippines	Singapore	Thailand
China	1.00								
Hong Kong	0.37	1.00							
Japan	-0.16	-0.33	1.00						
Korea	0.01	0.01	0.03	1.00					
Indonesia	-0.06	0.18	-0.01	0.31	1.00				
Malaysia	0.16	0.15	-0.01	0.54	0.45	1.00			
Philippines	0.01	0.10	0.11	0.30	0.46	0.43	1.00		
Singapore	0.17	0.30	-0.03	0.39	0.48	0.76	0.30	1.00	
Thailand	0.07	-0.12	0.12	0.76	0.40	0.74	0.45	0.51	1.00

† These are the contemporaneous correlations of residuals of ε_{1t} in the SVAR estimation 3.5

Table 3.6: Demand Shock Correlations between Germany and other Euro Economies

Belgium	Denmark	France	Greece	Ireland	Italy	Netherlands	Portugal	Spain	U.K.
0.33	0.39	0.35	0.19	-0.08	0.17	0.17	0.21	-0.07	0.16

Source: Bayoumi and Eichengreen (1992), "Shocking Aspects of European Monetary Unification"

domestic output and price level to capture demand shocks and supply shock respectively for each country. The demand shock correlations in Euro Area are presented in Table 3.6. As discussed in Section 3.4, East Asian countries are highly dependent on foreign demand. So we incorporate exports instead of output in the SVAR to capture demand shocks from the external.

3.6.2 Correlations of Productivity Shocks

The real exchange rate depreciates whenever there are shocks to the domestic output productivity or to the domestic demand for inputs from foreign countries. They are the contemporaneous correlations of residual series ε_{2t} between any two countries in our sample. The ratio of trade to GDP is high in the East Asian countries, as they import enormous components to assemble their export products. Increase in imports may lead to a surge in productivity considering the technology spillover.

Table 3.7 lays out the correlation coefficients gauging the productivity disturbances across the countries in East Asia. Compared with the domestic supply shocks correlations across Euroland researched by Bayoumi and Eichengreen (1992), the East Asian coefficients show tighter productivity link relations. In the group of ASEAN5, the highest correlation in productivity is 0.83 between Malaysia and Singapore whereas the lowest correlation is 0.6 between the Philippines and Thailand. Most of the bilateral correlations in this group drop in the band from 0.6 to 0.7. Similar to the performance in the international demand shocks correlation, Korea has an about 0.4 value of correlations with ASEAN5, and a fairly high value of 0.73 with Japan. This time, both China and Japan achieve plausible correlation relations with their East Asian neighbours. Most of the coefficients of Japan vary from 0.4 to 0.6. The coefficients of China are similar with the Japanese figures. However, Hong Kong does not have its highest correlation with China as it has in the demand shocks correlation.

The productivity shock correlations in Euro Area by Bayoumi and Eichengreen (1992) are shown in Table 3.8. These correlations are computed from the residuals of price level in their SVAR estimation for each country in Euro Area. Due to the highly openness of East Asian economies and their active participation in international production, we use exchange rates instead of domestic price

Table 3.7: Correlations of External Productivity Shocks between East Asian Economies

	China	Hong Kong	Japan	Korea	Indonesia	Malaysia	Philippines	Singapore	Thailand
China	1.00								
Hong Kong	0.45	1.00							
Japan	0.29	0.62	1.00						
Korea	0.15	0.64	0.73	1.00					
Indonesia	0.49	0.55	0.59	0.45	1.00				
Malaysia	0.53	0.71	0.40	0.43	0.68	1.00			
Philippines	0.40	0.47	0.35	0.39	0.67	0.65	1.00		
Singapore	0.60	0.71	0.55	0.48	0.78	0.83	0.63	1.00	
Thailand	0.52	0.71	0.56	0.44	0.68	0.65	0.60	0.72	1.00

[†] These are the contemporaneous correlations of residuals of ε_{2t} in the SVAR estimation 3.5

in Bayoumi and Eichengreen's work (1992) in our SVAR to capture productivity shocks from the external of economies.

In this chapter, the favourite productivity shocks to the domestic country are represented by the depreciation of its long run exchange rates. The long run exchange rates also depreciate if there is a shock to the domestic country's imports. East Asian countries, except Japan, are highly involved in the global trade. China, Malaysia and Thailand are the countries receiving big amount of FDI in their manufacturing sector. Japan invests a lot in East Asia to outsource its manufacturing sector. Economies in the region might be on the same production chain. It helps to explain the contradictions in Japanese coefficient signs of demand and productivity disturbances. Thailand is a good example. It has positive correlations with most countries in the region in terms of either external demand shocks or productivity shocks.

3.7 Conclusive Remarks

As pointed out in theory, the higher the economic disturbances correlate, the less cost for the economies to adopt common currency, and the more benefit from trade promotion. After the decomposition of shocks, our finding is consistent with the previous research that ASEAN5 is not faraway from forming a currency union. Our result, however, suggests to extent this possible union with Korea.

Given the highly ratio of trade to GDP in the region of our interest, we have to think the productivity disturbances, possibly represented by the disturbances in imports, is a more important determinant of forming a currency union, because the technology spillover by the trade will stimulate the growth of economy. In this sense, all the economies studied in this paper are suitable to form a common currency union. Given that ASEAN already is a group of 10 countries, therefore, we suggest that the future free trade area of ASEAN+3 should step forward to form a monetary union.

Our finding is similar to the finding by Bayoumi and Eichengreen (1999) that ASEAN countries are highly correlated in demand shocks. Bayoumi and Eichengreen (1999) uses similar variables to their 1992 paper on Euro Area,

Table 3.8: Supply Shock Correlations between Germany and other Euro Economies

Belgium	Denmark	France	Greece	Ireland	Italy	Netherlands	Portugal	Spain	U.K.
0.61	0.59	0.54	0.14	-0.06	0.23	0.59	0.21	0.31	0.11

Source: Bayoumi and Eichengreen (1992), "Shocking Aspects of European Monetary Unification"

output and price level, plus interest rates to indirectly capture the shocks from the external in their SVAR. They did not find that supply shocks are highly correlated in East Asia. Alesina et al. (2002) did not find a clear Japanese Yen area in Asia through the low correlations they computed from the residuals of their AR(2) regression on output and price level. Whereas, our study find out a strong connection of productivity amongst countries in East Asia, especially between Japan and Southeast Asian countries.

However, please note that the result derived from this study is only suggestive but not decisive for countries in East Asia to form a currency union amongst them. In another word, this finding reveals necessary but not sufficient condition for a monetary union in East Asia. There are still other factors that influence the decision to form a monetary union. However, they are not the focus of this research. This chapter examines the cost of giving up discretionary in terms of shock correlations. The higher correlated shocks to countries in the region, the less cost and more benefit for countries to share common monetary policies and other associated advantages, such as gains from trade. The key point of this argument is the relationship between trade and business cycle synchronisation.

From the classis theoretical point of view, closer international trade could result in either tighter or looser correlations of national business cycles. Cycles could, in principle, become more idiosyncratic. Closer trade ties could result in countries becoming more specialised in the goods in which they have comparative advantages, as noted by Eichengreen (1992); Kenen (1969); Krugman (1993). The countries might be more sensitive to industry-specific shocks, leading more idiosyncratic business cycles.

However, vertical specialization, or in another word, outsourcing is rapidly growing after the World War II. The fast global trade growth might be explained by this trend. Yi (2003) provide evidence. Vertical specialization implies the participating countries on the same boat when facing demand shocks. Also the growth of intra-industrial trade makes the shocks more common across countries, then, the business cycle may become more similar when countries trade more. This needs a further discussion in next chapter.

Chapter 4

Vertical-Speicialisation-Based Trade and Business Cycle Synchronisation

Abstract

It is still an open debate on the relationship between international trade and business cycle synchronisation. Traditionally, it is believed that closer trade relation leads to more idiosyncratic business cycles across countries as countries will be more specialised on the production which they have comparative advantages. However, Frankel and Rose (1998) argue that tighter international trade relation results in more correlated business cycle across countries, as they believe that intra-industrial trade accounts for most trade. This chapter offers new evidence to extend Frankel and Rose's work by considering vertical trade linkages across countries as trade in complementary goods, e.g. intermediates, induces higher symmetry of business cycles. Also, suggested by Coe and Helpman (1995), this type of trade will cause a more rapid spread of productivity shock, which will raise the covariance of countries' output. This chapter empirically estimates these effects from the supply side upon cross-country output co-movements and finds that vertical-specialisation production linkages generate positive effect on output co-movements across countries, both significant in statistics and in economics.

Keywords: Business cycle synchronisations; vertical linkages; spillover effects

JEL Classification Code: F15, F4

4.1 Introduction

It is traditionally believed that the more trade between countries, the more idiosyncratic business cycles these countries would experience. However, in the past decade international trade in intermediate goods and the FDI associated with this type of trade have substantially increased globally, in particular, in East Asia. High volumes of FDI and intermediate goods trade foster international production sharing, causing vertical production linkages extended across borders along the value chain. Will the trade based on vertical production linkages make countries experienced more symmetric business cycles when facing industry-specific shocks? This is the question of interest in this chapter. This chapter investigates the output co-movements across countries through vertical production linkages, in which industry-specific shocks propagate upwards to suppliers or downwards to buyers. In contrast to other research in literature on the relationship between trade and the business cycle synchronisation, this chapter looks at the problem from the perspective on the supply side by considering the vertical production linkages effects induced by increasing trade in intermediates, and shows, through a 2-step regression, that both backward production linkages and forward production linkages have positive significant effects on output co-movements across countries. This result suggests that higher intensity of trade will bring more synchronised business cycles between trading countries as long as the trade is based on vertical specialisation along the value chain.

International trade based on the specialisation of production sharing has changed a lot. In history, the major presentation of this production sharing was predominantly horizontal differentiated specialization in production, and trade between countries were mainly in final goods. For example, developing countries produced primary commodities, and exported to industrial countries for further processing. Then, a proportion of the processed products were shipped back to the countries where the primary commodities originally came from. Later after the World War II, a new form of production sharing has emerged. It is mainly represented by the vertical specialization in different stages along the production chain across country borders. For instance, developed countries primarily are responsible for product design, marketing and production management, etc. Then the emerging markets take over the processing stages such as assembly, in which they have comparative advantages. The final product may or may not finish in these emerging markets, and then export to the world. If the trade base on this

type of vertical production sharing is increasing, it implies that countries in the world are becoming more and more interdependent on each other.

The main push of this internationalisation of vertical production is the great progress in transportation and information technologies. The improvement of these technologies makes it more feasible for multinational corporations to differentiate production process into several vertical stages across countries to exploit the local comparative advantages. The differential of production process is usually achieved by outsourcing and foreign direct investment. There are currently more than 39,000 parent firms and 279,000 foreign affiliates worldwide, with a total FDI stock equal to $12.4 trillion in 2006, compared with $1.8 trillion in 1990. For the region of East Asia, the value of FDI stock was $923 billion in contrast to 49 billion in 1990. Accompanying the increase in FDI, parts and components trade has grown significantly.

Vertical specialisation is usually associated with the international trade in parts and components. Taking the advantage of SITC Rev. 2 which allows to distinguish components and parts in machinery and transport equipment (SITC 7) group, Yeats (1998) investigates how much production sharing taking place across country borders. For the OECD countries as a whole in the year 1995, it recorded a positive balance of trade in components and parts in the group SITC 7 by about 17%. It implies that the OECD countries export components and parts of machinery and transport equipments to assemble in the developing countries (non-OECD countries)which they have comparative advantage in this type of labour intensive activities. Japan, amongst these OECD countries, had a most rapid growth in these exports with their share increasing from about 15% to 26% over the 17 years period.[14] Furthermore, though the U.S. remains the largest destination of the OECD components exports, the value and share of these exports to developing countries increases sharply, to China in particular. Chinese imports of components rose from just under $200 million in the year 1978 to $10.7 billion in 1995 — a compound annual growth rate is more than 26%. Following China, other Asian developing countries, i.e. ASEAN5 countries, have big share of parts and components imports.

Because Standard International Trade Classification (SITC) can identify parts and components only of commodity Group 7, machinery and transport equip-

[14]The dominant markets for Japanese components exports are the U.S. China, Hong Kong, Korea, Singapore, Taiwan and Thailand. Yeats (see 1998).

ments, the finding based on SITC clearly understates the goods exchange of this kind globally. Hence, Yeats (1998) explores the U.S. tariff data on offshore assembly processing (OAP) activities and finds that tariff savings are not the key factor motivating trade with OECD countries, but non tariff related cost saving or other technical aspect of production count more in considerations. In his table of the importance of OAP activities in U.S. import for 1994, all ten East Asian economies of our interest have more than 10% share of assembled goods from U.S. content. All of these are undertaken by outsourcing or FDI from the U.S.

Hummels et al. (1998) identifies the increasing world trade associated with the vertical production link by four typical case studies. One of the typical phenomenon is the Mexico's maquiladoras. Mexico's maquiladoras are non-Mexican-owned production plants, mainly owned by Americans for favourable tax and tariff treatments, that complete processing or secondary assembly of imported components for exports. Between 1975 and 1979, the share of total U.S.-Mexican trade attributable to maquiladora vertical trade averaged about 20% per year, and this share rose to an average of 25% in the following decade and of 35% in the first half of 1990's. Because there is surely vertical trade originating from non-maquiladora channels, at least half of the U.S.-Mexican trade could be due to vertical specialisation.

The other typical case given by Hummels et al. (1998) is the Japan-Asia electronic trade. Many of Japanese manufacturing industries, in order to reduce costs or adverse the restriction on place of origin, outsource different stages of production, especially final assembly, to Southeast Asia. As in the year 1995, exports of components to Asia accounted for more than three quarters of all exports there, more than one-half of all exports of components, and more than one third of total electronics exports. Most of this offshore production is then exported back to Japan or to third countries. They find that in the years between 1985 and 1995 vertical-specialization-based trade has almost quadruple in yen terms and has increased nine-fold in dollar terms; as of 1995, it was approximately $55 billion. By contrast, total electronics exports from Japan during this period increased by on 23% in yen terms and by 81% in dollar terms.

As in classic trade theories, the increase in trade will induce countries to specialise more on the production of goods in which they have comparative advantages, and thus leads to more idiosyncratic business cycles because countries

Table 4.1: The Importance of OAP Activity in US Imports and Trading Partner Exports in 1994

	US content of foreign assembled goods		Imports from trading partner		
Exporter	Value ($million)	Share of assembled goods (%)	Value of assembled goods ($million)	Imports of all products ($million)	Share of assembled goods in all imports (%)
Haiti	25	71.4	35	62	56.5
Dominican Rep.	1,109	65.0	1,707	3,166	53.9
El Salvador	175	54.3	322	635	50.7
Jamaica	306	80.5	380	790	48.1
Mexico	11,508	50.2	22,944	50,280	45.6
Honduras	326	72.1	452	1,175	38.5
Costa Rica	411	66.0	623	1,767	35.3
Guatemala	219	48.6	451	1,386	32.5
Philippines	640	46.5	1,377	6,025	22.9
Germany	121	2.1	5,857	32,685	17.9
Sweden	17	2.0	859	5,243	16.4
Belgium	16	1.6	1,018	6,861	14.8
Malaysia	968	49.9	1,940	14,415	13.5
Japan	472	4.5	10,481	122,466	8.6
Korea	479	27.8	1,723	20,374	8.5
Singapore	335	27.3	1,229	15,651	7.9
Colombia	147	58.3	252	3,386	7.4
Thailand	353	59.4	594	10,799	5.5
UK	109	9.0	1,211	25,811	4.7
Taiwan (China)	372	32.0	1,161	27,940	4.2
France	78	11.0	708	17,316	4.1
Austria	24	40.0	60	1,811	3.3
Hong Kong	135	41.0	329	10,141	3.2
Spain	18	15.5	116	3,810	3.0
Indonesia	47	22.9	205	7,020	2.9
Netherlands	38	23.9	159	6,358	2.5
Ireland	17	25.8	66	2,953	2.2
Brazil	17	11.6	147	9,265	1.6
China, mainland	73	12.1	601	41,364	1.5
Australia	3	7.3	41	3,423	1.2
Canada	456	35.3	1,292	130,405	1.0
India	4	8.0	50	5,663	0.9
Italy	12	17.4	69	15,440	0.4
Other Developing	93	47.4	196	*n/a*	*n/a*
Other Developed	14	14.6	96	*n/a*	*n/a*
Total	19,137	32.6	58,751		

Source: Yeats (1998), "Just How Big Is Global Production Sharing?"

might be more sensitive to industry-specific shocks(Eichengreen, 1992; Kenen, 1969; Krugman, 1993). Kalemli-Ozcan et al. (2001) explore further in the context of international risk sharing. They insist that economic integration will lead to better income insurance through greater capital market integration which will, *ceteris paribus*, induce higher specialization in production and more trade resulting in fluctuations becoming less symmetric across countries.

However, Frankel and Rose (1998) argue that intensive trade between countries will result in higher symmetry of business cycles, if demand shocks predominate in the shock transmission which has been shown by Kollman (2001), or intra-industrial trade between countries increases, whose evidence might be embodied in the increasing trade in parts and components. Similar evidence provided by Imbs (2003) shows that amongst OECD countries, similar production structure can have more similar business cycles.

This chapter studies the relationship, on the supply side, between business cycle symmetry and trade, focusing on the channel created by trade in complementarities. Following Coe and Helpman's finding (1995) that international trade will cause knowledge and technology spillovers across countries, this chapter investigates the effects of the vertical production linkages as well as of international spillovers. Empirical result shows that vertical production linkages on directions of both the backward and the forward, and international spillovers have positive significant effects on output co-movements across countries.

The rest of the chapter is structured as followed. Section 4.2 provides a concept of vertical specialisation and the trade based on it. The related literature is reviewed in Section 4.3. The econometric framework is described in Section 4.4. Section 4.5 reports the results, and Section 4.6 concludes.

4.2 Concept of Vertical Specialisation and Vertical Trade

Vertical specialisation sometimes is referred as production sharing or as fragmentation — the splitting of a production process into two or more steps that can be undertaken in different locations of different countries but that lead to

the same final product.(Arndt, 1996)

Vertical specialisation is related to several production concepts including outsourcing, vertical integration, and vertical FDI, all of which have garnered much attention in academic research and the popular press. Outsourcing is the relocation of one or more stage of a good that was formerly produced entirely in the home country. Vertical integration and vertical FDI are activities in which multinational firms locate different stages of production of a good or goods in different countries. These concepts are similar to vertical specialization because they are all concerned with the location of production. The main distinction, however, is that vertical specialization concerns the activities of countries, while outsourcing, vertical integration and vertical FDI involve the behaviour of multinational firms.[15]

Following Hummels et al. (2001), vertical specialization occurs when:

1. a good is produced in two or more sequential stages;
2. two or more countries provide value-added during the production of the good;
3. at least one country must use imported inputs in its stage of production process, and some of the resulting output must be exported.

Vertical specialization involves both an import side and an export side. On the import side, vertical specialization is essentially a subset of intermediate good trade. While all intermediate good trade is consistent with the above condition (1) and (2), only the subset of intermediate goods imports that become embodied in exported goods is consistent with the third condition. On the export side, vertical specialization can involve either intermediates or final goods.

Figure 4.1 illustrates the situation of vertical specialization and the trade based on it. For country 2, it imports intermediates, and parts of her products which directly or indirectly embody imported inputs are exported to foreign countries either as new intermediates or final goods for foreign countries. The vertical share of Country 2 in Figure 4.1 (explained in Section 4.4) is $VS2 = (\frac{A}{D+E}) \times E = (\frac{E}{D+E}) \times A$.

[15]Hummels et al. (1998, p.82)

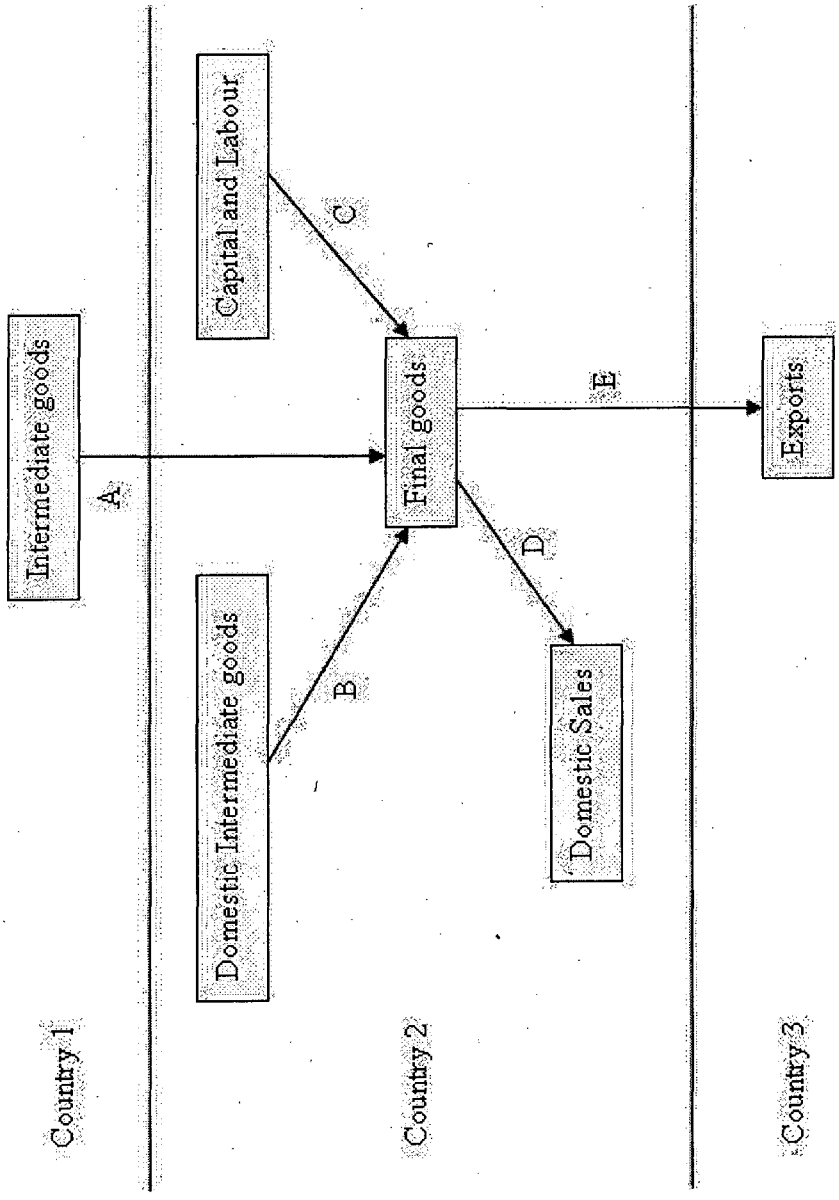

Figure 4.1: Vertical Specialisation

4.3 Literature Review

4.3.1 Vertical Specialization and Trade Boom

Most economists agree that decreases in tariff and non-tariff trade barriers, as well as improvements in communications and the transportation of goods, have led to increased world trade. These lifted trade barriers and improvements in "distance-reducing" technologies have enabled countries to specialise in goods that they have comparative advantages. China, for example, has become relatively more adept at manufacturing consumer products, while the U.S. has focused more on manufacturing high-tech products such as airplanes and business computers.

This concept of specialization, however, is the traditional horizontal one, which emphasizes production and trade of goods made entirely in one country. Vertical specialization carries the notion of specialization further, describing a process in which countries acquire expertise in particular stages of production. For example, computer production requires a skill-intensive stage — designing and manufacturing the chips — and a labour intensive stage – assembling the computer. Vertical specialization allows countries to unbundle these stages so they can focus on those activities in which they are relatively more efficient. The reduction in trade barriers and improvements in transportation and communication technologies have facilitated this multi-country production sequence and thus have led to increase vertical specialization.

Why has vertical specialization grown more rapidly then horizontal specialization? One answer is that improvements in communications technologies may favour vertical trade. Advances in such media as faxes, phones, pagers, email, and video-conferencing have made it easier for countries to coordinate and monitor production in diverse locations. Since the sequential production nature of vertical specialization requires intensive oversight and coordination of production, these technological advances would tend to benefit vertical-specialization-based trade more than horizontal-specialization-based trade.(Harris, 1993, 1995)

The second answer is that wide range of services enters the international markets and reduces the costs of these services connecting different production stages.

Jones and Kierzkowski (2001b) point out that services — ranging from transportation and insurance to telecommunications and banking — play a crucial role in the fragmentation process since they connect various production blocks. Production sharing may well be initially confined to national border of a country, since international service links are likely to be more expensive than domestic ones, and since coordination of production and quality control is more difficult to achieve internationally than domestically. Over time, however, fragmentation is bound to spill over into international markets in response to lowering prices of services, increased tradedness of services, and a whole range of technical improvements and innovations that allow geographic deconcentration of production.

In the research by Deardorff (1998) and by Jones and Kierzkowski (2001a), it is shown that production sharing may give a country a comparative advantage in a good where before it had no comparative advantage in a small open Richardian economy, and production sharing may well cause factor prices to become equalized across countries in a two-country H-O world. A less developed country which was initially frozen out of producing a commodity may, with production sharing, find that it can now compete successfully in a labour-intensive component.

As decrease in tariff and increase in vertical production sharing worldwide, trade based on vertical specialization booms dramatically. Yi (2003) calibrates a two-country dynamic Richardian model of vertical specialization and simulates the response of trade to a steady-state reduction in tariff. He tries to explain the non-linear boom of world trade after tariff reduces to a critical value. In his endogenous specialisation model, he finds that the smaller the elasticity of stage 2 productivity, the flatter the relative productivity curve and the greater the trade responsiveness to tariff changes. Lower tariffs reduce the cost of producing vertical specialised goods by more than regular goods. The cost reduction for those goods produced across countries is multiplied by the reduction in tariff. He voices that as the number of production across countries stages increases, the magnification effect of tariff reduction increases.

Empirically, Hummels et al. (1998) provide empirical evidence of the strong growth of vertical trade through four case studies. Their study on Input-Output tables of the goods industries (agriculture, mining plus twenty-two manufacturing industries) in ten countries from the Organisation for Economic Co-operation and Development (OECD) finds out that industries with the most vertical trade

are motor vehicles, shipbuilding, and aircraft, as well as industrial chemicals, nonferrous metals and petroleum and coal products. Also their finding suggests that the increase in vertical trade is positively linked to the growing trade share of output. The correlation coefficient between vertical trade as a share of total trade and total trade as a share of gross merchandise output for every country except Japan exceeds 0.79. By and large, the industries that account for overall export growth are the same ones that account for vertical trade growth. Almost 50% of the growth of exports, for Canada and the Netherlands, is due to growth in vertical trade. In Denmark, France and the U.K., growth in vertical trade accounts for more than 25% of export growth. They conclude that the large increase in vertical-specialization-based trade is attributed to the large reductions in tariff rates and the promotion of FDI policies in many developing countries. This changing nature of world trade will link heightened international trade to greater international production.

Hummels et al. (2001) create an index of vertical specialization share of total exports as a ratio of imported intermediates in exports to gross output. They examine this VS index through exploiting the Input-Output tables of 10 OECD countries and 3 other countries. They find that, for every country except Japan, the VS share grew between the initial and final year of the sample. If they exclude the oil crises effect, the VS share of total exports for every country experiences smoother and more monotonic increases. For the countries of their interest, the growth in VS accounts for more than 30% of export growth. By decomposing the variation in vertical specialization over time and across countries, they discover that changes in sector vertical intensity account for almost all of the overall VS share variation over time and across countries. They explain that technology shocks have led to the fragmentation of production across different locations. These technological developments may also be tied to the increasing importance of foreign direct investment, which has grown faster than international trade in recent decades.

4.3.2 FDI and Inter-Industrial Technology Spillovers

Most vertical production, or in another word, fragmentation, is accomplished by outsourcing or FDI by Multi-National Corporations (MNCs). Since MNCs locate their subsidiaries to avoid rent erosion due to local competition, other

things equal, the MNC' deployment of subsidiaries through FDI is designed to minimize the risk of propagation of specific technical knowledge to potential competitors. In particular, intra-industry knowledge spillovers for host country firms from manufacturing activities by subsidiaries are unlikely. If there is leakage of technical knowledge from the subsidiaries to domestic producers, such spillovers are most likely to generate productivity improvements in non-competing and complementary sectors. Hence, vertical propagation of knowledge that creates new technological opportunities for host country producers induces inter-industry spillovers but industry-specific knowledge flows are bound to be limited in scope.

The survey by Blomstrom and Kokko (1998) reviews a wide array of evidence suggesting that FDI generates spillover effects. Lichtenberg and van Pottelsberghe de la Potterie (1998) extend Coe and Helpman's work (1995) to examine whether inward and outward foreign direct investments as well as trade flows are sources of technology transmission. They use the same data set as Coe and Helpman (1995), but a different functional formula to compute the relation between foreign R&D spending and productivity increases through imports. R&D capital stocks are not converted into index. The evidence supports the widely spread idea that foreign investment is associated with sourcing. The authors confirm the hypothesis that technology transfer is enhanced by trade flows and technology sourcing associated with MNCs' activities abroad. They reject the hypothesis that inward foreign investment is a major mechanism of technology transmission to the host economies.

Markusen and Venables (1998) argues that proximity to potential competitors with absorptive capacity to reverse engineer proprietary technology would be detrimental to the MNCs, and subsidiaries will be set up where potential rivals cannot erode its market share. Since the MNCs can benefit from knowledge diffusion when it reaches downstream clients and upstream suppliers, it will encourage vertical flow of generic knowledge leading to inter-industry spillovers. Linkages can be a propagation mechanism for technological externalities above and beyond the pecuniary externalities highlighted by Hirschman (1977).

Some of the literature on backward linkages emphasizes the static effect of the increased demand by the MNCs for local intermediate inputs (Rivera-Batiz and Rivera-Batiz, 1990). More recent models emphasize the dynamic effect on host country productivity ensuing expansion of both the demand and supply

of intermediate input and services (Markusen and Venables, 1999). Not only do incumbent upstream sector producers benefit but also the MNCs, may start providing goods or services that were previously unavailable in the host country. Thus, MNC operations can induce local availability of new intermediate services and inputs, and thereby a nexus between FDI penetration and growth in the productivity of downstream manufactures (Romer, 1990; Rodriguez-Clare, 1996).

The second type of externalities by FDI, often called Jacobian spillovers, derive from the accumlation of knowledge associated with diversity and therefore involves learning across sectors. In other words, firms in one sector learn from the activities in other sectors. There is evidence that both intra- and inter-sectorial spillovers are highly localized (Glaeser et al., 1992).

Hence, the impact of FDI goes beyond the change in utilisation of the host country factor endowment that improves allocative efficiency. As the entry of the MNC induces the supply of new intermediate inputs, the productivity of downstream local firms can be enhanced due to a feasible increase in specialization. The direct demand effect on upstream sectors is primarily an inter-industry phenomenon. The indirect input-availability effect on downstream sector is likely to be stronger at the inter-industry level than at the intra-industry level.

Other things equal, the MNC will seek to set up subsidiaries in countries in which the market structure yields less direct competition within its industry but in which upstream sectors are competitive. Hence, FDI will be associated with situation in which there are few direct competitors and input suppliers resulting in limited intra-industry spillovers but a positive impact on the inter-industry level.

Empirically, Kugler (2006) studies whether FDI in a developing country generates positive externalities on local producers through his Panel data case study for Columbia. He finds that 1) the hypothesis of no cointegration between FDI financed capital formation and domestic manufacturing total factor productivity (TFP) is widely rejected at inter-industry level; 2) FDI inflows generate TFP growth across sectors but not within sectors; and 3) the spillovers can translate to growth if the beneficial sectors from FDI externalities provide inputs to other industries. The first finding is the general equilibrium effects of FDI.

4.3.3 Technology Spillover, Complementarities and Business Cycles

Backus et al. (1992) predict in their symmetric competitive world economy model with technology spillover across countries based on the Kydland and Prescott (1982) closed-economy model that consumption is highly positively correlated across countries, but foreign and domestic output are negatively correlated, which contrasts the observations on the post war international data. However, in their experiment allowing large technology spillover across countries, the results get close to the value derived from data. The correlation between foreign and domestic output changes sign from negative to positive. When the authors take the trading cost into account, the output's correlation across countries still changes sign to positive, though the value is much smaller than the one under large spillovers. But when if there is no trade but only the correlation between technology shocks being the sole connection between countries, the correlation of output is larger in this extreme autarky experiment than in the experiment with trading friction.

Backus et al. (1994) continue studying the behaviour of countercyclical net export and asymmetric cross-correlation between the trade balance and the terms of trade based on their previous JPE paper (1992). They find investment dynamics play a central role in explaining the properties of their model that the asymmetric S-curve pattern does not arise when the economy has no capital. Also they find, in their general equilibrium model, the correlations between trade and relative prices depend critically on the source of fluctuations due to the different response of investment to different type of shocks. In their model, both net exports and the terms of trade are highly autocorrelated, which implies to a large extent the high degree of persistence in the technology shocks. The elasticity of substitution between foreign and domestic goods affects the contemporaneous correlation between the trade balance and the terms of trade, but not the asymmetric shape of the cross-correlation function. The larger of the elasticity, the earlier the correlation value turns positive. Again, consistent with their 1992 finding consumption/output anomaly, in their perfect-substitutes experiment, the output correlation between domestic and foreign countries is -0.58, which contrasts to 0.70 in reality. With imperfect substitutability between foreign and domestic goods, the sign of output correlation changes, but becomes almost uncorrelated, with value of 0.02. Complementarity between foreign and domestic

goods increases the positive correlations between domestic and foreign outputs.

Kouparitsas (1998) replicates the North-South business cycles in a dynamic general equilibrium model which allows for both north and south to produce both primary and manufacturing goods, but the South is a net exporter of primary goods. The only driving force of the model is the sectoral productivity innovation. There are cross-region correlations of manufacturing sector innovations, though it is assumed that there is no correlation between primary and manufacturing sector innovations. He finds that the shocks to northern manufacturing productivity have positive correlation with southern primary and manufacturing production, whereas growth in the southern primary productivity leads to the expansion in the manufacturing sector both in the north and south, but worsens the terms of trade in the south. Consistent with Backus et al. (1994), the North-South output correlation is inversely related to the substitutability of northern and southern manufactured goods. The lower value of this elasticity of substitution, which implies that the higher complementary in North-South manufactured productions, leads to a higher co-movement of their outputs.

Kollman (2001) develops a two-country world where variations in aggregate demand, in the form of money supply shock, matter because of nominal rigidity which is the most different assumption from the works by Backus et al. (1992, 1994). He finds that countries tend to co-move when they are facing the demand shocks, to the extent increasing with trade linkages. At the disaggregate level, Horvath (2000) shows that the input-output structure must be chosen for shocks in intermediate and final goods sectors to result in aggregate fluctuations.

Shea (2002) argues that input-output linkages are important to short-run inter-industrial co-movements, with significant linkages that running both from downstream users to upstream suppliers and vice versa. In his simplified the input-output linkages model, technology shocks to industry A propagate downstream, affecting costs in sector using A as an input, but not affect upstream sectors supplying inputs to A. Conversely, taste shocks to industry A shift upstream demand curve, but do not affect downstream sectors using A as an input. Also in his model, he mimics local activity spillovers — industries that locate in the same cities should tend to co-move over the business cycle.

In his two-step estimation, Shea (2002) discovers that input-output linkages

and local activity spillovers are both statistically and economically significant to short-run co-movements at the nationwide level. With regards to gross output fluctuations, demand shocks linkages and local spillovers are stronger of effect than supply shocks linkages. In his postestimate analysis of variance decompositions, he finds that both aggregate shocks and complementarities are important to aggregate volatility, however, complementarities play an more important role in transmitting common shocks across sectors when assigning to aggregate shocks only their direct effects. Also input-output linkages are more important for gross output volatility than for employment or value added volatility.

In the other similar but complementary work, Shea (1995) shows that input-output linkages do not bind as strongly at the city local level as at the national level. But in this paper, Shea (1995) controls symmetric and asymmetric spillovers, which the latter implies that the pattern of co-movement within a particular place should resemble the pattern of industry located in other places. Under asymmetric local spillovers, industry pairs with strong links will co-move over time at the national level, and will also optimally cluster in the same place to take maximum advantage of their synergy. The information revealed in the input-output linkages, to a certain extent, overlaps the information revealed in the asymmetric local spillovers. Thus, it is understandable that the parameters of input-output linkages becomes smaller when the asymmetric spillovers is controlled.

As well known, Frankel and Rose (1998) empirically find that countries with closer trade links tend to have more tightly correlated business cycles. Imbs (2003)complements a determinant as economic structure of co-fluctuation studies in his cross-sectional regressions on the 1970 data from 49 countries. His index of similarities in manufacturing sectoral structure is computed, following Shea (1995), the correlation between sectoral shares in aggregate employment for all country pairs in the sample. He finds, in his results, that the sectoral structure similarities index, as well as trade which has been well documented in other literature, is significant in both a statistical and economic sense. He interprets that economic structure is an important independent fluctuation transmission channel, if holding trade constant. Countries with similar sectorial production patterns, as long as high trade intensity, are more synchronised.

4.4 Econometric Methodology

4.4.1 Measure the backward vertical linkages

Hummels et al. (2001) define two measurements for vertical specialization. The first one measures the imported input content of export goods for country h and sector i as:

$$VS_{h,i} = \left(\frac{\text{imported intermediates}}{\text{gross output}}\right) \times \text{exports} \tag{4.1}$$

$$= \left(\frac{\text{exports}}{\text{gross output}}\right) \times \text{imported intermediates} \tag{4.2}$$

That is to say, VS is the imported input content of export, or equivalently, foreign value-added embodied in exports. Hummels et al. (2001) do not count in those sectors which do not import intermediate inputs or do not export outputs even though import intermediates. Thus, the VS for those sectors are zero.

For sector i, the VS share of exports is equivalent to the imported input share of gross output.

$$VS \text{ share of exports} = \frac{\text{imported intermediates}}{\text{gross output}} \tag{4.3}$$

VS for country h is simply the sum of VS across all sector i, $VS_h = \sum_i VS_{h,i}$. We find it useful to calculate

$$VS \text{ share of total exports} \equiv \frac{VS_h}{X_h} = \frac{\sum_i VS_{h,i}}{\sum_i X_{h,i}} \tag{4.4}$$

Similarly, we can define the measurement for VS share of total imports. These two shares will differ when trade is not balanced. Subject to space limit, we are not to show the second measurement.

Hence, The VS share of total exports can also be expressed as

$$\begin{aligned}\text{VS share of total exports} &\equiv \frac{\text{VS}_h}{X_h} = \frac{\sum_i \text{VS}_{hi}}{\sum_i X_{hi}} = \frac{\sum_i \left(\frac{\text{VS}_{hi}}{X_{hi}}\right) \times X_{hi}}{\sum_i X_{hi}} \\ &= \sum_i \left[\left(\frac{X_{hi}}{X_h}\right) \times \left(\frac{\text{VS}_{hi}}{X_{hi}}\right)\right] \end{aligned} \tag{4.5}$$

Input-Output (I-O) tables provide information on distinguished foreign and domestic inputs, value-added, gross outputs and exports. A key advantage of using I-O tables is to avoid the arbitrariness of classification schemes that divide goods into intermediates or not.[16] In matrix notation, the formula for VS as a

[16]The input-output analysis assumes that the inputs used in producing a product are related to the industry output by a linear and fixed coefficient production function, at least in the short run. Under this assumption, input and output relationships are transformed into technical relationships. As originally designed by Leontief in 1936, an input-output coefficient table represents, in each of its column, a technique of production by which only one product is produced. Thus, the input-output tables for different years capture the change in technology of production.

An input-output table focuses on the interrelationships between industries in an economy with respect to the production and uses of their products and the products imported from abroad. Input-output analysis became an economic tool when Leontief introduced an assumption of fixed-coefficient linear production functions relating input used by an industry along each column to its output flow. For example, given a certain technology, for one unit of every industry's output, a fixed amount of input of each kind is required.

In a more general form with n industries and n products, where $a_{i,j}$ stands for input i (product of industry i) used in the production of one unit of output of industry j, the systems of equations can be written as follows:

$$\begin{aligned} a_{11}X_1 + a_{12}X_2 + \cdots + a_{1n}X_n + Y_1 &= X_1 \\ a_{21}X_1 + a_{22}X_2 + \cdots + a_{2n}X_n + Y_2 &= X_2 \\ \vdots \quad + \quad \cdots \quad + \cdots + \quad \cdots \quad + \vdots &= \vdots \\ a_{n1}X_1 + a_{n2}X_2 + \cdots + a_{nn}X_n + Yn &= X_n \end{aligned}$$

Or equivalent

$$\begin{bmatrix} a_{11} & a_{21} & \cdots & a_{n1} \\ a_{21} & a_{22} & \cdots & a_{n2} \\ \vdots & \ddots & \ddots & \vdots \\ a_{n1} & a_{n1} & \cdots & a_{nn} \end{bmatrix} \times \begin{bmatrix} X_1 \\ X_2 \\ \vdots \\ X_n \end{bmatrix} + \begin{bmatrix} Y_1 \\ Y_2 \\ \vdots \\ Y_n \end{bmatrix} = \begin{bmatrix} X_1 \\ X_2 \\ \vdots \\ X_n \end{bmatrix}$$

and in matrix form,

$$AX + Y = X$$

It is the basic input-output system of equations. Matrix A is called the input-output coefficient matrix, vector X is the vector of output and vector Y is the vector of net final demand.

If the value of the coefficients and of the net final demand are known, it is possible to solve this set of simultaneous equations in order to find the level of output of various industries necessary to satisfy the specific level of net final demand.

$$X = [I - A]^{-1} Y$$

where I is the identity matrix. $[I - A]^{-1}$ is the *Leontief inverse*, sometimes is referred as

share of total export for country h is

$$VS \text{ share of total exports } \equiv \frac{VS_h}{X_h} = \frac{\mu A^M_{f,h} X}{X_h} \tag{4.6}$$

where μ is a $1 \times n$ vector of 1's, $A^M_{f,h}$ is the $n \times n$ matrix of imported coefficients, X is an $n \times 1$ vector of exports, n is the number of sectors, X_h is the sum of exports across sectors. Element of $a_{i,j}$ of $A^M_{f,h}$ denotes the imported inputs from sector i in country f used to produce one unit of goods of sector j in country h.

Also, I-O tables allow us to calculate the value of imported inputs used indirectly in production of an exported good. That is, imported inputs may be used in one sector, whose output are employed in a second, a third, ... and so on till eventually embodied in the final export goods. If all direct and indirect imported inputs included in consideration, the more general way to compute VS as a share of total exports for country h is

$$VS \text{ share of total exports } \equiv \frac{VS_h}{X_h} = \frac{\mu A^M_{f,h}[I - A^D_h]X}{X_h} \tag{4.7}$$

where μ is a $1 \times n$ vector of 1's; $A^M_{f,h}$ is the $n \times n$ matrix of imported coefficients; I is the identity matrix; A^D_h is the $n \times n$ matrix of domestic coefficients; X is an $n \times 1$ vector of exports; n is the number of sectors; X_h is the sum of exports across sectors. Element of $a_{i,j}$ of $A^M_{f,h}$ denotes the imported inputs from sector i in country f used to produce one unit of goods of sector j in country h. $[I - A^D_h]$ is the term that captures allowing the imported input to be embodied in a domestic output at the 2nd, 3rd, 4th, ..., stage before it becomes embodied in the good that it is exported. It is the matrix analogue of an infinite geometric sum. And this formula allows the goods to circulate through all sectors of the economy before they are exported.

As Shea (2002) suggests, forward and backward matrices represent for the input-output linkages through which shocks propagate. Forward captures downstream propagation of technology shocks, from suppliers to users, whilst backward represents upstream propagation of demand shocks, from users to suppliers.

total requirements matrix, which represents the both direct effect captured by matrix A, and indirect effects of inputs on outputs.

The *Leontief inverse* $[I - A]^{-1}$ is fundamental to input-output analysis because it shows the full impact of an exougenous shock in net final demand on all industries in the economy. With such a matrix it is possible to unravel the technological interdependence of the productive system and to trace the generation of output demand from final consumption.

Thus, in this chapter, the VS share of total exports is regarded as the backward linkages index:

$$BAK_{f,h} = \frac{\mu A^M_{f,h}\left[I - A^D_h\right]X}{X_h} \tag{4.8}$$

It implies that for country h, the total imported intermediates are required from another country f in order to produce its exports.

4.4.2 Measure the forward linkages between countries

As you might have noticed there exists a circularity problem in the measurement of backward linkages defined in 4.1. When we consider the bilateral production linkage between two countries, the backward linkage of country h with country f actually is the forward linkage of country f to country h. However, the forward linkage is also of our interest that we want to investigate how the productivity shocks occurred in a country propagate to another country where its export is used as intermediates.

Inspired by Kugler (2006), we assume that the industrial output for country h is affected by the industrial output in other countries, in addition to the effect by the other industries in the same country. As the in-direct effect[17] is too complicated to estimate, we focus on the direct spillovers between countries. We estimate

$$y_{n,i,t} = \sum_{-i} y_{-i,t}\alpha_{1,-i} + \sum_{n^*}\sum_{i^*} y_{n^*,i^*,t}\alpha_{2,n^*,i^*} + \nu_{n,i,t} \tag{4.9}$$

to derive the forward linkage $\sum_{i^*}\alpha_{2,n^*,i^*}$ between countries. $y_{n,i}$ is an matrix of industry output in country n. $y_{n,-i}$ an $n \times (i-1)$ matrix of industry non-i output in country n. y_{n^*,i^*} represents the counterpart industries in foreign countries. $\sum_{i^*}\alpha_{2,n^*,i^*}$ is the weighted sum of estimated coefficients of inter-industrial effect across countries, i.e. it proxies the forward linkages of production in section i in country h utilising outputs of all sectors in foreign country f as inputs.

[17]The indirect effect means that the linkages are not directly from country A to country B. For instance, there is no direct input-output linkages between country A and B, however, there still might be in-direct linkages from country A to B via country C, if country C has direct input-output relations to A and B, respectively.

4.4.3 Measure the Spillover Effects across Countries

As in the literature, country will receive spillover from its trading partners. The spillovers from imports capture the productivity gains at an aggregate level. Import is a suitable proxy for bilateral inward linkages when we do not have any other statistics in hand, such as bilateral inward FDI flows, etc. We focus on this aggregate spillovers between countries. We estimate

$$TFP_{n,t} = \lambda + \sum_{n^*} IMPORT_{n^*}\gamma + \xi_{n,t} \tag{4.10}$$

where TFP[18] is the total factor productivity of country n, $IMPORT$ is the import from its trading partners, λ is constant, $\xi_{n,t}$ is the white-noise disturbance term. $\sum_{n^*}\gamma$ captures the spillover effect of interest, indicating the generic spillover effect of foreign investment or foreign business operation linkages.

4.4.4 Estimation Framework

Consider the following regression model which is used to describe the output fluctuation.

$$y_t = \mu + C\epsilon_t \tag{4.11}$$

where y_t is an observable $n \times 1$ vector of country fluctuation at time t; μ is an $n \times 1$ vector of constants; ϵ_t is a vector of zero-mean country level shocks, with variance-covariance matrix Ω; C is an $n \times n$ matrix governing how shocks are propagated across countries.

As discussed before, matrix C depends on observable measures of vertical trade linkages and the strength of sprillovers. It is specified as follows:

$$C = \beta_1 BAK + \beta_2 FWD + \beta_3 SP \tag{4.12}$$

where BAK is an $n \times n$ matrix of whose (i,j) element equals the backward linkage index of country j from country i; FWD is an $n \times n$ matrix of whose

[18] TFP, the total factor productivity is the estimated Solow Residual of each country in question. It is derived from estimating $Y_t = \alpha + K_t\theta_1 + N_t\theta_2 + \epsilon_t$ where Y_t is the output of the country, K_t is the fixed capital formation, and N_t is the total employment number. All variables are in logarithm. The TFP is the fitted value of ϵ_t.

(i, j) element equals the backward linkage index from country i to country j; SP is an $n \times n$ matrix of whose (i, j) element equals the general spillovers from country i to country j.

The aim of this chapter is to use the pattern of countries' output co-movement to identify the parameters β as well as the elements of the shock covariance matrix Ω. However, it is not possible to estimate both $\beta's$ and an unrestricted Ω matrix. Thus, following Shea (2002), I assume that country-level shocks consist of two orthogonal components: an unobserved country-specific component, assumed orthogonal across countries; and a component driven by observable aggregate disturbances. Specifically, I assume that

$$\epsilon_t = e_t + Da_t \tag{4.13}$$

where e_t is an $n \times 1$ vector of country level shocks, with diagonal covariance matrix Σ; a_t is a $k \times 1$ vector of observable aggregate shocks orthogonal to e_t; and D is an $n \times k$ matrix of factor loadings, indexing each country's sensitivity to aggregate shocks.

Also I assume that a_t consists of two elements: the world oil price index (OIL) and the international interest rates (INT), intended to proxy the worldwide generic aggregate shocks. INT represents for the demand shocks, whereas OIL represents for supply shocks.

Hence, the estimate framework can be re-written as:

$$y_t = \mu + Ha_t + Ce_t \tag{4.14}$$

where $H = C \times D$

In addition to these identifying restrictions, following Shea's suggestion(2002), we normalize the own effect of a country shock to one, and let β_1 through β_3 govern only the cross-country effects of shocks. In other words, we assume

$$C = ID + \beta_1 BAK + \beta_2 FWD + \beta_3 SP \tag{4.15}$$

where ID is an $n \times n$ identity matrix; and the diagonals of BAK, FWD and SP are set to zero.

We estimate the model through a two-step procedure. First, we estimate μ and H by running country-by-country OLS regressions of y_t on a constant, OIL and INT. Then we use the residuals from these regressions to estimate β and Σ using Gaussian maximum likelihood. In the statistical package of RATS, three estimation methods, which are BFGS, SIMPLEX and GENETIC, are offered. BFGS is the only one of three that can estimate standard errors. However, it is very sensitive to arbitrary initial values. Hence, we use a preliminary estimation method to refine the initial parameter values before switching to one of the other estimation methods. At the second stage of this estimation, the model is estimated by using the GENETIC method first, then getting the estimates with BFGS.

4.5 Empirical Results

4.5.1 Data

The input-output tables come from Asian International Input-Output (I-O) Tables developed by the Institute of Developing Economies, Japan. These tables offer the bilateral import coefficient tables between any two economies in the west coast of Pacific plus the U.S. as well as the normal standard national I-O tables. Therefore, we can derive the bilateral vertical linkage from these tables.

As there exist missing values in certain industries of some countries in the sample, and we do not know the reason behind these missing values — whether it is a true zero value for the reason there does not exist such industries, or it is a census mistake that leads to failure in collecting data, we have to focus on the manufacturing sector. The concentration on manufacturing sectors is important because they increasingly dominate world trade.(see Ishii and Yi, 2002, Table A.6)

The Asian International Input-Output Table is consisted of 24 sectors, 12 of which are under manufacturing. According to the vertical linkage index suggested by Hummels et al. (1998), the backward linkage matrix is a 24×24 matrix. The import coefficient matrix is a 24×12 matrix. In order to multiply the total requirement matrix, the total requirement matrix must be a 12×24 matrix.

The interpretation of this matrix product means that to produce a vector of exports, the total direct and indirect requirement import input embedded in all manufacturing sector. The disadvantage of this method is that information of indirect supply linkage with non-manufacturing sector in the domestic total requirement is ignored.

The Asian International Input-Output Table we are using is the 2000 statistics edition, consisted of 24 sectors, 12 of which are under manufacturing classification. Since there existed severed problem of missing values in the non-manufacturing sectors of Southeast Asian countries, the vertical linkage coefficients matrices we derive is just focused on the manufacturing sector. Thus, both the import coefficient matrix and the total requirement matrix are 12×12 matrices. The shortcoming of the process is that information of indirect supply linkage with non-manufacturing sector in the domestic total requirement is discarded.

Data rather than the data on Input-Output Tables covers the period from 1980 to 2004. The data of import and export of each country in the sample comes from the Direction of Trade Statistics (DOTS), developed by the International Monetary Fund (IMF).

The data of aggregate output, fixed capital formation and total employment of each country is taken from the World Development Indicator (WDI) developed by the World Bank. Annual data of Oil Prices comes from the Annual Statistical Bulletin published by the Organisation of the Petroleum Exporting Countries (OPEC). We take the interest rates in the U.S. and the interest rates in the Euro Area (before 1999, use interest rates in Germany) as International Interest Rates. I use the data of 6-month London Inter-Bank Offer Rates (LIBOR) on Euros and on US Dollars from the International Financial Statistics (IFS) developed by the IMF.

The disaggregated outputs of each manufacturing industry in each sample country are taken from the Industrial Statistics developed by United Nation Industrial Development Organisation (UNIDO). For those missing values in the Industrial Statistics, Industrial Demand-Supply Balance matrices also developed by UNIDO are an alternative source to impute the missing values.

4.5.2 Results and Interpretations

Table 4.2 presents the bilateral backward vertical linkages between sample countries according to the measurement by Hummels et al. (2001). These bilateral backward linkages are directed calculated from the Asian International Input-Output Table. Compared the values in Table 4.2 to those derived by Hummels et al. (2001), we notice that our values are smaller than the ones in their work. The reason lies in that the import matrices we used are different from those used by Hummel et al. in their 2001 paper. We use the bilateral intermediate import matrices instead of the general import matrices. Thus, the values we derive represent more precise bilateral linkages than just the linkage with the rest of the world.

On Table 4.2, rows represent suppliers and columns means demanders. Hence, when we read the backward vertical linkages between countries, we read the coefficients in columns. Each cell in the column exhibits the backward linkages of the country in Column with each country in rows. It means that in order to product manufacturing exports for each country in columns how much import inputs are totally required from each country in rows. The range of value of coefficients is between zero and one. The bigger the number in the cell is, the tighter backward linkages does the country have with countries in rows.

From Table 4.2 we can tell that within the whole sample Japan and the U.S. are mainly the upstream producers providing intermediates inputs to other developing economies in the region. In another word, the developing economies in East Asia have strong backward linkages with Japan and the U.S. This result is consistent with the finding by Hummels et al. (1998). In the sub-group of ASEAN in the sample, it is obvious that Malaysia is playing a role in the core of the Association. Countries within the ASEAN group have fairly close linkages with one another.

As discussed in subsection 4.4.2, there is a circularity problem in the backward linkages matrix. The above triangle of the diagonal is the forward linkages of countries in rows to countries in columns, whereas the below triangle of the diagonal is the backward linkages of countries in columns from countries in rows. However, we are still interested in identify the effect of forward linkages upon output co-movements because we want to investigate how productivity shocks

Table 4.2: The bilateral backward linkage indices between pair countries are computed directly the international input-output table, according to $\frac{\mu A^M_{f,h}[I-A^D_h]X}{X_h}$

	China	Japan	Korea	Indonesia	Malaysia	Philippines	Singapore	Thailand	U.S
China		0.0051	0.0150	0.0070	0.0154	0.0079	0.0236	0.0219	0.0038
Japan	0.0211		0.0542	0.0224	0.0878	0.1033	0.0975	0.0811	0.0121
Korea	0.0184	0.0059		0.0119	0.0248	0.0381	0.0196	0.0188	0.0047
Indonesia	0.0018	0.0016	0.0034		0.0097	0.0059	0.0116	0.0070	0.0005
Malaysia	0.0031	0.0026	0.0065	0.0057		0.0155	0.0607	0.0228	0.0025
Philippines	0.0008	0.0011	0.0023	0.0003	0.0117		0.0017	0.0037	0.0014
Singapore	0.0027	0.0011	0.0055	0.0051	0.0805	0.0280		0.0223	0.0020
Thailand	0.0018	0.0020	0.0026	0.0039	0.0249	0.0132	0.0169		0.0014
U.S	0.0094	0.0119	0.0420	0.0140	0.0729	0.0699	0.0598	0.0390	

[b] Source: author's calculation.

[h] Cells in each column represent for the backward linkages of country in the column with countries in rows. Numbers in the cells are calculated from Equation 4.8, $\frac{\mu A^M_{f,h}[I-A^D_h]X}{X_h}$. For cells in the same column, the *Leontief Inverse*, $\left[I - A^D_h\right]$, is the same, but the imported matrix, $A^M_{f,h}$, differs in lines with the importing countries in rows.

are transmitted to downstream producers in other countries where its exports are used as inputs. The proxy variable to these linkages is the coefficients we estimated from the Equation 4.9 in Section 4.4.2. It means that how the domestic output of each industry in the home country is affected by industries in foreign countries. The estimates are derived from fixed effect panel estimators. The number in each cell is the weighted sum of estimated coefficients of each industry α_2.

Table 4.3 illustrates the forward linkages between countries. Similar to Table 4.2, rows represent suppliers and columns means demanders. Hence, when we read the forward vertical linkages between countries, we read the coefficients in rows. It implies that when there are productivity shocks to countries in rows, how much these shocks can affect the output of countries in columns. This table exhibits the estimated sum effects on industrial outputs influenced by the other industries in other countries. The absolute value of numbers in each cell is also between zero and one. Signs of these coefficients vary across countries pairs. The difference in signs of coefficients captures the direction effects from the output co-movements between countries so it enhances the estimation of sign in our estimations of this productivity linkages effects on national output co-movements. These estimated coefficients are used as input data for our final estimation of linkages effect on output co-movements across countries. Thus, the statistical significance of estimated parameter for each industry in each country is neglected.

As Coe and Helpman (1995) and Backus et al. (1992) pointed out that technology spillovers generated from trade or investment linkages will increase output co-movements across countries. We are also interested in this effect on output co-movements. Table 4.4 shows the aggregated spillover effects across countries. These spillover effects are estimated from the Equation 4.10 in Subsection 4.4.3. Imports are used as a proxy for inward linkages from foreign countries. It is a consensus in literature that FDI from advanced economies to developing countries brings technology diffusions to host countries so to improve the productivities in the host countries. We investigate this inward linkages effect upon the productivity of the home country.

Table 4.4 reports the estimated effects on total factor productivity of each country affected by imports from its trading partners. Again like the previous two

Table 4.3: The bilateral forward linkages between the pair of countries are the weighted sum of estimated coefficients of foreign industrial outputs on domestic industrial outputs, according to $y_{n,i,t} = \sum_{-i} y_{-i,t}\alpha_{1,-i} + \sum_{n^*}\sum_{i^*} y_{n^*,i^*,t}\alpha_{2,n^*,i^*} + \nu_{n,i,t}$

	China	Japan	Korea	Indonesia	Malaysia	Philippines	Singapore	Thailand	U.S
China		0.2467	0.0010	0.4117	0.0526	0.1146	0.0722	-0.0388	0.1550
Japan	-0.1011		0.1214	-0.3644	0.0245	0.0920	-0.0493	-0.0261	-0.0863
Korea	-0.0030	0.0027		0.0730	0.0465	0.0915	0.1681	0.0242	0.0533
Indonesia	-0.1271	-0.2089	0.0143		0.1455	0.0175	-0.0023	0.0313	-0.0805
Malaysia	0.0189	0.0860	-0.1554	-0.0032		0.0347	0.1522	0.1374	0.0082
Philippines	-0.0257	-0.0732	-0.0061	-0.0582	0.0403		-0.0184	0.0341	-0.0060
Singapore	-0.1391	-0.0143	0.0545	0.0921	-0.0535	-0.0449		0.0092	0.0344
Thailand	0.0874	-0.0109	0.0245	0.0209	0.0486	-0.0766	0.1106		0.0299
U.S	0.1619	-0.0964	0.1388	0.0270	-0.1072	-0.5059	0.0086	0.2112	

[b] Source: author's calculation.

[h] Cells in each row represent for the forward linkages of country in the row with countries in columns. Numbers in the cells are the sum of estimates of Parameters 4.4.2, $\sum_{i^*} \alpha_{2,n^*,i^*}$, from Equation 4.9.

Table 4.4: The bilateral spillovers between pair of countries are estimated parameters of Equation 4.10, $TFP_{n,t}$ ‖ = $\lambda + \sum_{n^*} IMPORT_{n^*}\gamma + \xi_{n,t}$

	China	Japan	Korea	Indonesia	Malaysia	Philippines	Singapore	Thailand	U.S
China		-0.1201	-0.0122	-0.0418	-0.0069	0.1394	0.0050	-0.0078	-0.0211
Japan	0.0878		0.0585	-0.1632	0.0085	-0.0908	0.1283	-0.0583	0.0030
Korea	0.0051	-0.0668		-0.0823	0.0632	0.0655	0.1275	-0.0060	0.0213
Indonesia	-0.0498	-0.0949	-0.0498		0.0049	0.0030	-0.0073	-0.0267	0.0320
Malaysia	0.1653	-0.0992	-0.0046	0.0175		0.1524	0.1386	-0.0543	0.0251
Philippines	-0.0419	-0.0693	0.0066	-0.0465	0.0707		0.0966	-0.0172	0.0256
Singapore	0.0259	-0.0945	-0.0087	-0.0145	0.0009	-0.1007		-0.0433	0.0169
Thailand	0.0440	-0.0173	0.0505	-0.0438	-0.0498	-0.0254	0.0802		0.0213
U.S	0.1867	-0.0823	0.0122	0.0126	0.0016	-0.0764	-0.0333	-0.0331	

♭ Source: author's calculation.

‖ $TFP_{n,t}$ is the estimated Solow Residuals of each country in question. It is derived from $Y_t = \alpha + K_t\theta_1 + N_t\theta_2 + \epsilon_t$ where Y, K and N are the logarithm of output, fixed capital formation and total employment number, respectively for each country.

♮ Numbers in each cell are the estimates of $\sum_{n^*} \gamma$ from Equation 4.10. Countries in rows are source countries and countries in columns are destination countries, therefore, the upper and lower triangles of the diagonal are different. Negative value of spillovers may be evidence of competition effect on aggregated productivity of the destination countries.

tables, rows represent the source and columns means the destination. Therefore the meaning of cells above and below the diagonal is different. They capture the different direction of spillovers. Usually we understand that for each cell it stands for the spillovers gained by countries in columns from countries in rows. The absolute value of numbers in cells is between zero and one. The presence of negative signs probably comes from poor data collection, or it can be regarded as evidence of market competition effects on the destination country markets. Once again, these estimated coefficients are used as input data for our final estimation of spillover effect on output co-movements across countries. Thus, the statistical significance of estimated parameter for each country is neglected.

In order to look into how the country-specific shocks propagate through the channel of production linkage, we separate the countries in the sample in different grouping in accordance with the linkages between different types of countries.

Table 4.5 contains the information about the estimated coefficients of linkages effects upon output co-movements across countries for different groupings. These coefficients are obtained from the second step of the estimation. The variance-covariance matrix of output shocks across countries, which is estimated from the first step, represents for output co-movements between countries. Therefore, we are interested in the signs instead of the magnitudes of the estimated impacts of vertical linkages between countries on their output co-movements.

The first column is full sample. Full sample countries in this chapter are the countries of the so-called "ASEAN5" Group together with China, Japan, Korea and the U.S. In this grouping, the composition of economy types is as diversified as the global economy. The second column is the ASEAN+3, which represents almost the whole region of East Asia. Negotiations of economic integration between countries in the region have been taking place. Column One and Column Two are the groupings of our main interest in this chapter. The third, the fourth and the fifth column are the specification of countries groups consisted of upstream intermediate inputs producers which are the U.S. and Japan, and downstream product manufacturers, the ASEAN. The sixth column is the grouping of countries in North East Asia, namely China, Japan and Korea, and the U.S. The reason for this grouping is the argument by Bayoumi and Eichengreen (1999) that countries in Northeast Asia have business cycle correlations of their own, which are different from the countries in the group of South East Asia. The

Table 4.5: Results of Vertical Linkages and Spillovers Effects

Output Co-movements	Full Sampl[§]	ASEAN+3[‡]	ASEAN+US	ASEAN +Japan	ASEAN+ Japan+US	China+Japan +Korea+US	ASEAN +China	ASEAN[†]
Beta 1	3.5821***	3.6232***	4.6212***	2.7982***	3.4416***	4.8107***	33.6016***	10.6904***
(Backward Linkages)	(0.3122)	(0.2546)	(0.5793)	(0.4253)	(0.3789)	(1.0488)	(1.8091)	(0.6941)
Beta 2	1.3402***	2.5517***	0.3092	-0.0252	0.1389	0.0609	-1.1273***	-3.4258***
(Forward Linkages)	(0.3047)	(0.3206)	(0.5348)	(0.2950)	(0.2416)	(0.3205)	(0.2584)	(0.2587)
Beta 3	0.5883**	-0.4937	1.2668*	2.2296***	1.7817***	1.3857**	0.5206***	4.9399***
(Spillover)	(0.2799)	(0.3397)	(0.7215)	(0.4786)	(0.3385)	(0.5545)	(0.1873)	(0.2648)

*** at 1% confidence level

** at 5% confidence level

* at 10% confidence level

† ASEAN is the grouping of Indonesia, Malaysia, the Philippines, Singapore and Thailand

‡ ASEAN+3 is the grouping of ASEAN countries together with China, Japan and Korea

§ Full Sample contains countries of ASEAN+3 and the US

♭ Parentheses indicate the standard deviations

♮ These for the results of the second step of Estimation Equation 4.14, whose specification is Equation 4.15, $C = ID + \beta_1 BAK + \beta_2 FWD + \beta_3 SP$. Matrix C is the 10×10 variance-covariance matrix obtained from the first step of estimation of Equation 4.14. BAK, FWD and SP are 10×10 matrices of linkages, respectively.

fifth column is ASEAN and China, illustrating the connections amongst developing countries. It also reflects the fact of recent rapid increase in trade between China and ASEAN countries. And the last column is the grouping of ASEAN only, which also is of the main interest in this chapter.

The striking feature in Table 4.5 is that backward vertical linkages have positive significant effects on country output co-movements in all groupings at 1% confidence level. The backward vertical linkages capture how business cycles are transmitted through production linkages when there are shocks to demand for products in the downstream of the production chain. This finding contributes to the debate whether or not more intensive trade leads to higher level of business cycles symmetry. The positive estimate of Beta 1 reveals the idea of demand shocks propagation that when there is an increase (decrease) in the output of downstream sectors in a country, their demand for imported inputs from foreign countries will increase (decrease) accordingly. These positive correlated trade linkages induce outputs to co-move together between countries. The international trade in complementary inputs is a mirror to the vertical international production linkages. The more incentive vertical production linkages between countries results in the higher volume of international trade. As long as international trade is based on vertical-specialisation of production, trade will generate a closer links in output between trading partner countries.

Spillover between countries also has positive effects on outputs comovements, both significant in statistics and in economics (except the grouping of ASEAN+3). This result confirms the prediction by Backus et al. (1992, 1995) that business cycles synchronisation increases with the level of spillover between countries. Moreover, as suggested by Coe and Helpman (1995) that this type of international spillovers cause a rapid spread of productivity shocks, hence the symmetric business cycles between countries are indirectly attributed to supply linkages.

The signs of estimated Beta 2, the forward linkages in production across countries, are a bit mixed. Beta 2 tries to capture the productivity linkage effects on country output symmetry. We want to see when there is a productivity shocks to a certain industry of Country h, how this shocks is transmitted to Country f which uses Country h's outputs as intermediate inputs in Country f's production. In the first two groupings of the table, they have positive significant coefficients at 1% level. It implies that forward linkages of productions result

in a symmetric business cycles between countries. However, with respect to the groupings of ASEAN alone, and of ASEAN plus China, the estimated Best 2 are negative but significant. These estimates may be justified that ASEAN countries and China are mainly producing labour-intensive products in the downstream of production chain. In our sample period, there are not sufficient upstream intermediate inputs traded between these countries. In order to explain this negative sign, we need to study the same linkages as benchmark between countries in the European Community (EC) where there are more intensive intra-industrial trade to reflect the fragmentation in production. However, such benchmark is not able to generate due to data availability.

4.6 Conclusion and Further Discussion

This chapter empirically investigates the effects of vertical production linkages and spillovers on output comovements across countries using data of East Asian countries as sample.

Traditionally, classic theory predicts that the increase in trade will induce countries to specialize more on the production of goods in which they have comparative advantages, and thus leads to more idiosyncratic business cycles because countries might be more sensitive to industry-specific shocks.

However, the above theoretical prediction is based on the assumption that only final goods are traded between countries. As technology improved, vertical production specialisation enables countries to have some comparative advantages which they did not have before, and participate in international exchange in intermediates inputs. This type of international trade is based on vertical specialisation of production, exhibiting different features from horizontal specialisation.

Fully exploited the international input-output table, this chapter derived the vertical specialisation linkages across countries following the measurement suggested by Hummels et al. (2001). Also this chapter estimates the international spillover caused by international trade. A 2-step estimation is employed in this study to identify the effects of vertical linkages, including backward linkages from the demand side and forward linkages from the supply side, on national

output co-movements. Positive and significant effects of vertical specialisation linkages are found in our estimation. Moreover, international spillover positively contributes to the synchronisation of business cycles across countries.

There are still several remarks to highlight future study of this study. First, to measure productively shock linkages more precisely, micro-founded data on industrial product prices is to be considered. Second, countries in the European Community should be discussed in order to examine the supply linkages in full spectrum, since countries in the EC area produced larger range of upstream products than the ASEAN countries. Third, in this study, we adopted the assumption of technology is constant and does not change. We should allow technology linkages between countries change overtime and obtain a completed picture. Last, examining the data on FDI may provide another good point of view to study the vertical specialisation effects on business cycles synchronisations across countries.

Chapter 5

Regional Free Trade Agreement Effect on Vertical-Specialisation-Based Trade

Abstract

It is obvious that regional free trade area boosts international trade amongst member countries in the area. However, it has not been studied whether or not regional free trading agreements promotes trade based on vertical specialisation in production. In another word, will regional free trading blocs foster vertical specialisation in production so to stimulate trade in complementary intermediate goods in the region? This chapter employs a gravity framework to estimate the regional bloc effect on the trade based on vertical specialisation in the sample of East Asian countries plus the U.S. In order to avoid to endogenous problem existed in the regional trading agreement (RTA) dummy, the propensity to form a trading agreement suggested by Teneryro and Barro (2003) is calculated as the instrument for the RTA dummy. We find that both bilateral and multinational regional trading agreements have positive effects on vertical-specialisation-based trade. Also the result of this chapter suggests that closer economic integrations, such as currency unions, will enhance trade based on vertical production fragmentation by reducing the risk of exchange rates volatility.

Keywords: regional free trade agreements; vertical trade; production sharing; gravity estimation

JEL Classification Code: F15, F55

5.1 Introduction

As reported by Evans et al. (2006), economic integrations linked by regional trading agreements (RTAs) have recently been in a trend of moving from shallow integration to deep integration. "New regionalism" considers potential links between deep integration, productivity and trade. However, while "new trade theory" and "new regionalism" provide insights into linkages between deep integration and economic performance, they do not provide evidence of the RTA impact on trade based on vertical production linkages, which is a key feature of deep integration. This chapter investigates the RTA effect on vertical-specialisation-based trade. This chapter employs a standard gravity framework to estimate the RTA effects, of both bilateral and multilateral, on trade based on vertical-specialisation linkages. The instrumented estimation yields positive significant effects of RTAs on trade based on vertical production linkages across countries. The result implies that the signature and implementation of RTAs stimulates deeper economic links between countries.

International production sharing can be perceived by international trade based on vertical specialisation along the value chain extended across borders. Hummels et al. (1998) document the growth of international trade based on vertical specialisation. Notably, all of the four cases they studied are the case that vertical trade takes place within a certain economic region in the world. The case of the Mexico's maquiladoras is about the production and trade linkages between the U.S. and Mexico. Mexico's maquiladoras are non-Mexican-owned production plants, mainly owned by Americans for favourable tax and tariff treatments in both countries, that complete processing or secondary assembly of imported components for exports. Between 1975 and 1979, the share of total U.S.-Mexican trade attributable to maquiladora vertical trade averaged about 20% per year, and this share rose to an average of 25% in the following decade and of 35% in the first half of 1990's. Because there is surely vertical trade originating from non-maquiladora channels, at least half of the U.S.-Mexican trade could be due to vertical specialization.

Another typical case given by Hummels et al. (1998) is the Japan-Asia electronic trade. Many of Japanese manufacturing industries, in order to reduce costs or adverse the restriction on place of origin, outsource different stages of production, especially final assembly, to Southeast Asia. As of 1995, exports of

components to Asia accounted for more than three quarters of all exports there, more than one-half of all exports of components, and more than one third of total electronics exports. Most of this offshore production is then exported back to Japan or to third countries. They find that in the years between 1985 and 1995 vertical-specialization-based trade has almost quadruple in yen terms and has increased ninefold in dollar terms; as of 1995, it was approximately $55 billion. By contrast, total electronics exports from Japan during this period increased by on 23% in yen terms and by 81% in dollar terms.

It is no doubt that vertical-specialization-based trade is related to trade in intermediate goods, e.g. parts and components, which has also risen sharply in the recent decades. Yeats (1998) studies the global trade in parts and components by exploiting the advantages of Standard International Trade Classification (SITC) Rev.2. There is a strong intra-bloc effect on this trade in parts and components. In the study, he reveals that OECD countries are still the main destinations of OECD countries exports of parts and components. From the year 1985 to 1995, the share of this type of trade between OECD countries is steadily around 29%, and around 27% between EC 12 and OECD countries.

All of these phenomenon raise a worthy policy issue to consider - whether or not the regional free trade agreements amongst groups of countries strengthen the vertical production linkages and the trade based on this linkages between the Free Trade Area/Agreement/Arrangement (FTA) members. It is also the interest of research presented in this chapter.

In the literature on regionalism, vast body of them are focused on the effects of regionalisation on trade (including trade creation and trade diversion), on welfare and regional economic convergence. There are few papers that study the regional integration arrangement effect on vertical specialisation in production across the member countries within the regional arrangement.[19] This chapter studies the regional effect on the vertical production linkages amongst East Asian economies because the availability of data for the interdependent relationship of production across countries is limited. We find that regional free trade area has positive significant effect on trade based on vertical-production-specialisation. The finding of our study partially answers the question above proposed by Hummels et al. (1998). This finding, to a certain extent, confirms Hanson's (1996) argument

[19]Hanson (1996) investigates the vertical trade on the production network in a two-country model and illustrate with the apparel industry in Mexico and the U.S.

that vertical trade across countries will create a production network from the domestic to a global scale. Also this paper can be regarded as an extension of the literature on trade and regionalization. e.g. the work by Frankel and Rose (1998).

The rest of the chapter comes as follows. Related Literature will be reviewed in Section 5.2, and the econometric framework is described in Section 5.3. Section 5.4 offers the data description and estimate result. Section 5.5 concludes.

5.2 Literature Review

5.2.1 Regional Bloc Effect on Trade

Loads of literatures have documented the relationship between bilateral trade and the regional bloc. Most of the existing empirical work has been framed in the context of the standard "gravity model". According to the approach, bilateral trade between a pair of countries is increasing in their GDPs and is inversely related to their distance. Here, the distance has a broad meaning. Not only the physical distance between countries is included, but also all factors that create "trade resistance" are considered, for example, languages, colonized relation, free trade arrangements, currencies and etc. can be augmented as dummy variables.

On regional free trade arrangements, the effect of regional trading bloc on bilateral trade has been found strong and significant. By estimation from a gravity framework, Frankel and Wei (1993) found that: 1) there are indeed intra-regional trade biases in the European Community (EC) and the Western Hemisphere and perhaps in East Asia; but 2) the greatest intra-regional bias was in one of these three, but in the APEC grouping, which includes the U.S. and Canada with the Pacific countries; and 3) the bias in the East Asia and Pacific groupings did not increase in the 1980s.

Consistent with their 1993 paper, their work in 1994 find that the strongest bloc effect is the Pacific bloc which includes the U.S. and Canada along with East Asia, Australia and New Zealand. The significant gravity coefficient suggests trade the bloc effects double trade between members in the group of East Asian

countries alone. Also in their currency bloc regression, there is no strong evidence to support the East Asian currency bloc. If there is any, it is more likely to be classed in a US dollar bloc. Embedded a term of exchange rate volatility in the gravity model, an instrumental estimation with the standard deviation of relative money supply as instrument for the volatility of exchange rate is employed to correct the simultaneity. They find the trading bloc effect is a bit attributed to exchange rate links.

If one takes a step further regarding regional integration arrangement from the stage of regional free trade area to the stage of monetary/currency union, the effect of currency union on bilateral trade has been well discussed in academia, which most notable is Rose's work.

Rose and his co-authors provide a series of evidence through exploiting the gravity model for the idea that currency union like EMU will largely increase international trade. Cross-sectionally, Rose (2000) estimates countries within a currency union trade over three times than those countries adopt their own individual monies from a data pooled 186 countries from 1970 to 1990 in a five-year span. Rose also finds that currency unions are associated with trade growth is faster than non-currency unions, and the impact of a common currency is an order of magnitude larger than the effect of reducing moderate exchange rate volatility to zero but retaining separate currencies.

On the time series dimension which involves cases in which currency union is either implemented or abandoned, Pakko and Wall (2001) reveal a negative, though insignificant, effect of currency union on trade. However, Glick and Rose (2002) use an expanded panel data set that includes more episode of regime switch to analysis the effect. They find that joining/leaving a currency union leads bilateral trade increase/decrease by about 100% in the fixed effect estimation, and the other estimators produce even bigger effects.

When people do research related to the topic mentioned above, they usually do pairwise regression when using the U.S. as a benchmark. There is some trouble in this comparison, because the U.S. as an optimal currency area and the labour and other factors have fully mobility, alleviating the external supply shocks, whereas now Euroland still has some barriers to free mobility of labour and etc.

Klein (2002) also points out that the manner that Frankel/Rose gravity mechanism has a short leg of sets of dyads on bilateral trade. He changes the sets of dyads, making one candidate country and the U.S. in pair, and finds out that there is little robust evidence that dollarization promotes greater trade with the U.S. from the non-industrialized countries. But he did not gave conclusion of the bilateral trade between non-U.S. candidate countries.

Together with Rose and van Wincoop (2001), Nitsch (2002); Melitz (2001); Yeyati (2003), point out the problems of aggregate bias, arguing that pooling different currency unions may mask differential effects. Yet, all these studies still confirm a significant and positive effect on trade.

5.2.2 Regional Trade and Regional Economic Integration

Whenever studying regional bloc effect on trade, the standard starting point is the Viner (1950) distinction between trade creation and trade diversion. Trade creation means that the volume of trade increases between countries in a regional free trade agreement because of lowering tariffs amongst member countries which shifts away from reliance on high-cost domestic industry to imports from the lower-cost partner countries. Trade diversion implies the low-cost production outside the free trade area is replaced by high-cost production in the member countries of the regional arrangement.

There are several types of regional trade arrangements with varying degrees of integration. From low to high degree of linkages between countries, they are: Preferential Trading Area (PTA), Free Trade Area/Agreement/Arrangement (FTA), Customs Union (CU), Common Market (CM), monetary unions (MU), and totally Regional Economic Integration (REI).

Krueger (1997) argues that all else equal, customs union arrangements are strictly *Pareto superior* to free trade agreements because an FTA cannot lead to any more trade creation than can a customs union and, when ROOs export any protection, an FTA leads to more trade diversion than does a customs union. For a customs union, it is generally accepted that the larger the share of trade pre-existing amongst union partners, the more likely there is to be net trade creation and the less trade diversion will normally result. Of course, if a customs

union were formed amongst countries which collectively would produce goods and services at factor prices that would prevail at a full global free trade equilibrium, the welfare effects of customs union would be those of free trade. It is arguable that customs unions between developing countries are less likely to provide welfare gains than those between developing and developed.

Leamer (1994) voices that a custom union is compatible with global free trade if the vast majority of trade takes place naturally within the confines of the association. A custom union that is likely to have this property would combine countries to form a nearly exact economic replica of the globe. He shows that if association members are large enough to satisfy the demand for imports from third countries, then the discriminatory barriers are completely ineffective since they divert trade but do not destroy trade. In his case study of Mexico-U.S. free trade agreement, he argues that Mexico is large enough to satisfy a substantial share of U.S. demand for labour intensive products and for this reason the NAFTA may serve as a major deterrent to the erection of U.S. barriers again Asia.

Arndt (2003) points out that production sharing based on intra-product specialisation has been shown to be welfare enhancing under conditions of free trade. At a sufficiently flat domestic-world price ratio, welfare improves relative to the MFN equilibrium. The partner countries in the MFN engage in deeper economic integration, creating an economic area in which traditional preferential trade liberalisation is combined with production sharing. This is still a trade-diverting arrangement, welfare falls by less than before. Thus, deeper integration, which includes production sharing, mitigates the negative welfare effects of narrow preferential trade liberalisation. By specialising in the components of products in which each has comparative advantage, the two countries can improve productivity. This rise in efficiency is passed through to a lower intra-area price ratio. This improvement in the country's term of trade raises welfare.

Trade in components has important implications for the interaction between exchange rates and the trade balance. Trade tends to become less sensitive to exchange rate change and trade-balance accounting needs to distinguish between the value of total trade and trade in value-added.

If countries within the regional free trade area collectively produce goods

and services, in another word, there is production sharing within the member countries, and this production sharing can be done by the FDI or Multi-National Corporations (MNCs).

Blomstrom and Kokko (1997) document the literatures on the regional bloc and FDI flows. In fact, the reduction of regional trade barriers could instead stimulate overall FDI flows among the relevant trading partners by enabling MNCs to operate more efficiently across international borders. This argument applies in particular for vertical integrated FDI, where the operations of the MNC's different affiliates are specialised according to the locational advantages of the host country, and where a predictable and liberal trade environment is a prerequisite for the international division of labour at the firm level.

Studies of the impact of economic integration on intra-regional investment are much rare and generally constrained by data shortage. A similar picture is suggested in later study by Molle and Morsink (1991), based on FDI flows between EC countries during the period 1975 – 1983. The study suggests that intra-EC trade and intra-EC investment are complementary to each other, but only above a certain level of trade intensity.

Thus, in his well-cited paper, Hanson (1996) shows that vertical trade recreates the regional production network on a global scale. Large country becomes the global industry centre and subcontract input production to its small trader partner countries, and this type of trade causes a spatial redistribution of labour in small countries. In his case study of Mexican apparel industry, he finds that there has been a substantial relocation of Mexican apparel production since its opening to trade, and NAFTA reinforces this production relocation. Border producers in Mexico have easier access to the US market which reduces the importance of distance from its industry centre to Mexico City. For a developing economy, trade liberalisation involves a transition from vertically integrated manufacturing to a specialised role of subcontracting for developed-country firms. Mexican experience of regional specialisation under NAFTA is at least as profound as those of industrial specialisations.

5.2.3 Linkages and Agglomeration

The costs of accessing goods and services give a role for special proximity and regional concentration in the present of internal returns. Transport costs create cost advantages of proximity to specialised input suppliers and consumers. Transport cost savings when utilizing the services of locally available specialised inputs (cost linkages) and selling differentiated inputs and final goods (demand linkages) lead to agglomeration economies even if increasing returns are internal to firms.

Forward or cost linkages refer to the reduction in the cost of producing final and intermediate goods due to greater local input availability. A region offering a wider range of intermediate goods generates savings in transport costs to local users, thus providing cheaper access to inputs. Cost-reducing forward linkages among firms in one location arise because abundant locally produced input varieties entail a lower price index form intermediates. *Ceteris paribus*, less costly input lower the average and marginal production costs of firms using these inputs, including both final goods and intermediate goods producers. Lower production costs raise short-run firm profitability in region with a larger number of firms thus inducing addition firms entry and inter-sectorial mobility and further agglomeration.

Backward or demand linkages refer to the greater demand due to the lower prices implied by saving in transport costs when a higher number of firms produce in a given location. These linkages arise because the agglomeration of manufacturing firms increases local demand for locally produced differentiated inputs and final goods, which can be bought at zero transport cost. *Ceteris paribus*, these demand linkages cause the demand and marginal revenue curves facing intermediate and final goods producers to shift upward. A region featuring greater input and final good demand due to availability at a zero trading cost is more attractive to input and final good producers than a region with a smaller manufacturing sector. Greater demand and marginal revenue raise short-run firm profitability in region with a larger number of firms, thus inducing further entry of firms into the region.

Venables (1996) examines the interdependence of demand and supplier decision in the presence of vertical linkages and transport costs. The linkages are

important. They derive their effects from the interaction of trade costs with increasing returns to scale and imperfect competition. He finds that if economic integration reduces trade costs, the happening of agglomeration and consequent divergence of regional economic performance depends on the strength of vertical linkages and the level of trade costs. If vertical linkages are strong and trade costs remain substantial, economic integration may lead to clustering. If linkages are weaker and transport costs are small, then integration may lead to dispersion as firms relocate in response to wage differences.

One may ask a question: has European integration promoted agglomeration? Amiti (1998) finds that European economic activity exhibited increased geographic concentration and increased industrial concentration during the 1968-1990 period. During this period trading costs declined due to the fall of transport costs, tariff and non-tariff barriers.

Shea (1995, 2002) reveals that industries clustered in the same region tend to co-move together no matter the data is at the nationwide level or at the local city level. When using the data at the city level instead of the national level, he finds that the input-output linkage effect is smaller whereas effects of local symmetric and asymmetric spillovers are positive and significant.

5.2.4 NAFTA Experience

Krueger (1999) exploits gravity model and shift-and-share analysis to investigate the trade creation and trade diversion effects of NAFTA. She found there is no obvious trade diversion effect after forming of NAFTA, and there is still trade creation amongst members, but she also pointed out that there might be shifts of location in production of non-member countries to take the NAFTA-derived advantage.

Madariaga et al. (2004) find that agglomerations are important for NAFTA and MERCOSUR members whatever the sector is after the implementation of treaties. Industries in member countries will relocate to new concentration centres where they are closer to each other than where the old centres were before.

Schiff and Wang (2004) empirically investigate the dynamic effects of NAFTA

on Mexico's total factor productivity (TFP) through its impact on trade-related technology diffusion. They discover that Mexico's trade with NAFTA members (mainly U.S.) has large and significant impact on TFP in Mexico's manufacturing sector, which is different from the bench mark that Mexican trade with the rest of OECD countries brings not significantly different from zero effect on its TFP.

Romalis (2005) exploits the commodity and time variation in the tariff preference that is afforded to goods originating in NAFTA partners to identify NAFTA's and CUSFTA's effect on trade and welfare. He finds that NAFTA and CUSFTA have had a substantial impact on international trade volumes. His large estimated elasticities of substitution on demand side suggest that consumers are very willing to substitute between sources of a commodity for small costs occurred to international trade either by natural transport costs or by artificial cost like tariff. He also finds that the supply elasticity to the U.S. is fairly elastic even for those products where the U.S. consumes most of the output.

The experience of Mexico suggests that North-South integration may be greatly beneficial for the Southern partners, and illustrates some of the prerequisites for achieving these beneficial effects. Consequently, regional integration has been connected to significant increases in the inflows of foreign investment, in particular from countries outside the NAFTA region.

5.3 Econometric Methodology

5.3.1 Endogeneity between Trade and Regional Bloc

Economists argue that there exists a "Lucas Critique" endogeneity problem with the relationship between bilateral trade and the forming a regional free trade arrangement, or a bit further, a currency union. In the previous studies, it has been found that the bilateral trade is boosted while there is a free trade arrangement between these countries because of the reduced trade barriers. On the other hand, one may believe that the decision to establish a free trade area between countries is due to the intensification of trade between these countries in history.

Frankel and Rose (1998) use four de-trended variables (real GDP; industrial production; employment; or the unemployment rate) to measure the correlated economic activities between countries. Estimation with instrumental variables built up on the gravity model is employed to avoid a downward estimated effect of trade. Also a dummy variable as unity if two countries shared a bilateral fixed exchange rate is added in to their sensitivity test. The robust result of trade effect contrasts with the Bayoumi-Eichengreen (1992) view that the high correlation amongst European incomes is a result not of trade links, but of Europeans' decision to relinquish monetary independence *vis-à-vis* their neighbours. They conclude that with trade boosting up, a country is more likely to satisfy the criteria for entry in a currency union *ex post*, even it does not *ex ante*.

Persson (2001) voices that a different critique based on the potential for self-selection in the decision to form a currency union. Using semi-parametric methods, he finds little support for a currency union effect on trade; his point estimates, ranging from 13% to 45%, are not statistically significantly different from zero. This result is not surprising, however, because the matching procedure — designed to deal with nonlinearities in observable variables — throws out much of the information in the sample.

5.3.2 Instrument for Endogeneity

When estimate the regional bloc effect on bilateral trade, the underlying assumption in these studies is that regional integration arrangements are randomly assigned. As discussed above, it is not true. Greater culture links, better infrastructure for bilateral transportation and tied bilateral transfer may increase the propensity to establish a regional free trade arrangement. Similarly, countries with free trade arrangements may take additional policies to foster integration and facilitate trade. These omitted variables may cause a downward bias in OLS estimates.

Thus, in the case to find out the regional bloc effects, such as the currency union effect, Tenreyro (2003) construct a new instrumental variable for currency union dummy by estimate the propensity of a country to join a currency union. It does not work directly to use the estimates from the probit equation because the determinants of the probability of currency also enter directly into the de-

terminants of bilateral trading volume. So Tenreyro (2003) adopts an indirect approach to compute the join probability of both country i and country j adopt the currency of anchor country k. And if this join probability is high enough, it implies that country i and j are close enough to adopt the same currency or form a currency union.

One can then use this joint probability as an instrument for the currency dummy in equations for bilateral trade between countries i and j. The underlying assumption for the validity of this instrument is that the bilateral trade between countries i and j depends on bilateral gravity variables for i and j but not on gravity variable involving third countries, notably those associated with the potential anchor countries k. These gravity variables involving third countries affect the propensity of countries i and j to be part of the same currency zone and, thereby, influence bilateral trade between countries i and j through that channel. However, these variable do not (by assumption) directly influence the bilateral trade between countries i and j.

5.3.3 Estimation Framework

A gravity equation is given below to describe the regional bloc effect on bilateral vertical trade.

$$VT_{i,j,t} = \alpha X + \theta RTA_{i,j,t} + \varepsilon_{i,j,t} \tag{5.1}$$

where $VT_{i,j,t}$ stands for the vertical trade between counties i and j at time t; X is a vector of covariates that capture the role of tradition determinants of this gravity; $RTA_{i,j,t}$ is a dummy variable which takes a value of one if there is a free trade arrangement between countries i and j at time t; $\varepsilon_{i,j,t}$ is an error term. Accordingly, θ is the parameter of interest: the effect of regional free trade arrangement upon bilateral vertical trade.

As discussed above, the regional bloc dummy $RTA_{i,j,t}$ is endogenous with the regressand $VT_{i,j,t}$, causing OLS estimate downward bias. Thus, $RTA_{i,j,t}$ is instrumented by the propensity, $P_{i,j,t}$, of forming a regional free trade agreements

between two counties i and j suggested by Tenreyro (2003).

$$P_{i,j,t} = W\beta + u_{i,j,t} \tag{5.2}$$

Here, we can not strictly follow Tenreyro's instrument of the joint probability for countries i and j to establish a free trade arrangement with the third country k because our sample countries, except the U.S. did not sign more than one free trade arrangement within the sample period, it is impossible to compute this multi-lateral probability to create a free trade area.

The decision to have regional free trade arrangement is assumed to depend linearly on vector W. Some of the variable in W may be included in X. $\varepsilon_{i,j,t}$ and $u_{i,j,t}$ are error terms assumed to be bivariate normal, with a zero mean and a covariance matrix given by:

$$\begin{bmatrix} \delta & \gamma \\ \gamma & 1 \end{bmatrix} \tag{5.3}$$

if the gravity and regional trade arrangement equations are independent, the covariance term γ will be equal to zero however, it is likely that this covariance term will be different from zero.

Hence, we are becoming to simultaneously estimate a system framework

$$\begin{cases} VT_{i,j,t} = \alpha X + \theta RTA_{i,j,t} + \varepsilon_{i,j,t} & (5.4) \\ RTA_{i,j,t} = \begin{cases} 1, & if \widehat{P_{i,j,t}} \geq 0.5 \\ 0, & \widehat{P_{i,j,t}} < 0.5 \end{cases} & (5.5) \\ P_(i,j,t) = W\beta + u_{i,j,t} & (5.6) \end{cases}$$

The interest of our study is the parameter of θ, the RTA impact on vertical trade. Wooldridge (2002) shows that a consistent estimator of θ, when $RTA_{i,j,t}$ is endogenous, is obtained by a two-step procedure. A 2SLS estimator is more robust whereas estimators of Generalised Method of Moments (GMM) or Three-Stage Least Square (3SLS) are more efficient.

In this study, we employ the 2SLS method to derive the RTA effect on vertical trade between countries. In the first step, we estimate the parameters in Equation 5.6 using a probit regression. Then, we use these estimated parameters

to generate the predicted values of $P_{i,j,t}$. We substitute zero for the values of $RTA_{i,j,t}$ if the predicted value of propensity, $\widehat{P_{i,j,t}}$, is less than 0.5, and one for the values of $RTA_{i,j,t}$ when $\widehat{P_{i,j,t}}$ is not smaller than 0.5. In the second step, we estimate the parameters in Equation 5.4 using the substituted values of $RTA_{i,j,t}$ to to instrument the RTA variable. Both Equation 5.4 and 5.6 are estimated under the random effect model on panel data.

5.4 Empirical Result

5.4.1 Data

5.4.1.1 Vertical Trade

As suggested by Hummels et al. (2001), the vertical trade between countries h and f can be measured by a vertical share index:

$$VS \text{ share of total exports } \equiv \frac{VS_h}{X_h} = \frac{\sum_i VS_{h,i}}{\sum_i X_{h,i}} \tag{5.7}$$

or equivalently as

$$\begin{aligned} \text{VS share of total exports } &\equiv \frac{\text{VS}_h}{X_h} = \frac{\sum_i \text{VS}_{hi}}{\sum_i X_{hi}} = \frac{\sum_i \left(\frac{\text{VS}_{hi}}{X_{ki}}\right) \times X_{hi}}{\sum_i X_{hi}} \\ &= \sum_i \left[\left(\frac{X_{hi}}{X_h}\right) \times \left(\frac{\text{VS}_{hi}}{X_{hi}}\right)\right] \end{aligned} \tag{5.8}$$

Applying this implication to the Input-Output (I-O) tables, the vertical share is

$$VS \text{ share of total exports } \equiv \frac{VS_h}{X_h} = \frac{\mu A^M_{f,h}[I - A^D_h]X}{X_h} \tag{5.9}$$

where μ is a $1 \times n$ vector of 1's; $A^M_{f,h}$ is the $n \times n$ matrix of imported coefficients from country f to country h; I is the identity matrix; A^D_h is the $n \cdot \times n$ matrix of domestic coefficients; X is an $n \times 1$ vector of exports; n is the number of sectors; and X_h is the sum of exports across sectors. $[I - A^D_h]$ is the *Leontief Inverse* that captures allowing the imported input to be embodied in a domestic output at the 2nd, 3rd, 4th, ..., stage before it becomes embodied in the good that it

is exported. It is the matrix analogue of an infinite geometric sum. And this formula allows the goods to circulate through all sectors of the economy before they are exported.

As $A^M_{f,h}$ is the $n \times n$ matrix of coefficients from country j to country i, the $VT_{i,j}$ is the sum of $VS_{j,i}$ and $VS_{i,j}$. Specifically

$$VT_{i,j} = VS_{j,i} + VS_{i,j} \tag{5.10}$$

which represent the vertical backward/forward linkages between country i and country j. The higher value of $VT_{i,j}$ implies tighter vertical linkages between them — they have a higher ratio of imported inputs from each other in order to produce their output for export.

5.4.1.2 Data

The bilateral intermediate import matrices together with the Leontief Inverse matrices are taken from the Asian International Input-Output (I-O) Table developed by the Institute of Developing Economies, Japan. This series of Asian International I-O Table provide five-year span tables to represent technology changes over time. In this chapter, we exploit the Tables for the year 1990, 1995 and 2000.[20] As there are missing values in the non-manufacturing sectors in some sample countries, we are not sure these missing values were due to failure in data collecting in census or they represents a true value of zero. Hence, we are just focused on the manufacturing sector that includes 12 industries in the I-O Table. The disadvantage of chopping off non-manufacturing sector is that the information embedded in non-manufacturing sector, in particular in the *Leontief Inverse* was discarded. However, we still believe that this information lose is limited, because manufacturing products have been increasingly dominate the world trade.

All the data used in this chapter is in the sample period from 1980 to 2005, except that the Export Data of China is available from 1984 onwards, thus, VS_{china} is computed from the year 1984. The disaggregated industrial export data to compute the vertical specialisation index for each country was taken from

[20] 1990 is the earliest table and 2000 is the latest table available.

the dataset of UNComTrade developed by the Statistics Division of the United Nation (UNSD). Aggregated Export and Import data is from the Direction of Trade Statistics (DOTS) developed by the International Monetary Fund (IMF). Data of bilateral or multilateral trade agreements is taken from the World Trade Organisation (WTO). Data of GDP and GDP per capita were extracted from the World Development Indicator (WDI), a dataset created by the World Bank. Data of exchange rates are taken from the International Financial Statistics (IFS), a dataset developed by the IMF. Data for other control variables, such as dummies of proximity, same languages, same religion and same ex-coloniser, are taken from the World Fact Book edited by the Central Intelligence Agency (CIA), U.S. For the bilateral distance between two countries, we use the Great Circle distances between the largest ports of each country[21] in order to represent the distance of two economy centres.[22]

5.4.2 Results

In the propensity equation 5.6, the control variables include: i) the logarithm of GDP product of two countries, representing the economy size; ii) the logarithm of the product of per capita GDP between two countries indicating the wealthy conditions; iii) the dummy of proximity which takes value of one if two country has common border, and zero, otherwise; iv) the dummy of same ex-coloniser which equals to one if both countries have the same ex-coloniser, otherwise zero; v) the dummy of same religion which takes value of one if the largest region is the same in two countries, if not the dummy takes the value of zero; vi) the bilateral trade dependency which is a ratio of the bilateral trade of country and to the total trade volume of these two countries;[23] vii) a set of dummy variables to indicate the existence of any other rival regional trading bloc, e.g. EC92, MERCOSUR and NAFTA. Goto and Hamada (1995) show that the creation of an Asian regional bloc, for instance EAEC, is a natural response of Asian countries when facing the situation that the rest of the world is forming several big regional blocs, because no one wants to be left behind.

[21]The author is grateful to the great assistance with computing the Great Circle distance from Mr. Jianheng Tan of the China Shipping Container Lines Co. Ltd. (CSCL).

[22]The economy centre is not the same as its political capital in some countries of the sample.

[23]This measurement is slightly different from the similar trade dependency measurement used by Goto and Hamada (1994) which is a ratio of trade to GNP.

The regressors in the gravity equation 5.4 are retrieved from standard gravity framework in the literature. The specification of the gravity equation incorporates the following covariates: a) the logarithm of GDP product of two countries as a measure of economies size; b) the logarithm of the product of per capita GDP between two countries to represent the difference in wealth of two countries; c) the logarithm of distance; d) RTA indicator which is of our interest; and e) the APEC dummy which test the effect of a wider-range covered multilateral arrangement on this bilateral vertical specialisation;[24] and f) the variability of bilateral exchange rates, which is the logarithm of the standard deviation of the bilateral exchange rates.

There are nine economies in the sample, which covers from developed countries such as the U.S. and Japan, to developing countries like China, Indonesia, the Philippines, Thailand and like emerging markets such as Korea, Malaysia and Singapore. We can take this privilege of the diversity of country sample so that we can group the countries in lines with the different combinations of regional trading agreement (RTA) memberships.

Table 5.1 and 5.2 report the estimate results of the instrumented Gravity Equation 5.4. The left hand side of the Equation is the bilateral vertical trade (VT) linkages between countries, which is the ratio of total required imported inputs for exported outputs of both countries in the pairs. Theoretically the values of VT are in a range of 0 to 200. The mean values of VT vary with respect to different groupings of countries.

We are interested in θ, the parameter of the instructmented RTA dummy variable. θ captures the effect of the implementation of bilateral regional free trade arrangements (FTAs). If θ is positive, it implies that the implementation of FTAs promotes vertical linkages between countries in pairs and *vice versa*. The relative measure of this RTA effect on vertical linkages can be derived as $\frac{\theta}{200}$, the percentage change in VT linkages caused by the implementation of FTAs. The meaning of θ is the change of VT from its mean when $RTA = 0$ — there is not any FTA between countries to $\overline{VT}|_{RTA=0} + \theta$ when $RTA = 1$ — there is an FTA between countries.

The first impression of the results presented in Table 5.1 is both bilateral

[24]Goto and Hamada (1995) show that a looser APEC is the compromised outcome due to the US opposition to a closer EAEC bloc.

Table 5.1: Estimated Coefficients of the Gravity Equation 5.4 for countries in East Asia

Vertical Trade	ASEAN[†]	ASEAN+China	ASEAN+Japan	ASEAN+3[‡]
VT Mean ($RTA = 0$)	2.0287	1.6319	4.6477	3.3891
RTA (instrumented)	0.3353^{*}	-0.5077^{***}	2.0044^{**}	1.5185^{***}
	(0.1853)	(0.2217)	(0.9374)	(0.4352)
GDP Product (logarithm)	1.2095^{***}	1.2995^{***}	0.0748	0.1946
	(0.2610)	(0.1934)	(0.3341)	(0.1698)
per capital GDP Product (logarithm)	−0.0849	−0.3773	0.9648^{***}	0.2685
	(0.3550)	(0.2501)	(0.3560)	(0.2038)
Distance (logarithm)	-4.2020^{****}	-5.0487^{***}	−0.9972	-0.9848^{*}
	(0.8723)	(0.8122)	(0.7572)	(0.5840)
APEC Dummy	-0.6701^{***}	-0.3419^{**}	0.5382^{**}	0.5721^{***}
	(0.2042)	(0.1418)	(0.2283)	(0.1501)
Exchange Rates Variability (logarithm)	-0.7200^{***}	-0.5521^{***}	-0.5144^{**}	-0.35555^{*}
	(0.1753)	(0.1670)	(0.2283)	(0.1837)
Observation	260	390	390	728

*** at 1% confidence level

** at 5% confidence level

* at 10% confidence level

† ASEAN is the grouping of Indonesia, Malaysia, the Philippines, Singapore and Thailand

‡ ASEAN+3 is the grouping of ASEAN countries together with China, Japan and Korea

$^{\flat}$ Parentheses indicate the standard deviations

$^{\natural}$ This table presents the estimated parameters of the Gravity Equation, $VT_{i,j,t} = \alpha X + \theta RTA_{i,j,t} + \varepsilon_{i,j,t}$. $VT_{i,j,t} = VS_{j,i} + VS_{i,j}$ is the vertical trade between pair of countries. X is a vector of control variables, such as the logarithm of GDP product for Country i and j; the logarithm of GDP *per capita* product for Country i and j; the logarithm of distance between Country i and j; the logarithm of standard deviations of exchange rates between Country i and j; and the APEC dummy. RTA is the dummy variable of interest, taking the value of one if there is a bilateral free trade arrangement between Country i and j; taking the value of zero, otherwise.

trade agreement (indicated as RTA) and multilateral trade agreements have positive significant effect on bilateral vertical-specialisation-based trade in most groupings. The first column is the grouping of ASEAN alone which mimics the south-south integration of MERCOSUR. Its positive significant effect of bilateral trading agreements but negative significant effect of multinational trading agreements insinuates that countries in the group reply more on bilateral trading agreements. However, as suggested in literature that a trading agreement is sustainable and welfare enhancing when the member countries in the agreement deeper integrate their economies in a production sharing framework and trade in complementary goods. Therefore, we include Japan and the country group of China, Japan and Korea to the ASEAN group. The results of these two groupings are plausible. Especially, the ASEAN+3 grouping covers the East Asian economic area. This result implies that the East Asian regional trading bloc stimulates the intra-regional exchange of intermediate inputs based on vertical specialisation in production. The negative signs of the coefficients of our interest in the grouping of ASEAN plus China basically reflect two facts: 1) the lower trade level between China and ASEAN compared with the level between Japan and ASEAN. China just started increasing its trade with ASEAN countries after the year 2003 which it is the second last year in the sample. 2) the similar economy structure between China and ASEAN. China and ASEAN countries are specialised in labour-intensive production stages. The vertical specialisation between China and ASEAN countries are not clear at all.

In TableTable 5.1, for example, the mean value of VT when $RTA = 0$ is 4.6477 for the grouping of ASEAN+Japan. It is the highest mean value of VT amongst all groups. With respect to this group, $\theta = 2.0044$ shows that the implementation of FTA between countries in this group will stimulate about 1% vertical trade in theory. Given the level of pre-FTA vertical trade linkages, the implementation of FTA will add 2.0044 on top of 4.6477. It implies that 43% growth of VT after the stimulus of FTA.

Table 5.2 shows the results of country grouping included the U.S. The result in the first column is interesting. Both bilateral RTA dummy and multilateral APEC dummy have positive effects on the vertical trade between countries. But the bilateral RTA dummy has significant effect whereas the multilateral APEC dummy is not significant. These results mirror the trading strategies of the U.S that it counts more on bilateral agreements than multinational mechanism.

Table 5.2: Estimated Coefficients of the Gravity Equation 5.4 expanding sample countries including the U.S.

Vertical Trade	ASEAN+U.S.	ASEAN+U.S.+Japan	ASEAN+3+U.S.
VT Mean ($RTA = 0$)	3.3095	4.5202	3.5610
RTA (instrumented)	2.1063***	-0.1707	0.3495
	(0.7658)	(0.9920)	(0.6010)
GDP Product (logarithm)	0.9541***	1.0983***	0.5478***
	(0.2572)	(0.2992)	(0.1585)
per capital GDP Product (logarithm)	-0.0566	-0.0381	0.0588
	(0.2907)	(0.4094)	(0.2041)
Distance (logarithm)	-2.0852***	-2.0657***	-1.0345**
	(0.4045)	(0.6129)	(0.4306)
APEC Dummy	0.0184	0.6260***	0.6582***
	(0.1987)	(0.2056)	(0.1304)
Exchange Rates Variability (logarithm)	-0.6862***	-0.7571***	-0.3918**
	(0.1461)	(0.2354)	(0.1572)
Observation	390	546	930

*** at 1% confidence level

** at 5% confidence level

* at 10% confidence level

† ASEAN is the grouping of Indonesia, Malaysia, the Philippines, Singapore and Thailand

‡ ASEAN+3 is the grouping of ASEAN countries together with China, Japan and Korea

♭ Parentheses indicate the standard deviations

♮ This table presents the estimated parameters of the Gravity Equation, $VT_{i,j,t} = \alpha X + \theta RTA_{i,j,t} + \varepsilon_{i,j,t}$. $VT_{i,j,t} = VS_{j,i} + VS_{i,j}$ is the vertical trade between pair of countries. X is a vector of control variables, such as the logarithm of GDP product for Country i and j; the logarithm of GDP *per capita* product for Country i and j; the logarithm of distance between Country i and j; the logarithm of standard deviations of exchange rates between Country i and j; and the APEC dummy. RTA is the dummy variable of interest, taking the value of one if there is a bilateral free trade arrangement between Country i and j; taking the value of zero, otherwise.

However, the results demonstrated on the second and the third column confirms that prediction by Goto and Hamada (1995) that the U.S. will promote APEC when facing East Asian countries to form their own regional trading bloc which excludes the U.S. out of the bloc. Hence, either in the grouping of ASEAN plus Japan and the U.S. or in the grouping of whole East Asia (ASEAN+3) together with the U.S., APEC effect enlarges and becomes significant whilst the bilateral RTA effect becomes insignificant, although it is still positive.

There is an interesting phenomena presented in Table 5.1 and 5.2. When we observe the first two rows in both tables, roughly we will find a trend that the values of θ increases with the mean values of VT when $RTA = 0$. The grouping of ASEAN+China in Table 5.1 has the lowest mean value of VT, which is evidence of lower level of both trade and vertical linkages between China and ASEAN. This grouping of countries also have negative values of parameters on both RTA and $APEC$ Dummies. Though the groupings of ASEAN+US+Japan and ASEAN+3+US do not enjoy a significant parameters of RTA, they still have positive significant coefficients on the $APEC$ dummy. This phenomena is a evidence to confirm the predictions that regional free trade arrangements will benefit countries which they have collectively produce products before.(Arndt, 2003; Krueger, 1999)

Results of other coefficients are as expected. Negative significant distance effect shows that trading costs still matter in international trade or international production. The production network can not expand far to a global scale. Production sharing still agglomerates in a regional level. Moreover, the negative significant coefficient of exchange rate variability hints that a tighter economic integration, e.g. a currency union, may improve this vertical trade based on production fragmentation.[25]

5.5 Conclusive Remarks

This chapter, to our best knowledge, is the first research of empirical study the regional trading agreement effect on vertical specialisation in production and the trade based on this vertical specialisation. Instrumented gravity estimation is

[25]Deardorff (2001) shows that trade based on production fragmentation is more vulnerable to the exchange rates variability.

employed in this study in order to identify the regional trading agreement effect.

Our finding shows that regional trading bloc promotes international trade based on vertical specialisation in production. We also find that as the regional trading bloc enlarges, multinational trading agreements take over the role of bilateral agreements to continue stimulating trade based on production fragmentation. All these results confirm theoretical predictions that with technology improvement and trade expansion, production network can relocate from a domestic to a regional level of scale to fully exploit the comparative advantages.

The result obtained in this study also completes the conjecture of higher level of trade inducing a higher level of business cycles synchronisations. It is a three-fold conclusion that regional bloc stimulates vertical trade in complements products, and trades in complementarities results in a closer links between output co-movement across countries; and higher level of co-movement of business cycles makes countries the region sacrifice less to give up their own discretionary monetary policy tool to create a even tighter integration organisation, such as a currency union. In the result of this paper, we note that less risk in exchange rate volatility also promotes this vertical-specialisation-based trade.

However, the data sample used in this study is still in a narrow range. So the conclusion of this paper is suggestive but not decisive. In the further study, one should consider to examine the situation of production linkages in European Union, especially after the enlargement of the EU. Second thought of the research presented in this research is that except the group of ASEAN countries, other countries in the sample are the ones that either just signed up a free trade agreement before the end of the sample period or actively negotiate on a free trade agreement. We can re-examine this trading bloc effect on vertical specialisation once the data series is long enough to contain all necessary information.

Chapter 6

Long March towards an Integration Union: Conclusions and Future Work

Economic integration is not purely affected by the evolution of economies within the region. As discussed in literature, it is also strongly influenced by political relations. The purpose of the research presented in this thesis is to provide evidence and analysis on economic integration in East Asia, from an economic perspective.

East Asian regional integration, embracing Japan, is not desirable at this stage at least. The horrible memory of Japanese military aggression to the countries in the region during the World War II exists amongst the victim countries. By the time of the war, the Japanese military invasion was in the name of creating a virtual Japanese Yen bloc - the "Greater East Asia Co-prosperity Sphere". In one form, Japan issued military scripts in the area it invaded. In the other form, Japan created central banks in some regions in war that issued regional currencies pegged at par with the Yen. These measures took away the seigniorage rights from the Asian nations. Through the monetary expansion by these measures, the invaded region suffered tremendous inflation.[26]

[26]Goto and Hamada (1994)provide the data on money supply and price index for the occupied territories by Japan during the World War II.

As mentioned in Chapter One that the East Asian economic integration is contrast to the process in Europe Union, Asia still falls well in the lack of sufficient institutional integration. In Europe, economic and monetary cooperation was supported by strong institutional underpinnings which allowed to develop appropriate micro-foundations, effective monitoring, and communication channels through which member countries could coordinate their economic policies with a view to eliminating imbalance. However, in Asia, during the first thirty years after the ASEAN was born in the year 1967, the main agenda of cooperation has been concentrated on trade liberalisation.

In a research on Asian integration conducted by the European Central Bank (ECB) in 2002, it is mentioned that four broad aspects of the European experience and their roles in creating the conditions for successful deeper regional integration would be useful in Asian countries, namely:

- The creation of sound political, institutional and legal underpinnings;
- The pursuit of a high degree of trade/economic integration through the creation of a single market;
- The development of a regional approach to financial market regulation and supervision; and
- The pursuit of macroeconomic convergence through economic policy coordination and mutual surveillance.

The countries in East Asia are on the tracks towards creating a tighter linked economic integration in the region. In parallel to the process of trade integration, monetary and financial surveillance and cooperation started building up a regional framework. Historically, NAFTA and MERCOSUR are good examples to show the formation of blocs predated any explicit RTAs.[27]

As Paul-Henri Spaak put it,

> *those who drew up the Rome Treaty ... did not think of it as essentially economic; they thought of it as a stage on the way to political union.*

[27] Evans et al. (2006),P.27

Europe has already spent fifty years till it achieves such a high degree of economic integration. A similar historical process may be happening in East Asia in the future.

East Asia is highly open to international trade, both intra-regionally and inter-regionally. The substantial increase in intra-regional trade suggests the process of economic integration within the region.

High openness to international trade implies that countries are more vulnerable to shocks originated from the external of the economies. We first examine the correlations of external shocks to countries in the region because the finding will form the basis of our further discussion but also it has strong policy implication — since the higher correlations of shocks across countries, the less cost these countries have to sacrifice to adopt common economic policies. We discover that demand shocks and supply shocks original from the external are highly correlated across countries in the region. This is presented in Chapter 3.

The research presented in Chapter 4 and Chapter 5 is based on the finding of Chapter 3, and should be taken as two parallel piece of work. We are interested in the attributions to high correlations of shocks, especially of supply shocks to countries. The trade in intermediate inputs generates vertical linkages between trading partner countries, which makes countries participating in international production sharing face more common industrial-specific shocks. This type of trade based on production sharing spreads shocks of demand and productivity rapidly than the old-style international trade. Hence, we look at the effect of vertical specialisation upon output co-movements across countries, and we find that the degree of business cycles symmetry amongst countries increases with the vertical-specialisation-based trade between them.

If it is less costly but more beneficial for countries to set up regional integration arrangements if shocks correlations are highly amongst them. Therefore, we are also interested in the impact of regional integration arrangements on vertical linkages between countries. It is the study presented in Chapter 5. Through a gravity estimation, we report that regional trading bloc promotes vertical trade amongst member countries. Also a tighter economic integrated agreement can stabilise exchange rates variability. Trade in intermediates takes place across border more frequently than the traditional trade in final products.

Thus, vertical-specialisation-based trade is more sensitive to trade policy and exchange rates risk. Therefore, a closer linked regional bloc promotes vertical production specialisation and the trade based on it across countries within the bloc.

The main finding of the thesis is summarised as followed.

6.1 Structure and Main Findings of the Thesis

6.1.1 High Correlations of Supply Shocks between Japan and Other Economies in the Region

Chapter Three of this thesis examines the correlations of external shocks to countries in East Asia. It employs a Structural-VAR to investigate the long run shocks. Exports are used to symbolise the demand shocks from the destination markets of East Asian countries. Exchange rates of SDRs are regarded to represent for the productivity shocks.

The results shows that correlations of disturbances from outside of the economies are highly correlated, either the disturbances driven by the business cycles in the industrial countries presented as demand shocks or the disturbances linkages with Japan, the economic superpower in the region which supplies inputs to other developing countries to assemble and export to the U.S. or European markets. The high correlations of demand shocks confirm the finding by Frankel and Rose (1998). Since destinations of export markets of countries in East Asia are similar, it makes countries in the region more fragile in face with the demand shocks. The Asian financial crisis in 1997–1998 exhibited a fact that countries, even like Japan, depreciated their currencies when currency of their peer country in the region devalued. It was an evidence of their fear of losing export market shares. Actually, this experience shows the basis of building up a mechanism of regional exchange rates and monetary policy cooperation. Moreover, the finding that countries between ASEAN countries and Japan have highly symmetric shocks of productivity is a new result different from that by Bayoumi and Eichengreen (1999). Coe and Helpman (1995) also suggest that international spillovers

may spread productivity disturbances across borders rapidly than before. Considered the fact that Japan provides upstream intermediate inputs to countries in South East Asia, the finding of highly correlated productivity disturbances between Japan and South East Asian countries hints that vertical specialisation in production and trade based on this vertical specialisation are channels for productivity shocks to transmit through.

6.1.2 Positive Vertical Production Linkages Impact on Output Co-movements

Chapter Four investigates the impacts of vertical production linkages and of international spillovers through trade on output co-movement across countries. To my best knowledge, it is the first empirical research on the relationship between vertical production linkages and business cycles synchronisations. In order to derive the vertical linkages between countries, an Asian International Input-Output Table is exploited, following the measurement suggested by Hummels et al. (2001). Also the international spillovers were estimated from regressing countries' total factor productivity on imports.

A 2-step estimation technique is used in this Chapter. In the first step, generic shocks and constants are first estimated in a country-by-country regression. In the second step, the residual derived from the first-step regression is used to estimate the effects of backward, forward linkages and spillovers on output co-movement in the sample countries by a recursive least square procedure. For all groupings in the sample, backward vertical linkages have positive and significant effect on output comovement. It implies that demand shocks to final products are propagated through production linkages to upstream inputs producers across countries. This result complements the finding by Frankel and Rose (1998) that demand shocks to intra-industrial trade is attributed to symmetric business cycles. For those groupings which can be regarded having a more completed structure of differentiated production, forward linkages also generate a positive and significant coefficient. In addition to the vertical linkages, international spillovers have been proved to positively contribute to international output co-movement. This result is consistent with the prediction by Backus et al. (1992).

6.1.3 Regional Trading Agreements Promote Vertical Specialisation

Chapter Five tries to answer firstly to the question whether or not regional free trade agreement, either bilateral or multilateral, stimulates vertical specialisation across the member countries of the agreement.

A gravity framework of estimation is exploited to estimate the effect of regional dummy on the sum of vertical specialisation index for each pair of countries on a panel sample of East Asian countries plus the U.S. In order to overcome the endogeneity problem of vertical trade and regional trading agreement, a simultaneous equations model is applied to estimate. The regional free trading agreement dummy is instrumented by the propensity to form a trading agreement which is obtained from a probit regression.[28] The results in this chapter show that regional trading bloc, either bilateral or multilateral, significantly promotes vertical specialisation within the region. The result evidences that higher degree of production sharing in the regional bloc induces larger benefits of the regional agreement to vertical-specialisation-based trade.

All in all, this thesis has provided a three-fold conclusion. The more incentive vertical specialisation engaged in countries of a region, countries will experience a higher level of business cycle synchronisation through vertical production linkages. The higher level of business cycle symmetry, the less cost but more benefits countries will enjoy from the establishment of regional economic integration arrangements. The regional economic integration arrangements, in turn, promote vertical specialisation across countries in the region.

6.2 Future Work

The results obtained from the research presented in this thesis are suggestive but not decisive subject to data availabilities and reliabilities. My work in the future to extend the research on this topic includes the following possible prospects.

[28]Tenreyro and Barro (2003)

6.2.1 Understand the Driving Force of the Business Cycles

It is generally believed that the business cycles in East Asia are driven by the business cycles of the industrialised countries, such as the U.S. and the E.U. because of the intensive export-oriented economic structures in these countries. However, some articles argue that output shocks are largely domestically driven for most emerging markets including East Asia (Ahmed and Loungani, 1998; Larsen and Aziz, 1998). In order to model better the business cycles transmission in East Asia, it is worth having a look into the driving force of the business cycles in East Asia given two facts: 1) the economies in East Asia is turning from export-oriented to domestic consumption driven; and 2) East Asia's deep involvement in global production sharing makes countries in the region vulnerable to productivity shocks from countries supplying intermediate inputs to them.

6.2.2 Model Forward Linkages by Considering FDI

The forward production linkages are the linkages on the supply side through which productivity shocks are transmitted across countries. In order to detect productivity shocks, it is better to exploit the micro-founded data on prices of industrial outputs. Nonetheless, international supply linkages, such as outsourcing and trade in intermediates, are highly associated with FDI. For this reason, investigating data of bilateral FDI may provide more fruitful information to model better the forward production linkages between countries.

6.2.3 Allow Technology Change over Time

In Chapter Four of this thesis it was assumed that technology linkages between countries are constant and do not change over time in the sample period. Actually, Cheng et al. (2001) show that international production sharing indeed changes the economic structure of participating countries. By allowing technology change over time, it may provide information in how the vertical linkages evolve over time which in turn can help understand the behaviours of business cycles. To do this, longer time series data is a must.

6.2.4 Extent to Cross-Region Comparison and Longer Data Series

Due to the data availability, of the international input-output table in particular, the research, which is presented in this thesis, on vertical trade, business cycles symmetry and regionalisation are focused on the region of East Asia. In order to generalise the conclusion in this thesis, other regions on the globe are to be considered to examine, e.g. the E.U. after its enlargement, and MERCOSUR. E.U. is another ideal region to study vertical trade and business cycles. There is intensive intra-industrial trade taking place in the Western European countries. Countries in Western European have comparative advantages in producing upstream intermediates inputs which may generate an identifiable forward linkages effect on business cycles synchronisations. Moreover, the E.U. expansion to Central and East Europe allows production fragmentation enlarge to countries with more diversified economic performance. However, the economic integration in East Asia and the recent E.U. enlargement to East Europe are still in an ongoing process. We need to wait for longer series of data to be available and re-examine the effects.

6.2.5 Incorporate Political Institutional Effect

As discussed at the beginning of this chapter, political economy should be introduced to consider when studying on regional integration. Either, institutional integration is used to foster trade and economic integration, or actual progress made in trade and economic integration would at some point makes further institutional integration desirable or even necessary to preserve the achieved degree of interdependence. In contrast with experiences in Europe that political institutional efforts are the push for economic integration, Asian economic integration are mainly driven by the market. It is wise to incorporate political institutional effects in the future study on regional integration, for instance, to examine the impact of rules and regulation harmonisation upon productivity. Then, the productivity gains from those political institutional arrangements suggest higher correlations of shocks between countries in the arrangement, and imply a possibility of finer vertical production sharing. Eventually, we would study whether or not political institutional arrangements lead to deep integration through the

channel of productivity enhancement.

Abbreviations

2SLS	Two-Stage Least Square
3SLS	Three-Stage Least Square
AFTA	the ASEAN Free Trade Area
AIC	the *Akaike* Information Criterion
APEC	Asian-Pacific Economic Cooperation
AR	Autoregression
ASEAN	the Association of South East Asian Nations
CAN	Comunidad Andina; The Andean Community
CEP	Comprehensive Economic Partnership
CFA	Communauté Financière d'Afrique; Franc of the African Financial Community
CIA	the Central Intelligence Agency
CM	Common Market
CSCL	the China Shipping Container Lines Co. Ltd.
CU	Customs Union
CUSFTA	the Canada-United States Free Trade Agreement
DFID	the Department for International Development
DOTS	the Direction of Trade Statistics
EAEC	the East Asia Economic Caucus
EAFTA	the East Asia Free Trade Area

EC	the European Community
ECB	the European Central Bank
ECCA	the Eastern Caribbean Currency Area
EEA	the European Economic Area
EFTA	the European Free Trade Association
ERM	the European Exchange Rate Mechanism
EMU	the European Monetary Union
EU	the European Union
FDI	Foreign Direct Investment
FOB	Free On Board
FTA	Free Trade Area/Agreement/Arrangement
GDP	Gross Domestic Products
GMM	Generalised Method of Moments
GNP	Gross National Products
IFS	the International Financial Statistics
IIT	Intra-Industrial Trade
IMF	the International Monetary Fund
I-O	Input-Output
IV	Instrumental Variable
JPE	Journal of Political Economy
LIBOR	London Inter-Bank Offer Rates
MERCOSUR	the Mercado Común del Sur; the Southern Common Market
MFN	the Most Favoured Nation
MNC	Multi-National Corporation
MU	Monetary Union

NAFTA	the North America Free Trade Agreement
OAP	offshore assembly processing
OCA	Optimal Currency Area
OECD	the Organisation for Economic Co-operation and Development
OLS	Ordinary Least Square
OPEC	the Organisation of the Petroleum Exporting Countries
PPP	Purchasing Power Parity
PTA	Preferential Trading Area
REI	Regional Economic Integration
RIA	Regional Integration Agreement/Arrangement
ROO	Rules Of Origin
RTA	regional trading agreement
SDR	Special Drawing Right
SITC	Standard International Trade Classification
SVAR	Structural Vector Autoregression
TFP	total factor productivity
UNComTrade	United Nations Commodity Trade Statistics Database
UNIDO	United Nation Industrial Development Organisation
UNSD	the Statistics Division of the United Nation
VAR	Vector of Autoregression
VT	vertical trade
WDI	the World Development Indicator
WTO	the World Trade Organisation

Bibliography

Ahmed, S. and P. N. Loungani (1998). Working paper, Board of Governors of the Federal Reserve System.

Alesina, A. and R. J. Barro (2002, May). Currency unions. *Quarterly Journal of Economics 107*(2), 409–436.

Alesina, A., R. J. Barro, and S. Tenreyro (2002). Optimal currency areas. Working Paper 9072, National Bureau of Economic Research.

Alesina, A. and V. Grilli (1992). The european central bank: Reshaping monetary politics in europe. In M. B. Canzoneri, V. Grilli, and P. R. Masson (Eds.), *Establishing a Central Bank: Issues in Europe and Lessons from the U.S.*, Chapter 3, pp. 49–85. Cambridge, U.K.: Cambridge University Press.

Alesina, A. and V. Grilli (1993). On the feasibility of a one or multi-speed european monetary union. Working Paper 4350, National Bureau of Economic Research.

Amiti, M. (1998). New trade theory and industrial location in the eu: A survey of evidence. *Oxford Review of Economic Policy 14*(2), 45–53. Summer.

Anderson, J. E. and E. van Wincoop (2003, March). Gravity with gravitas: A solution to the border puzzle. *American Economic Review 93*(1), 170–192.

Arndt, S. W. (1996). Globalization and the gain from trade. In K. Jaeger and K.-J. Koch (Eds.), *Trade, Growth and Economic Policy in Open Economy.* New York: Springer-Verlag.

Arndt, S. W. (2003). Global production networks and regional integration. Working Paper 2003-12, Claremont McKenna Colleage.

Artis, M. and W. Zhang (1995). International business cycles and the erm: Is there a european business cycle. Discussion Paper 1191, Centre for Economic Policy Research.

Backus, D. K., P. J. Kehoe, and F. E. Kydland (1992, August). International real business cycles. *Journal of Political Economy 100*(4), 745–775.

Backus, D. K., P. J. Kehoe, and F. E. Kydland (1994, March). Dynamics of the trade balance and the terms of trade: The j-curve? *American Economic Review 84*(1), 84–103.

Backus, D. K., P. J. Kehoe, and F. E. Kydland (1995). International business cycles: Theory and evidence. In T. F. Cooley (Ed.), *Frontiers of Business Cycle Research*, Chapter 11, pp. 331–356. New Jersey: Princeton University Press.

Baldwin, R. E. and A. J. Venables (1995). Regional economic integration. In G. M. Grossman and K. Rogoff (Eds.), *Handbook of International Economics*. Amsterdam: Elsevier Science B.V.

Bayoumi, T. and B. Eichengreen (1992). Shocking aspects of european monetary unification. Working Paper 3949, National Bureau of Economic Research.

Bayoumi, T. and B. Eichengreen (1999). Is asia an optimal currency area? can it become one? regional, global and historical perspectives on asian monetary relations. In S. Collignon, J. Pisani-Ferry, and Y. C. Park (Eds.), *Exchange Rate Policies in Emerging Asian Countries*. U.K.: Routledge.

Bayoumi, T., B. Eichengreen, and P. Muro (1999). On regional monetary arrangement for asean. *Journal of the Japanese and International Economies 14*, 121–148.

Blanchard, O. J. and D. Quah (1989, September). The dynamic effects of aggregate demand and supply disturbances. *American Economic Review 79*(4), 655–673.

Blomstrom, M. and A. Kokko (1997). Regional integration and foreign direct investment. Working Paper 6019, National Bureau of Economic Research.

Blomstrom, M. and A. Kokko (1998). Multinational corporations and spillovers. *Journal of Economic Survey 12*, 247–277.

Blomstrom, M., R. E. Lipsey, and M. Zejan (1994). What explains the growth of developing countries. In W. J. Baumol, R. R. Nelson, and E. N. Wolff (Eds.), *Convergence of Productivity. Cross-National Studies and Historical Evidence*, Chapter 9, pp. 243–262. New York: Oxford University Press.

Cheng, L. K., L. D. Qiu, and G. Tan (2001). Foreign direct investment and international fragmentation of production. In S. W. Arndt and H. Kierzkowski (Eds.), *Fragmentation: New Production Patterns in the World Economy*, Chapter 9, pp. 165–186. Oxford, U.K.: Oxford University Press.

Clarida, R. and J. Gali (1994). Sources of real exchange rate fluctuations: How important are nominal shocks? Working Paper 4568, National Bureau of Economic Research.

Coe, D. T. and E. Helpman (1995). International r&d spillovers. *European Economic Review 39*(5), 859–887.

Deardorff, A. V. (1998). Fragmentation in simple trade model. Discussion Paper 422, University of Michigan.

Deardorff, A. V. (2001). Financial crisis, trade, and fragmentation. In L. K. Cheng and H. Kierzkowski (Eds.), *Global Production and Trade in East Asia*, Chapter 2, pp. 9–32. the Netherlands: Kluwer Academic Publishers.

Edwards, S. and I. Magendzo (2003). A currency of one's own? an empirical investigation on dollarization and independent currency unions. Working Paper 9514, National Bureau of Economic Research.

Eichengreen, B. (1992). Should the maastricht treaty be safe? *Princeton Studies in International Finance 74*.

European Central Bank (2002). *The European Experience with Monetary and Exchange Rage Cooperation: Potential Lessons for Asia?* European Central Bank.

Evans, D., M. Gasiorek, P. Holmes, L. Iacovone, K. Jackson, S. Robinson, and J. Rollo (2006). A framework for evaluating regional trade agreements involving developing countries. Assessing regional trade agreements with developing countries: Shallow and deep integration, trade, productivity and economic performance, Department for International Development, U.K.

Evans, D., P. Holmes, L. Iacovone, and S. Robinson (2006). Deep integration and new regionalism. Assessing regional trade agreements with developing countries: Shallow and deep integration, trade, productivity and economic performance, Department for International Development, U.K.

Frankel, J. A. and A. K. Rose (1998, July). The endogeneity of the optimum currency area criteria. *Economic Journal 108*(449), 1009–1025.

Frankel, J. A. and A. K. Rose (2002, May). An estimate of the effect of common currencies on trade and income. *Quarterly Journal of Economics 117*(2), 437–466.

Frankel, J. A. and S.-J. Wei (1993). Trade blocs and currency blocs. Working Paper 4335, National Bureau of Economic Research.

Frankel, J. A. and S.-J. Wei (1994). Yen bloc or dollar bloc? exchange rate policies of the east asian economies. In T. Ito and A. O. Krueger (Eds.), *Macroeconomic Linkages: Savings, Exchange Rates and Capital Flows*, Chapter 12, pp. 295–334. Chicago: University of Chicago Press.

Glaeser, E. L., H. D. Kallal, J. A. Scheinkman, and A. Shleifer (1992, December). Growth in cities. *Journal of Political Economy 100*(6), 1126–1152.

Glick, R. and A. K. Rose (2002, June). Does a currency union affect trade? the time series evidence. *European Economic Review 46*(6), 1125–1151.

Goto, J. and K. Hamada (1994). Economic preconditions for asian regional integration. In T. Ito and A. O. Krueger (Eds.), *Macroeconomic Linkage: Savings, Exchange Rates, and Capital Flow*, Chapter 14, pp. 359–388. Chicago: University of Chicago Press.

Goto, J. and K. Hamada (1995). Eu, nafta, and asian responses: A perspective from the calculus of participation. Working Paper 5325, National Bureau of Economic Research.

Hanson, G. H. (1996, December). Localization economies, vertical organization and trade. *American Economic Review 86*(5), 1266–1278.

Harris, R. G. (1993, November). Globalization, trade, and income. *Canadian Journal of Economics 26*(4), 755–776.

Harris, R. G. (1995, November). Trade and communication costs. *Canadian Journal of Economics 28*(S1), S46–S75.

Hirschman, A. (1977). A generalized linkage approach to development, with special reference to staples. *Economic Development and Cultural Change 25 Supplement*, 67–98.

Horvath, M. (2000, February). Sectoral shocks and aggregate fluctuations. *Journal of Monetary Economics 45*(1), 69–106.

Hummels, D., J. Ishii, and K.-M. Yi (2001, June). The nature and growth of vertical specialization in world trade. *Journal of International Economics 54*(1), 75–96.

Hummels, D., D. Rapoport, and K.-M. Yi (1998, June). Vertical specialization and the changing nature of world trade. Economic policy review, Federal Reserve Bank of New York.

Imbs, J. (2003). Co-fluctuations. http://www.hec.unil.ch/jimbs/Research/Cofluct2001.pdf.

Institute of Developing Economies (1998). *Asian International Input-Output Table, 1990*, Number 81 in Publication Statistical Data Series, Chiba, Japan. Institute of Developing Economies: Institute of Developing Economies/Japan External Trade Organisation.

Institute of Developing Economies (2001). *Asian International Input-Output Table, 1995*, Number 82 in Publication Statistical Data Series, Chiba, Japan. Institute of Developing Economies: Institute of Developing Economies/Japan External Trade Organisation.

Institute of Developing Economies (2006). *Asian International Input-Output Table, 1990*, Volume 2 of *Publication Statistical Data Series*, Chiba, Japan. Institute of Developing Economies: Institute of Developing Economies/Japan External Trade Organisation.

International Monetary Fund (IMF). *Direction of Trade Statistics (DOTS)*, ESDS International. International Monetary Fund (IMF): (MIMAS) University of Manchester.

International Monetary Fund (IMF). *International Financial Statistics (IFS)*, ESDS International. International Monetary Fund (IMF): (MIMAS) University of Manchester.

Ishii, J. and K.-M. Yi (2002, May). The growth of world trade. Research Paper 9718, Federal Reserve Bank of New York.

Jones, R. W. and H. Kierzkowski (2001a). Globalization and consequences of international fragmentation. In G. A. Calvo, R. Dornbusch, and M. Obsfeld (Eds.), *Money, Factor Mobility and Trade: Essays in Honor of Robert A. Mundell*, Chapter 10, pp. 365–384. Cambridge, Massachusetts: MIT Press.

Jones, R. W. and H. Kierzkowski (2001b). Horizontal aspect of vertical fragmentation. In L. K. Cheng and H. Kierzkowski (Eds.), *Global Production and Trade in East Asia*, Chapter 3, pp. 33–52. the Netherlands: Kluwer Academic Publishers.

Kalemli-Ozcan, S., B. E. Sorensen, and O. Yosha (2001, October). Economic integration, industrial specialization, and the asymmetry of macroeconomic fluctuations. *Journal of International Economics 55*(1), 107–137.

Kenen, P. B. (1969). The theory of optimum currency areas: An eclectic view. In R. A. Mundell and A. K. Swoboda (Eds.), *Monetary Problems of the International Economy*, pp. 41–60. Chicago: University of Chicago Press.

Klein, M. W. (2002). Dollarization and trade. Working Paper 8879, National Bureau of Economic Research.

Kokko, A. (1994, April). Technology, market characteristics, and spillover. *Journal of Development Economics 43*(2), 279–293.

Kollman, R. (2001, October). Explaining international comovements of output and asset returns: The role of money and nominal rigidities. *Journal of Economic Dynamics and Control 25*(10), 1547–1583.

Kouparitsas, M. A. (1998, April). North-south business cycles. Working Paper Series WP-96-46, Federal Reserve Bank of Chicago.

Krueger, A. O. (1997, October). Free trade agreements versus customs unions. *Journal of Development Economics 54*(1), 169–187.

Krueger, A. O. (1999). Trade creation and trade diversion under nafta. Working Paper 7429, National Bureau of Economic Research.

Krugman, P. (1993). Lessons of massachusetts for emu. In F. Giavazzi and F. S. Torres (Eds.), *Adjustment and Growth in the European Monetary Union*, Chapter 8, pp. 241–269. New York: Cambridge University Press.

Kugler, M. (2006, August). Spillovers from foreign direct investment: Within or between industries? *Journal of Development Economics 80*(2), 444–477.

Kydland, F. E. and E. C. Prescott (1982, November). Time to build and aggregate fluctuations. *Econometrica 50*(6), 1345–1370.

Larsen, F. and J. Aziz (1998). Asean in the world economy. In J. Hicklin, D. Robinson, and A. Singh (Eds.), *Macroeconomic Issues Facing ASEAN Countries*, Chapter 12. Washington D.C.: International Monetary Fund.

Leamer, E. E. (1994). American regionalism and global free trade. Working Paper 4753, National Bureau of Economic Research.

Lichtenberg, F. R. and B. v. van Pottelsberghe de la Potterie (1998, September). International r&d spillovers: A comment. *European Economic Review 42*(8), 1483–1491.

Madariaga, N., S. Montout, and P. Ollivaud (2004). Regional convergence, trade liberalisation and agglomeration of activities: an analysis of nafta and mercosur cases. Cahiers de la Maison des Sciences Economiques bla04069, Universit Panthon-Sorbonne (Paris 1).

Markusen, J. R. and A. J. Venables (1998, December). Multinational firms and the new trade theory. *Journal of International Economics 46*(2), 183–203.

Markusen, J. R. and A. J. Venables (1999, February). Foreign direct investment as a catalyst for industrial development. *European Economic Review 42*(2), 335–356.

McKinnon, R. I. (1963, September). Optimal currency areas. *American Economic Review 53*(4), 717–725.

Melitz, J. (2001). Geography, trade and currency union. Discussion Paper 2987, Centre for Economic Policy Research.

Molle, W. and R. Morsink (1991). Intra-european direct investment. In B. Brgenmeier and J. L. Mucchielli (Eds.), *Multinationals and Europe 1992: Strategies for the Future*. London, U.K.: Routledge.

Mundell, R. A. (1961, September). A theory of optimum currency areas. *American Economic Review 51*(4), 657–665.

Ng, F. and A. Yeats (2001). Production sharing in east asia: Who does what for whom, and why? In L. K. Cheng and H. Kierzkowski (Eds.), *Global Production and Trade in East Asia*, Chapter 5, pp. 63–110. the Netherlands: Kluwer Academic Publishers.

Nitsch, V. (2002, April). Honey, i shrunk the currency union effect on trade. *The World Economy 25*(4), 475–474.

Organisation of the Petroleum Exporting Countries (OPEC) (2007). *Annual Statistical Bulletin.* Organisation of the Petroleum Exporting Countries (OPEC).

Pakko, M. R. and H. J. Wall (2001, May). Reconsidering the trade creating effect of currency union. Review, Federal Reserve Bank of St Louis.

Persson, T. (2001). Currency union and trade, how large is the treatment effect? *Economic Policy 33*, 433–448.

Rivera-Batiz, F. L. and L. A. Rivera-Batiz (1990, November). The effects of direct foreign direct investment in the presence of increasing returns due to specialization. *Journal of Development Economics 34*(1-2), 287–307.

Rodriguez-Clare, A. (1996, September). Multinationals, linkages, and economic development. *American Economic Review 86*(4), 852–873.

Romalis, J. (2005). Nafta's and cusfta's impact on international trade. Working Paper 11059, National Bureau of Economic Research.

Romer, P. M. (1990, February). New goods, old theory and the welfare cost of trade restrictions. *Journal of Development Economics 43*(1), 5–38.

Rose, A. K. (2000, April). One money, one market: Estimating the effect of common currencies on trade. *Economic Policy 15*(30), 7–45.

Rose, A. K. and E. van Wincoop (2001, May). National money as a barrier to international trade: The real case for currency union. *American Economic Review 91*(2), 386–390.

Schiff, M. and Y. Wang (2004). Regional integration and north-south technology diffusion: The case of nafta. Working Paper 283, Central Bank of Chile.

Shea, J. (1995). Comovement in cities. Working Paper 5304, National Bureau of Economic Research.

Shea, J. (2002, May). Complementarities and comovements. *Journal of Money, Credit and Banking 34*(2), 412–433.

Tenreyro, S. and R. J. Barro (2003). Economic effects of currency unions. Working Paper 9435, National Bureau of Economic Research.

United Nations Industrial Development Organisation (UNIDO). *Industrial Demand-Supply Balance Database*, ESDS International. United Nations Industrial Development Organisation (UNIDO): (MIMAS) University of Manchester.

United Nations Industrial Development Organisation (UNIDO). *Industrial Statistics Database*, ESDS International. United Nations Industrial Development Organisation (UNIDO): (MIMAS) University of Manchester.

Venables, A. J. (1996, May). Equilibrium location of vertical linked industries. *International Economic Review 37*(2), 341–359.

Viner, J. (1950). *The Custom Union Issue* (1 ed.). Number 10 in Studies in the Administration of International Law and Organization. New York: Carnegie Endowment for International Peace.

Winters, A. L. (1997). Lebanons euro-mediterranean agreement: Possible dynamic benefits. In W. N. Shahin and K. S. Shehadi (Eds.), *Pathways to Integration: Lebanon and the Euro-Mediterranean Partnership*. Lebanon: Konrad Adenauer Foundation/The Lebanese Center for Policy Studies.

Wooldridge, J. M. (2002). *Econometric Analysis of Cross Section and Panel Data* (1 ed.). Cambridge, Massachusetts: MIT Press.

World Bank. *World Development Indicator (WDI)*, ESDS International. World Bank: (MIMAS) University of Manchester.

Yeats, A. J. (1998, January). Just how big is global production sharing? Policy Research Working Paper 1871, The World Bank.

Yeyati, E. L. (2003, April). On the impact of a common currency on bilateral trade. *Economics Letters 79*(1), 125–129.

Yi, K.-M. (2003, February). Can vertical specialization explain the growth of world trade. *Journal of Political Economy 111*(1), 52–102.