QUANTITATIVE IMPACTS OF ALTERNATIVE EAST ASIA FREE TRADE AREAS: A CGE ASSESSMENT

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Abstract

The aim of this thesis is to make a comprehensive assessment and comparison of the quantitative economic impacts at both the domestic and the international level of four alternative FTA options in East Asia – ASEAN-China, ASEAN-Japan, ASEAN-Korea and East Asia – by using a static multi-region, multi-sector CGE model as a tool. With two main extensions to the 'standard' CGE model in this study – the introduction of unemployment and the incorporation of highly disaggregated household data (Thailand is a case study) – the analysis is enhanced on the issues of labour markets and poverty and the income distribution.

The model results show that trade liberalisation could alleviate real wage inequality in countries abundant in unskilled labour, i.e. China and ASEAN. In contrast, real wage inequality worsens in Japan and Korea, where skilled labour is relatively abundant. The unemployment feature incorporated in the model gives quantitative predictions of both lower unemployment and higher real wages. In general, under a regional agreement – **East Asia FTA** – member countries would enjoy higher economic welfare gains than under any of the bilateral agreements – ASEAN-China FTA, ASEAN-Japan FTA or ASEAN-Korea FTA.

When focusing on poverty and income distribution effects in Thailand, the model results at the national level suggest that all the trade liberalisation options will alleviate the poverty problem in Thailand, but that the degree of poverty reduction will vary depending upon the implemented policy. The poverty in the poorest community (villages), and in the poorest region (the Northeast) improves the most from the **East Asia FTA**. On the other hand, trade liberalisation, under all options, does not have a major impact on income disparity in Thailand. Sensitivity tests indicate that these results are robust.

However, such an 'ideal' regional agreement might be deterred by the different strategies of other East Asia nations and by the uneasy relationship between China and Japan, reflecting their economic and political differences.

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Chapter 1

Introduction

1. Motivation

The East Asian economies have been very active over the last decade in seeking the rapid expansion of Preferential Trade Agreements (PTAs) in the region. Establishing the East Asia Free Trade Area Agreement (EAFTA), which ideally would include all of ASEAN[1] (the Association of Southeast Asian Nations), China, Japan and Korea, is the major goal.

Calls for regional PTAs in East Asia have proliferated for three main reasons: (1) the failure of the Asia Pacific Economic Cooperation (APEC) group to deliver the desired level of cooperation among member countries, coupled with the slow progress in increasing multilateralism under the auspices of the World Trade Organization (WTO); (2) the perceived need for the East Asia economies to establish their own institutional identity in order to strengthen mutual co-operation, in particular following the adverse impacts on their economies of the Asian financial crisis in 1997; (3) the continued highly discriminatory nature of intra-regional trade in East Asia, which remains a major obstacle to expanding trade within the region.

The ASEAN-China Free Trade Area (ACFTA), implemented in 2005, is the most ambitious initiative in the East Asia region. Its economic effects on both ASEAN

[1] There are 10 countries in ASEAN: Brunei, Cambodia, Indonesia, Laos PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam.

members and China are expected to be substantial due to the increasing importance of China in world trade. The expanding role of China in the world market has been closely observed by most countries, particularly in the light of the way in which China has reformed her domestic economic institutions since the 1980s, notably by moving towards a market-based system. Those reforms, coupled with the opening of trade with the rest of the world and a decrease in government intervention, have achieved a globally-recognized success. One important consequence is that China became a member of the World Trade Organization (WTO) in 2001.

China's WTO accession involves an increasing access to Chinese markets through the reduction of trade barriers. In complying with the rules and regulations of WTO on multilateral trade agreements, China's trade policy encompasses the possibility of both global and regional trade agreements.

The reform of trade policy in China has sent strong signals, both economic and political, to Japan, which was once the dominant economy in Asia, that China is now ready to take part in and exert an influence on the pattern of global trade. Even though Japan soon recognized the increasing economic power of China, it was not until in late 2002 that Japan enacted its first free trade agreement, with Singapore. Struggling with the issues raised by its having a highly protected domestic agricultural sector, Japan has inaugurated a number of bilateral trade agreements with various countries in ASEAN with the intention of maintaining its position as one of the world's major economies.

At the same time, in what is often called the 'domino effect', Korea feared that it might be excluded from the benefits of free trade with ASEAN. Consequently, in late 2004, Korea also concluded a framework agreement that established an ASEAN-Korea Free Trade Area, the intention being to eliminate bilateral import tariffs on approximately eighty percent of the tariff lines by 2010.

Under the present circumstances, where multilateral negotiations under the WTO are becoming increasingly time-consuming and unilateralism under APEC is politically difficult, the trend towards further sub-regional trade agreements in East Asia can be viewed as a second-best approach to accelerating trade liberalisation in the region. At this stage, ASEAN is playing a significant role in the networking of bilateral trade agreements in the East Asia region, and will be a crucial player in the formation of the East Asia Free Trade Area.

There are concerns that the East Asia Free Trade Area may lead to the creation of a new Asian bloc which, along with the North American Free Trade Area – which it is proposed will develop into the 'Free Trade Area of the Americas' (FTAA) in the future – and the European Union, could result in a tripolar global trading system, which might erode the multilateral regime of the WTO (Scollay, 2001). However, some Asian countries have already implemented bilateral agreements with members of NAFTA, while ASEAN and the EU launched free trade area negotiations in late 2007.

2. Objectives and methodology

Even though the establishment of EAFTA is a priority on the agenda of the East Asian economies, it is not yet known how and when the full EAFTA will be implemented. In practice, it seems that each of the large East Asia economies, i.e. China, Japan, and Korea, is showing a genuine interest in initiating bilateral agreements with the ASEAN nations, which may be seen as a first step. ASEAN is now perceived as a strategic hub in the East Asia region. It has been suggested that these bilateral agreements will eventually be extended to cover the whole region. The aim of this study is therefore to make a comprehensive assessment and comparison of the quantitative economic impacts at both the domestic and the international level of four possible FTA options – ASEAN-China, ASEAN-Japan, ASEAN-Korea and East Asia. This is done by using a static multi-region, multi-sector Computable General Equilibrium (CGE) model as the basis of the analysis.

CGE models are very useful for this type of analysis because the equations defining each economy and those modelling the operation of international trade and financial flows provide a consistent structure for the analysis of changes in trade policies for individual economies and for regional groupings. Since such models are built to be consistent with micro-optimal outcomes they can provide comprehensive and internally consistent predictions in terms of both quantities and prices of inputs, outputs, private and public consumption, investment, exports and imports for all sectors in all regions and/or countries. The model developed here has been formulated and solved by using the General Algebraic Modeling System (GAMS) software, which is designed to solve complex non-linear mathematical programming problems.

This study uses two main extensions to the “standard” CGE model of the world economy. *First,* standard CGE models based on neo-classical assumptions, leave no room for the possibility of unemployment when, in reality, unemployment is a feature of all countries. Unemployment is therefore incorporated into the model with the intention of assessing the changes in the real wage and unemployment in each region under each FTA option.

Second, there is an increasing concern about how trade liberalisation may affect the level of poverty and the distribution of income across and within countries. However, the commonly-used assumption of a single representative household made in standard CGE models rules out the possibility of an analysis of these issues. By incorporating additional data on the income and expenditure of individual households, the representative household can be replaced with a highly disaggregated set of households. In this thesis Thailand is chosen as the case study, and a modified model is used to simulate the impacts on the employment, income and expenditure of individual households, and then to calculate poverty and income inequality indices for the simulated outcomes of the various East Asia FTAs that have been proposed.

3. Outline

The thesis is organized as follows. **Chapter 2** provides general information on the background to, and an economic assessment of, regionalism in East Asia. The perspectives of East Asia countries on Regional Trading Arrangements have changed dramatically in the last five years. Many sub-regional bilateral Free Trade Areas have already been instituted. Chapter 2 also provides information on the economic structure of each of the East Asian economies, and of the pattern of trade between the possible members of the various national groupings.

Chapter 3 provides a brief history of Computable General Equilibrium (CGE) models, discusses the conceptual framework, and then makes caveats about their limitations. In addition, the chapter also surveys the CGE models that have been used in analysing policies within the East Asia countries.

Chapter 4 develops a static multi-region, multi-sector CGE model that focuses in particular on East Asia. The model descriptions place particular emphasis on the theoretical foundations and equation linkages used in the CGE framework. One distinctive feature, a deviation from the standard neo-classic assumptions, is the incorporation of unemployment in the model, allowing an assessment of changes in real wages and unemployment levels in each region.

Chapter 5 details the construction of Social Accounting Matrix (SAM) and the calibration of the model to that SAM. The benchmark equilibrium is taken from version 6 of the GTAP database, which is based on the global economy in 2001.

The key results of the model simulations are presented in **Chapter 6**. These results are drawn from the macro and sectoral effects of trade liberalisation from four possible alternatives of regional and sub-regional of East Asia Free Trade Areas. The macro effects are measured in terms of the trade creation, trade diversion and terms of trade effects. In addition, simulation results on the changes in the levels of real Gross Domestic Product (GDP) and real absorption, regional welfare and welfare decomposition, real wages, unemployment, government transfers, real investment and international trade are also discussed. The sectoral effects are described in terms of changes in the levels of domestic production and of intra-regional trade. These results are then used to identify the most probable preferred strategy for each region. Finally, the chapter reports on the sensitivity analysis conducted as a test of model robustness.

The analysis in **Chapter 7** focuses mainly on the poverty and income distribution effects in Thailand under alternative East Asia Free Trade Areas. In doing so the assumption of a representative household has been relaxed, and substituted for by using additional data on Thailand's household income and expenditure. The procedures for reconciling household survey and national account data are explained in detail. The poverty and income inequality effects are then measured by the calculation of relevant indexes, for example, the headcount index and Gini coefficients.

Finally, **Chapter 8** summarises the final conclusions, compares the model results with other previous studies, discusses the role of regionalism as an accelerator to multilateralism, points out the model's limitations and suggests extensions for future research.

Chapter 2

Regionalism in East Asia

1. Introduction

A standard result in the theory of international trade is that, subject to certain conditions, global free trade will lead to an efficient use of resources in all countries, so that (subject to efficient transfers from gainers to losers) all countries and all factor owners are at least no worse off, and possibly better off. The General Agreement on Tariffs and Trade (GATT) and its successor, the World Trade Organization (WTO) were established in order to further cooperation between (member) countries in the reduction of trade barriers. However the process of multilateral negotiations is time-consuming and the final gain may not be as much as is theoretically feasible due to the need to compromise.

An alternative

Over the last decade, East Asia has probably been the region that has been most active in seeking the rapid expansion of Preferential Trade Agreements (PTAs). Establishing the East Asian Free Trade Area Agreement (EAFTA), which includes ASEAN (the Association of Southeast Asian Nations), China, Japan and Korea, is the major goal for the whole region. Therefore, the aims of this chapter are to provide both general information about the background to regionalism in East Asia, and to give a broad picture of the nature of possible Free Trade Agreements in the region.

2. Free Trade and Preferential Trading Agreements

2.1 Background

There are three main approaches that a country may take to reducing its trade barriers: (a) unilateral trade liberalisation; (b) multilateral trade liberalisation; and (3) bilateral/regional trade liberalisation. Any country can pursue *unilateral trade liberalisation* at any time. Reduction of its trade barriers is consistent with GATT/WTO rules, and can be implemented regardless of trade policies in other countries. That they usually do not choose to do so is generally attributed to domestic political pressure, with those domestic industries competing with imports opposing the proposed liberalisation.

Multilateral trade liberalisation has many advantages, in particular that reduction in the trade barriers of other countries will benefit its exporting sectors, which then provide domestic political pressure in favour of liberalisation. Such liberalisation requires coordination as well as cooperation. This coordination has, since the end of World War II, been provided by the General Agreement on Tariffs and Trade (GATT) and subsequently the World Trade Organization (WTO), through successive 'Rounds' of negotiation. These negotiations have been successful in many aspects of trade liberalisation, such as the general replacement of quantitative barriers to trade in commodities (e.g. import quotas) by tariffs, and reductions in those tariffs over time. They have however been less successful in liberalising trade in services, and have only recently started to reform trade in textiles and other 'sensitive' products. Moreover, the process of multilateral talks is extremely time-consuming, and the final gains have not always been as high as hoped due to the many compromises needed in reaching a mutually accepted settlement.

Bilateral/Regional trade liberalisation is allowed under GATT/WTO rules subject to specified conditions on the tariffs set by members on imports from the non-members. In this thesis the focus is on Preferential Trading Agreements (PTAs). The member countries of a PTA agree to reduce or remove barriers on trade with each other, but keep (and may reduce) their barriers on imports from non-member countries. As the participant countries are much fewer, negotiations on mutual trade barrier elimination are less complicated and can be concluded more quickly.

2.2 A global versus an East Asian perspective on PTAs

Preferential Trade Agreements are becoming an important part of international trade policy, but remain controversial (Humphreys, J. and Stoeckel, A., 2005). First, there is a possibility that a PTA may be susceptible to the adverse effects of trade diversion,[1] in which the PTA would replace imports from more efficient non-member countries with imports from less efficient PTA members. Second, since in practice some countries participate in more than one PTA, there may be a "spaghetti bowl"[2] of overlapping arrangements. In particular, problems arise when the various agreements have different tariff schedules, different implementation periods, different rules of origin, etc., which then leads to more complexities of domestic administration for various commitments (Majluf, L. A., 2004).

There are many types of PTAs, e.g. Free Trade Areas, Customs Unions, Common Markets and Economic Unions, which vary in terms of their comprehensiveness and degree of economic integration. The majority of PTAs are Free Trade Areas (FTAs).

[1] See Viner, J. (1950).
[2] See Bhagwati, J. (1995).

Since the 1990s PTAs have proliferated, from less than fifty in 1990 to over two hundred in 2004.

In general GATT/WTO rules and regulations embody the *non-discrimination* principle.; i.e. members should not impose different barriers on imports from different member countries. However, there are three exceptions under these rules. First, Article XXIV of the GATT allows countries to form a PTA as long as (a) the PTA covers 'substantially all' trade,[3] and (b) non-member regions must not be made worse off. In other words, the PTAs should be comprehensive enough to be significant in scope and scale. Second, the PTA should not infringe Article V of the General Agreement on Trade in Services (GATS). Finally, the Enabling Clause, formally known as the 'Decision on Differential and More Favourable Treatment, Reciprocity and Fuller Participation of Developing Countries', allows the developing countries to form PTAs without the requirement of internal barrier removal on 'substantially all' trade as stated under Article XXIV.

The popularity of PTAs may largely be attributed to four aspects. First, PTAs are seen by domestic producers to be 'fairer' than other alternatives, and therefore they result in less adverse domestic pressure than would unilateral trade liberalisation. Second, members of PTAs have more flexibility in choosing the products covered under the PTA agreement, and so can base these choices on their mutual benefits and interests, so that they are likely to be more willing to cooperate and commit on the agreements. Third, the negotiation progress in the WTO forum is extremely time-consuming, as it needs to obtain a consensus between 149 countries, whereas

[3] GATT article XXIV has been criticized as a 'vague' provision which gives legality to FTAs and custom unions because it does not explicitly specify the requirements needed to meet the criterion.

negotiations between a smaller group may be conducted more swiftly. Finally, the finalized agreements from a WTO Round may not yield any obvious benefits to a particular country as a consequence of the many political compromises needed to achieve a final agreement.

The East Asian economies that are the focus of this study are China, Japan, Korea and The Association of Southeast Asian Nations (ASEAN).[4] Currently all of these, except Cambodia, Myanmar and Laos PDR, are members of the Asia-Pacific Economic Cooperation (APEC) group.[5] The principle of 'open regionalism'[6] has been significant in APEC initiatives on liberalising trade, facilitating trade and investment, and cooperating on other economic issues. Since it is non-discriminatory, APEC is not classified as a PTA.

Even though APEC has been established since 1989, its achievements are not very impressive, largely because, unlike the WTO, APEC has no treaty obligations required of its participants. Decisions made within APEC are reached by consensus

[4] The ASEAN members, which include 10 countries in South East Asia, are Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam. ASEAN economies differ widely in their level of economic development and country size. In the literature, Cambodia, Laos PDR, Myanmar and Vietnam are sometimes grouped as the CLMV countries due to their lower economic development.

[5] There are 21 members of APEC – Australia, Brunei Darussalam, Canada, Chile, China, Hong Kong, Indonesia, Japan, Korea, Malaysia, Mexico, New Zealand, Papua New Guinea, Peru, Philippines, Russia, Singapore, Taiwan, Thailand, Unites States, and Vietnam. Fifteen of these also join, at least, one of existing regional trading agreements of ASEAN Free Trade Area (AFTA), Central America Free Trade Area (CAFTA), Andean Community of Nations (CAN), The Australia-New Zealand Closer Economic Relations (CER), Commonwealth of Independent States (CIS), Free Trade Area of the America (FTAA), and North America Free Trade Area (NAFTA).

[6] The concept of 'open regionalism' in APEC differs from the tradition of economic regionalism in the sense that it does not create a trade bloc within the Asia Pacific region. In other word, APEC attempts to reduce barriers to trade in goods and services and investment without detriment to other economies (APEC, 1991a). Basically, in practice, economic cooperation in APEC is based on a voluntary consensus on the unilateral trade liberalisation approach to reduce the possibility of large scale negotiations.

and commitments are undertaken on a voluntary basis (APEC official website).[7] A second reason is that, since the creation of APEC, the ASEAN countries have been wary about US participation, fearing that it might undermine the role of ASEAN due to its significant political and trade powers. However, under pressure from Japan, which regarded the US as relatively more important than the ASEAN countries at that time, the US was finally included.

A combination of slow progress in the WTO forum and non-cooperation in APEC has left the member countries, especially ASEAN; feeling uncertain and sceptical about the future. In addition, the establishment of the ASEAN Free Trade Area (AFTA) in 1992 and the North American Free Trade area (NAFTA) in late 1992 has been seen as inconsistent with the concept of non-discriminatory trade agreements.

Viewed as 'loose and frail' agreements, the first strategies proposed by APEC (in 1995), known as Individual Action Plans (IAPs), have been criticized as a total failure, since the member states have been reluctant to adopt the concept of 'open regionalism', in which APEC members undertake unilateral liberalisation without direct reciprocal concessions from other members. Even when the second strategy – the Early Voluntary Sectoral Liberalisation (EVSL) scheme – was introduced in 1997, aimed at fifteen targeted sectors, they also faltered. Japan was unwilling to liberalise its agricultural sector, while the United States made it clear that it would liberalise only on a reciprocal basis (Bergsten, 1997).

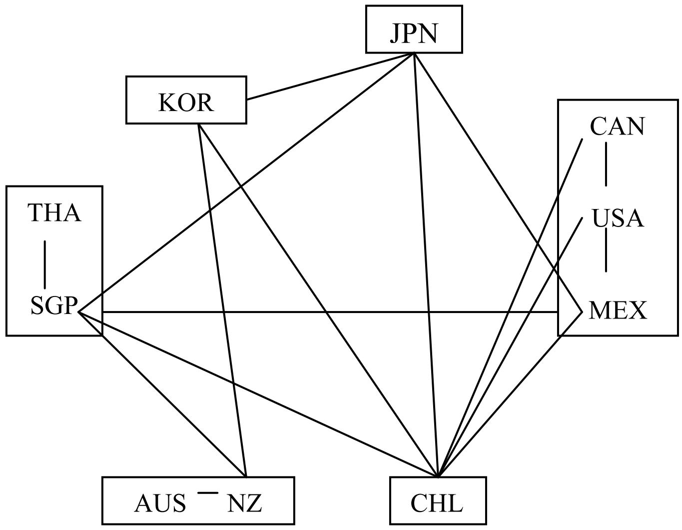
Since the late 1990s there has been evidence that APEC trade policies have departed dramatically from the preceding approach. They have switched from the ideal

[7] Visit www.apec.org

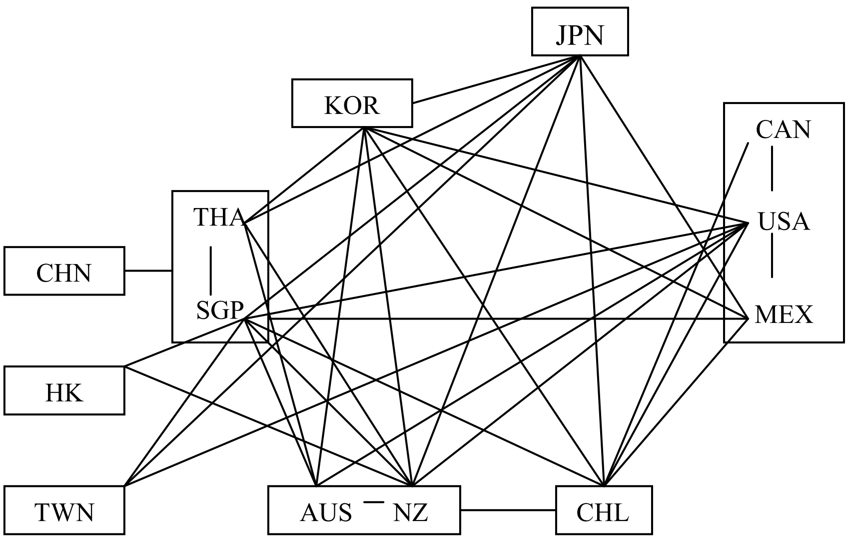
concept of open regionalism, which is supposed to be complementary to the WTO multilateral regime, to a bilateral relationship between members. As figure 2.1 shows, the number of PTAs specifically embodying bilateral trade agreement has risen sharply from thirteen projects[8] at the end of 1999 to thirty-three by mid 2002.

Figure 2.1: PTAs among APEC members in 1999 and 2002

a) in 1999



b) in 2002



Source: Dent, C. M. (2003)

Note: CHN is China, HK is Hong Kong, TWN is Taiwan, THA is Thailand, SGP is Singapore, JPN is Japan, KOR is Korea, AUS is Australia, NZ is New Zealand , CAN is Canada, USA is United States, MEX is Mexico, CHL is Chile.

[8] The projects include those initiated or implemented between member states in that time.

This phenomenon implies that the non-discriminatory nature of APEC has been replaced by one of reciprocity. Bilateral agreements are rapidly emerging in the region, partly because of perceived APEC failures, and partly because of the pressure of PTA proliferation worldwide.

3. An economic assessment of Preferential Trading Agreements

It is undoubtedly the case that Preferential Trade Agreements (PTAs) have become a crucial part of a modern trading system in a global economy. Considered as a 'second-best' strategy, in which trade barriers are removed among members but are retained for non-members, the potential economic impacts of PTAs have engaged the attention of economists for decades. Even though the basic purposes of establishing any form of PTA is to encourage more trade and cooperation between member countries, the PTAs themselves effectively discriminate against non-member countries. As a consequence, it is likely that not every country can win in this situation. A country may enjoy welfare gains or suffer from welfare losses, depending on the static and dynamic effects of the PTA.

3.1 Static effects

PTAs in general are successful in inducing more trade between members. However; while increased trade will in some cases lead to relatively inefficient domestic production being replaced by more efficient production from other PTA members ('trade creation'), in other cases such increased trade may result in imports being diverted away from more efficient non-PTA sources in favour of less efficient sources within the PTA ('trade diversion'). Furthermore, PTA formation may change the relative prices of a member's exports and imports (a 'terms of trade effect').

Traditionally, according to the theory of Customs Unions,[9] the net changes in national welfare are determined by the interaction of these trade creation, trade diversion and terms of trade effects.

3.1.1 Trade creation and trade diversion

Trade creation in a PTA country is the substitution for higher cost domestic production by a lower cost supply source in a fellow PTA member. This is beneficial to the member countries and the world as a whole. In contrast, trade diversion is the substitution in the importing country of relatively cheap supply sources in countries outside the PTA by more costly supply sources in PTA members.

Trade creation brings an improvement in production and consumption efficiency. As a country opts for higher imports from more efficient PTA suppliers, its less efficient domestic production will fall. Consumers in the PTA will enjoy lower prices and expand their consumption, resulting in an increase in consumer welfare. On the other hand, trade diversion results in a reduction in production and consumption efficiency. Since they no longer pay the tariff, the less efficient producers in other PTAs members have an advantage over more efficient producers in countries outside the PTA. Consumers will pay less for the imported good (and so less for domestic goods) under the PTA, but the border cost of imports will be higher.

Trade creation is necessarily welfare-increasing. However, trade diversion may increase or decrease welfare: only if the benefits to consumers of paying lower prices exceed the costs to the economy of purchasing from less efficient PTA producers

[9] See Viner (1950); Meade (1955).

will the net effect be positive. Evidence shows that both trade creation and trade diversion may be found in most PTAs. However, what is more important is whether the PTA is, net, a trade-creating rather than a trade-diverting one.[10]

3.1.2 The terms of trade

The terms of trade of a country are defined as the ratio of aggregate export prices to aggregate import prices. PTAs can affect their terms of trade because changes in the supply and demand of imports and exports will inevitably lead to changes in both consumer prices and border (import) prices for both member and non-member countries. The magnitudes of these changes can be very different, depending on the level of the initial protection and the substitutability of products from member and non-member countries. Generally, a gain in the terms of trade implies that a given level of exports can buy more imports, resulting in a welfare gain. In contrast, a loss in the terms of trade imply that a given level of exports can buy fewer imports, so that welfare-falls.

PTAs are likely to improve the terms of trade for member countries at the expense of non-member countries' terms of trade (Burfisher and Jones, 1998). This is because more intra-PTA trade is induced among member countries, raising their exports prices and improving their terms of trade. In contrast, the exports of non-member countries to member countries decline, resulting in a lowering of their export prices and a decrease in their terms of trade.

[10] The vast majority of empirical results on CGE models which analyse the Regional Trading Agreements (RTAs) – one form of PTAs, show that aggregate trade creation dominates trade diversion. (Robinson and Thierfelder, 1999)

It is clear that a tariff reduction in a member country unambiguously improves the terms of trade of the partner country. However, under the situation of mutual preferential tariff reduction between two member countries, only some sets of reductions can improve both members' terms of trade. This would imply that gains in the terms of trade may not necessarily happen in both member countries. But it is still true that mutual preferential tariff reductions would improve the terms of trade of one of the two countries relative to the rest of the world (Mundell, 1964)

The other possibility that the terms of trade of some member countries' may worsen when there are asymmetries in the level of protection (World Bank, 2005). Such adverse terms of trade shocks can occur when a high-tariff country signs a free trade agreement with a low-tariff country. This is because there is only a small trade creation effect in exports to the low-tariff country, so that the reduction in domestic sales in the high-tariff country in such goods may not be offset by the small rise in exports to the low-tariff country.

Currently the outcome of the debate on the net welfare effects of PTAs remains inconclusive. This is because the nature and the level of comprehensiveness in each PTA may be markedly different. A PTA can yield both trade creation and trade diversion effects, resulting in net welfare-enhancement or welfare-reduction depending on the relative magnitude of these two forces. Generally, it is globally desirable to create a PTA as a building bloc rather than a stumbling bloc.[11] As PTAs may promote costly trade diversion, this cost can be reduced by making them consistent and compliant with the WTO. Setting low MFN tariffs for trade with non-

[11] See Bhagwati (1991); Krueger (1999) and Panagariya (2000).

member countries, and introducing tariff preferences covering 'substantially all trade' with member countries, will ensure that producers within PTAs will have access to low cost inputs. As a consequence, the welfare of member countries will rise without generating too much cost in terms of a welfare-reduction for non-member countries.

3.2 Dynamic effects

Calculating the welfare effects of PTAs by using only a static comparative measurement ignores the possibility of dynamic effects, which can be an important factor in any change in welfare. Potentially, following economic integration, extra gains in welfare may come from access to a wider market (Wonnacott, R. and Wonnacott, P., 1967); and new investment promotion (Baldwin, R., 1989).

Access to larger internal markets may result in economies of scale and/or reduce the losses from imperfect competition. The substance of trade diversion has become less important as a result of declining import tariff rates in global trade system. The 'new regionalism' has drawn on the 'New Trade Theory', where scale economies and imperfect competition play a key role in the evolution of PTAs. Furthermore, once a time dimension is included in a CGE analysis then dynamic effects from factor accumulation and technical efficiency, can be captured. New investment would generate higher growth rates in the members of PTAs, while greater technical efficiency, which lowers production costs, could arise from greater competition.[12]

[12] More discussion on dynamic effects under a CGE framework is given in Chapter 3: Literature Review.

4. An East Asia Free Trade Area and other possible options

4.1 Trade weighted average import tariffs in East Asia

The average import tariffs in East Asia by sectors are presented in **table 2.1**. Overall, the average tariff in China is the highest among the East Asian countries at 11.6 percent, followed by Korea at 8.5 percent, Japan at 4.1 percent, and ASEAN at 4.0 percent.

As in many countries, the agricultural sectors tend to be more highly protected than manufacturing sectors. For example, the import tariff rate on the 'plants and products' sector in Korea is at a prohibitive rate of 168.1 percent, while, the import tariff rate for the 'animals and products' sector in Japan is very high at 42.6 percent.

Although tariffs on the manufactures imports are relatively lower, almost half of the import tariffs in the East Asian economies are 10 percent or more. Only in Japan are some of the manufacture sectors virtually unprotected, e.g. 'other manufactures', where the average import tariff is only 0.5 percent, and the 'motor and equipment' and energy sectors, which are tariff-free.

ASEAN as a whole has one of the lowest average import tariff rates, but there are marked differences among the tariffs of individual members. At one extreme is Singapore, which is more or less tariff-free, while others still apply high tariff rates. The average import tariff is 2.8 percent in the Philippines, 3.6 percent in Indonesia, 4.7 percent in Malaysia, 8.8 percent in Thailand, 9.0 percent in Other ASEAN, and 10.3 percent in Vietnam.

Table 2.2 shows the average import tariffs in East Asia by bilateral trade flows. One of the noteworthy features of tariff structures in East Asia is the highly discriminatory nature of their policies on intra-regional trade. For example, the average import tariff rate that Korea applies to imports from China is high, at 21.6 percent, in marked contrast to the average tariff of 4.1 percent that it applies on imports from the EU.

Table 2.1 Trade weighted average import tariffs in East Asia by sectors

(unit: percent)

Sectors	China	Japan	Korea	ASEAN	ASEAN						
					Indonesia	Malaysia	Philippines	Singapore	Thailand	Vietnam	Other ASEAN
Plant and products	59.5	50.3	168.1	8.8	4.3	20.2	14.4	0.0	16.2	15.5	4.3
Animal and products	9.9	42.6	19.7	5.3	4.2	1.3	7.5	0.0	10.5	15.7	8.7
Other agriculture	21.6	10.4	25.2	20.8	7.2	20.7	6.1	0.8	44.5	55.9	28.1
Textile and apparel	20.5	9.0	10.0	12.4	8.6	12.3	6.5	0.0	18.5	31.3	10.1
Leather and shoes	10.0	12.6	7.0	9.0	2.7	4.9	6.5	0.0	11.3	20.4	15.2
Motor and equipment	20.5	0.0	3.9	14.7	9.6	31.7	11.5	0.0	24.0	46.9	25.0
Energy	0.3	0.0	3.7	0.8	0.3	1.6	3.2	0.0	0.2	3.8	2.6
Other manufactures	11.2	0.5	4.4	3.2	4.0	3.2	1.7	0.0	7.9	8.1	6.1
Transport	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other services	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Weighted average	**11.6**	**4.1**	**8.5**	**4.0**	**3.6**	**4.7**	**2.8**	**0.0**	**8.8**	**10.3**	**9.0**

Source: Author calculation from GTAP database version 6

Similarly, ASEAN applies relatively low average tariff rates to imports from non-East Asia nations, ranging from 2.2 to 4.0 percent, while applying higher tariff rates on imports from other East-Asian countries, ranging from 5.5 to 6.7 percent.

Table 2.2 Trade weighted average import tariffs in East Asia by bilateral trade flows

(unit: percent)

Exporter	Importer			
	China	**Japan**	**Korea**	**ASEAN**
China	-	5.2	21.6	6.7
Japan	13.6	-	5.1	5.5
Korea	13.4	2.6	-	6.1
ASEAN	11.6	2.8	3.8	3.8
NAFTA	12.9	7.5	12.1	2.2
EU	10.9	2.5	4.1	3.1
CER	11.0	14.1	6.2	4.0
ROW	9.5	1.2	8.1	3.6
Weighted average	**11.6**	**4.1**	**8.5**	**4.0**

Source: Author calculation from GTAP database version 6.

4.2 ASEAN Free Trade Area (AFTA)

Unlike other regional integration/cooperation agreements, regionalism in the Southeast Asian nations was originally based solely on national security grounds. In its long history, the region has had many conflicts, both internal and external. Prior to the colonial period, most of the Southeast Asian nations were preoccupied with their own civil wars and external interference from China and India. During World War II, they were occupied for much of the time by Japan. When the war ended with Japan's surrender, the western countries took control and solidified the country structure. Eventually, the East Asian nations regained their independence; and the perceived need to create a regional identity was strong.

The Association of Southeast Asian Nations (ASEAN) was established in 1967 to promote regional peace and stability and to accelerate the economic growth, social progress and cultural development in the region.[13] Initially ASEAN consisted of five former nations, Indonesia, Malaysia, the Philippines, Singapore and Thailand. In 1984, Brunei became the sixth member country, a week after it became independent.

It took another 11 years before ASEAN expanded from its six core members. Vietnam became the seventh member in 1995, and Laos and Myanmar joined in 1997. Cambodia had nominally joined ASEAN at the same time, but membership was deferred due to the country's internal political struggle. It subsequently joined in 1999, following the stabilization of its government. Thus the ASEAN-10 objective was attained, covering all the Southeast Nations for the first time.

Even though ASEAN has existed since 1967, the first concrete agreement regarding trade issues was initiated in 1992 when the ASEAN countries agreed to establish the ASEAN Free Trade Area (AFTA), through *a Common Effective Preferential Tariff (CEPT) scheme*, in order to attract foreign direct investment (FDI) from abroad. Principally, the AFTA agreement required that tariffs levied on a specific range of products traded within the region be reduced and eventually eliminated. In addition,

[13] Visit www.aseansec.org (ASEAN Secretariat Official website).

there was to be cooperation in removing quantitative restrictions and other non-tariff barriers within the region.

The CEPT is a significant mechanism by which tariffs on goods traded within the ASEAN region and which meet a 40% ASEAN-content requirement, were to be reduced to 0-5% by 2003 (2006 for Vietnam, 2008 for Laos PDR and Myanmar, and 2010 for Cambodia). ASEAN members have the option of excluding products from the CEPT in three lists.[14] First, the 'temporary exclusion' list refers to products for which tariffs will ultimately be lowered to 0-5%, but which are being protected temporarily by a delay in tariff reductions.

Second, there is a 'sensitive agriculture' list which is subdivided into 'sensitive' and 'highly-sensitive'. The ASEAN-6 are to reduce import tariffs on products on the 'sensitive' list to zero by 2015, while Cambodia, Laos PDR, Myanmar and Vietnam (CLMV) must do so by 2018. The tariffs on the 'highly-sensitive' items are to be reduced to 50% of the initial rates, by 2018 for ASEAN-6, and by 2020 for CLMV; however, the residual tariff rates for highly sensitive items will remain after 2018.

Third, goods on the 'general exclusion' list, which represents about one percent of all tariff lines in ASEAN, are to permanently excluded from the free trade area for reasons of national security, protection of human, animal or plant life and health, and of goods of artistic, historic or archaeological value.

[14] The detail of all lists can be found on the ASEAN Secretariat official website.

Table 2.3 presents the number of products covered under the AFTA. Approximately 90 percent of the tariff lines in ASEAN are in the 'inclusion' list, in which the import tariff are to be completely removed by 2010 by the ASEAN-6, the original six members, and by 2015 by the CLMV, the four new members. The import tariffs in the 'temporary exclusion' and 'sensitive' lists will be gradually reduced. The ASEAN Secretariat estimates that around 98 percent of the tariff lines in ASEAN, i.e. excluding items on the 'highly-sensitive' and 'general exclusion' lists, will eventually be liberalised under the AFTA.

Table 2.3: Number of products covered under AFTA

Product coverage	Number of tariff lines	Percent share to total
Inclusion list	40,773[1]	89.46%[2]
Temporary exclusion list	2,888[3]	6.11%[4]
Sensitive list	261[3]	0.55%
General exclusion list	467[3]	0.99%

Source: Adapted from Pasadilla G. (2006), p10.
Notes: [1] 1993
[2] Total tariff line; 1993 = 45,575
[3] 1995
[4] Total tariff line; 1995 = 47,252

4.3 ASEAN-China Free Trade Area (ACFTA)

It is undeniable that China has become one the most important economies in the world. Since the 1980s the Chinese economy has undergone rapid changes thanks to her domestic economic reforms. China's trade policies have gradually adjusted, by the reduction of both tariffs and non-tariff barriers, and the opening of her market to foreign trade and investment. China's annual GDP has grown at dramatically. During

1980-1989, the average annual GDP growth rate of China was 9.75 percent. Moreover, China's economy was virtually unaffected by the Asian Financial Crisis of 1997-8, and its average annual growth rate during the 1990s was close to 10 percent. In the first five years of the twenty-first century it has reconfirmed its world status with an average annual growth rate of 9.2 percent (World Bank).

The rapid emergence of China as a world trade power has raised concerns in developed and developing economies about its potential impact on the world market. Since China became a WTO member in 2001, the possible effects of that membership on the patterns of world trade and economic growth have attracted intense interest in both academic and policy discussions. (Walmsley and Hertel, 2001)

To fulfil its membership requirements at the WTO, China had to implement her commitment to adopting broad and deep trade liberalisation measures to make her trade regime consistent with WTO rules. Implementation of these liberalisation measures implied a substantial reduction in tariffs and non-tariff barriers across all economic sectors in one of the world's largest and most rapidly expanding markets. Clearly, the WTO accession was to play a highly important role, not only on China's resource allocation among her domestic production and export sectors, but also on the structure of China's trade with her trade partners. World trade patterns and production elsewhere will also have to adjust to accommodate such changes. (Wang, 2003)

A crucial milestone for closer trade relations between ASEAN and China was set on 6 November 2001. At the annual summit in Brunei, both parties agreed to an initiative aimed at establishing a bilateral Free Trade Area (FTA) within 10 years, i.e. by 2010. By contrast, the differences in the levels of economic development among ASEAN member countries is prolonged, the timeframe to achieve FTA status for ASEAN-4 and/or the CLMV, consistent with AFTA, stretching to 2015.

The new free trade area created by this initiative will have 1.8 billion consumers, a combined GDP of approximately US$ 1,775 billion, and total international trade of US$ 1,540 billion (GTAP database version 6). Although the ASEAN-China Free Trade Area (ACFTA) is rather small in terms of GDP relative to those of NAFTA or the EU, it will be the world's biggest FTA in terms of population. This implies advantages based on abundant labour and low wages, as well as the potential market extension in the region. Therefore, its economic impacts will undoubtedly be enormous for regional and global trade.

The re-emergence of the idea of creating some form of regional economic cooperation among Asian countries has been solidified in the aftermath of the Asian Financial Crisis in 1997-8. Previously, regionalism in Asia had been slowly developed, reflecting weak internal economic situations, major gaps in income per capita, and different levels of economic development. The current surge of regionalism in Asian is also somewhat caused by the global increase in regional and preferential trade arrangements. Many countries are the members of one or more Free Trade Areas so that they can enjoy the duty-free benefits of being within the group.

China could be both a large potential market and a major competitor to ASEAN. The most salient economic challenges arising out of the ACFTA come from intensified competition, as ASEAN and China have the same abundant factor – labour. Trade liberalisation would enable China to produce more goods for exports. Due to the much lower labour costs in China, ASEAN's exports may lose competitiveness and lead to temporary or short-run unemployment problems.

However, at the same time this will encourage ASEAN members to produce their goods more efficiently. The competition is already intensified in low-tech products. But once ASEAN countries develop their labour skills and adopt more advanced technology in their production, they may import intermediate inputs from China and export final high-tech products to third countries or even to China itself. Intra-regional trade will, therefore, support both parties' trade in the long run. Specifically speaking, ASEAN countries are eager for economic integration, but they are still worried about their competitive vis-à-vis China.

Although ASEAN recognizes a possible short run negative impact from ACFTA, it feels confident about the long run outcome. In November 2002, ASEAN and Chinese leaders signed the framework agreement on comprehensive economic cooperation between ASEAN and the People's Republic of China. The negotiations on liberalisation, started in 2003, were concluded by the end of June 2004, and have been implemented since 1st July 2005.

Under the agreement, the MFN tariff rates on trade between ASEAN-6 and China will be gradually reduced and/or eliminated over the period from 1st July 2005 to

2010. In the case of the ASEAN-4, the period of tariff elimination shall be from 1st July 2005 to 2015 with higher and more stages of tariff reduction. China has also offered special treatment and development assistance for ASEAN-4 as well as an extension of WTO MFN benefits to the non-WTO member of ASEAN. [15]

The content of product coverage under ACFTA is more or less the same as under the AFTA agreement, apparent from the basis that 90 percent of the products are in the inclusion list in which import tariffs will be eliminated by 2010. The excluded products are in the temporary exclusion, sensitive and general exclusion lists. Even though ACFTA has been formed under the WTO Enabling Clause, in which FTAs establishing among developing countries do not necessarily have to cover 'substantially all' trade, ASEAN and China mutually agreed to limit the sensitive list to 10% of total import value (Soesastro, 2005)

Table 2.4: Modality for tariff reduction and elimination for tariff lines (HS 6-digit) placed in the sensitive list under ACFTA

Country	Number of sensitive items	Number of highly sensitive items
Brunei	66	34
Cambodia	350	150
China	161	100
Indonesia	349	50
Laos	88	30
Malaysia	272	96
Myanmar	271	0
Singapore	1	1
Philippines	267	77
Thailand	242	100
Vietnam	n.a.	n.a.

Source: ASEAN Secretariat (2004): Agreement on trade in goods of the framework agreement on comprehensive economic cooperation between ASEAN and the People's Republic of China, Annex II.

[15] The ASEAN member which is not WTO members is Lao PDR.

Table 2.4 shows the modality for tariff reduction and elimination for tariff lines placed on the sensitive list under ACFTA.[16] The number of sensitive and highly-sensitive items varies across member countries. Cambodia is probably the most protective member country, with 350 items on the sensitive list and 150 items that will remain on the highly-sensitive list. In contrast, Singapore is the most open economy, with only 1 item on each of the sensitive and highly-sensitive lists.

It should be noted that achieving the goal of establishing the ASEAN-China Free Trade Area by 2010 is only one part of the whole content in the formal agreement on comprehensive economic cooperation between ASEAN and the People's Republic of China. The objectives of the agreement also cover other areas, e.g. investment, trade in services, other economic cooperation on human resource development, information and communication technology, etc. All this information is available from the ASEAN Secretariat official website. As we are focusing only on the economic impacts from the Free Trade Areas in commodities in this study, we therefore ignore the possible effects of other areas of the agreement.

4.4 ASEAN-Japan Free Trade Area (AJFTA)

Japan has played an important role in economic and political issues at both the regional and global levels for a long time. In terms of trade policies, Japan and Australia are the key protagonists of Asia-Pacific Economic Cooperation – later established as APEC. However, due to APEC's unimpressive outcomes and the proliferation of FTAs throughout the world, Japan (whose trade policies were

[16] Details of the full sensitive list can be downloaded from http://www.aseansec.org/4979.htm

originally strongly focused on multilateral negotiations) has now turned to negotiating bilateral trade agreements with various countries.[17]

It was not until late 2002 that Japan enacted its first free trade agreement, the 'New Age Economic Partnership' with Singapore. The agreement was designed to generate a significant impact not only on trade in goods but also in people, funds and information across borders. The content thus goes beyond tariff and non-tariff removal issues into other areas such as Foreign Direct Investment (FDI), trade and FDI facilitation, intellectual property, etc.

Japan's trade policies towards ASEAN as a whole are somewhat complicated as Japan is conducting a dual strategy. On the one hand, Japan is forming bilateral agreements with individual ASEAN members. On the other hand, Japan is also negotiating with ASEAN members as a whole. At present, Japan has successfully concluded Bilateral Economic Partnership Agreements with six of the ASEAN nations – Brunei, Indonesia, Malaysia, Philippines, Singapore, and Thailand.

The bilateral agreement between Japan and Singapore has been implemented quite smoothly because contentious issues such as trade liberalisation in agriculture were limited for both parties. In contrast, the bilateral negotiations with other ASEAN nations are heterogeneous in the details of tariff schedules and product coverage (Ministry of Foreign Affairs of Japan official website),[18] mainly because of the high

[17] Japan's currently implemented bilateral trade agreements are with Singapore (2002), Mexico (2005), and Malaysia (2006). The bilateral agreements with Korea, Chile and India are under negotiation, while bilateral agreements between Japan and Australia, and Switzerland are currently under consideration.

[18] Visit www.mofa.go.jp

protection given to agriculture sectors in Japan. Some of the most contentious issues in Japan's FTA negotiations with ASEAN are, for example, trade liberalisation in plywood with Malaysia, in rice with Thailand, and in bananas with the Philippines (Urata, S., 2006). As Japan is likely to continue to protect its agriculture sectors due to domestic pressures, the Japanese FTA programs with the six ASEAN nations have been criticised on the grounds that they will have little impact on the economy.

The negotiations between Japan and ASEAN as a whole began immediately after both parties had approved the framework for the Comprehensive Economic Partnership between ASEAN and Japan on 8 October 2003. However progress has been very slow as a result of a 'single undertaking' approach to the negotiation, in which all related issues must be simultaneously negotiated. The establishment of AJFTA has not yet been notified to the WTO. The main reason is that Japan, as a developed country, has to conform to the GATT/WTO requirements under Article XXIV, so that AJFTA must cover 'substantially all' trade. Moreover, it is still unclear how the agreements with CLMV will be included in the arrangement.

4.5 ASEAN-Korea Free Trade Area (AKFTA)

Initially Korea was not prepared to participate in a bilateral trade agreement with ASEAN as (a) its policy is focused on promoting the East Asian Free Trade Area, and (b) the value of its trade with ASEAN is much less than that of China or Japan. Nevertheless, having observed that China and Japan were both very active in initiating trade agreements, Korea was afraid that it would lose the benefits of similar bilateral trade agreements.

Eventually, ASEAN and Korea agreed and signed the framework of the ASEAN-Korea Comprehensive Economic Partnership agreement on 30 November 2004. The aim is to liberalise trade in commodities between the two parties by eliminating import tariffs for at least eighty percent of their tariff lines by 2010 for the ASEAN6, by 2016 for Vietnam, and by 2018 for Cambodia, Laos PDR and Myanmar. AKFTA is broadly similar to other FTAs involving ASEAN in terms of its comprehensive scope and the flexibility given to the CLMV. The final lists of normal and sensitive products have been successfully negotiated, and were signed in May 2006.[19]

Currently, the FTA between Korea and three ASEAN members – Malaysia, Singapore and Vietnam – came into force in 1 June 2007. The FTA with Indonesia and Myanmar is waiting for the approval of their Ministers of Finance. On the other hand, the FTA with the other four ASEAN nations – Brunei, Cambodia, Laos PDR and the Philippines – will be slightly delayed owing to uncompleted domestic procedures.

As with the ASEAN-China Free Trade Area, the ASEAN-Korea Free Trade Area has been implemented in such a way that the ASEAN countries, excepting Thailand, are treated as a single region, with some exceptions made following requests from

[19] At the time of writing, the agreement includes South Korea and nine of the ten ASEAN nations (excluding Thailand). Thailand, as the world's largest rice exporter, refused to join the agreement in protest at South Korea's insistence on excluding rice from the programme. Baldwin (2006) has pointed out that this is an interesting case. Even though rice is also an extremely sensitive product for Japan and is thus excluded from AJFTA, this issue did not prove to be a significant obstacle for the Japan-Thailand bilateral agreement as Thailand perceived that restricted access for Thai rice would be compensated by better access on other products. Since trade between Thailand and Japan is higher than that between Thailand and Korea, a political deal can probably be concluded. On the other hand, Baldwin has argued that the Thai rice issue will become more serious when negotiating with Korea, as Thai-Korean trade is balanced at a very low level, with neither nation depending on access to the other's market, so that protectionism is likely to win in this case.

individual countries. The tariff reduction and elimination procedure is categorized into normal, sensitive and highly sensitive lists.[20]

4.6 East Asia Free Trade Area (EAFTA)

The first proposal for East Asian regionalism was made by the former Malaysian Prime Minister Mahathir in the early 1990s. The proposal, initially known as the East Asian Economic Caucus (EAEC), was to include ten members, the ASEAN countries, China, Japan and Korea in the bloc. Unfortunately, at that time, the plan was not supported by the Japanese government, which wanted to participate in APEC rather than in EAEC, and which had the USA as a major ally.

It took years for the proposal of East Asian regionalism to be reconsidered. In January 1997, as a first step, Japan's Prime Minister Ryutaro Hashimoto initially visited the ASEAN countries in order to strengthen the relationship between the two parties. Three months later, ASEAN took a further step by proposing a summit meeting of ASEAN, China, Japan and Korea. The proposal was not favoured by Japan initially, but the outbreak of Asian Financial Crisis in 1997-8 led to Japan becoming involved.

The forum of East Asian economies[21] was initially intended to foster cooperation in solving the financial crisis and re-establishing financial stability in Asia. Subsequently the forum was extended to take economic cooperation into consideration. The obvious outcome of this is the proliferation of bilateral trade

[20] Full lists can be viewed and downloaded from http://www.aseansec.org/akfta.htm.
[21] In the literature, East Asia is sometimes referred to as ASEAN+3 – ASEAN, China, Japan, and Korea.

agreements between members. The success of the establishment of the ASEAN-China Free Trade Area has dramatically changed Japan's perspective, leading to its following the same path.

Unlike the American and Europe continents, Asia does not have a concrete economic cooperative institution of its own. Setting up the East Asian Free Trade Area is undoubtedly deemed to be the ideal outcome, and thus a major step for the region, especially when the large economies of China and Japan are included. However, due to the differences in the level of openness and economic development of member countries, establishing EAFTA could prove to be a very difficult task.

The current debate is focused on how and by what route EAFTA could be formed. The evidence suggests that ASEAN and China want to pursue member enlargement, specifically to include Japan and Korea, but based on the existing agreement of ASEAN-China Free Trade Area in which the agricultural sectors are included. Korea, whose agriculture is highly-protected, has launched its own ASEAN-Korea Free Trade Area proposal. On the other hand, Japan has resorted to a more complicated approach by negotiating Free Trade Area agreements with ASEAN at both the individual country level and at the regional level.

The linking of Japanese Free Trade Agreements with other larger East Asian trading partners, such as Korea and China, has either been suspended or accorded a lower priority. In December 2003, Japan began negotiations with Korea. Unfortunately, until now, there has been little progress, partly as a consequence of Japan's refusal to cut tariffs on imports of agricultural and marine products, and partly because South

Korea was reluctant to reduce the tariff protection given to its manufacturing sectors. On the other hand, Japan also perceives that there is a greater possibility of establishing bilateral FTAs with Australia, Chile, and India rather than with China, largely due to their political unease about their conflict during WWII.

5. Economic structure and trade statistics

5.1 Economic Structure

5.1.1 Population and GDP

The population and the value of Gross Domestic Product (GDP) are commonly used as measures of the 'size' of an economy. **Table 2.5** reports the economic size of countries and regions in 2001. Based on the population, China has the greatest population among the East Asian economies, 1,269.9 millions. The ASEAN region, comprised of seven sub-regions, has a population of 529.6 millions. Japan and Korea have 126.8 and 47.6 millions respectively.

On the other hand, Japan has the highest values of both GDP and GDP per capita at US$ 4,177.6 billion and US$ 32,946.1 respectively. China has a national GDP greater than those of Korea and ASEAN, but its GDP per capita is the lowest in the East Asian economies.

There is also a massive spread in the levels of population and GDP within the ASEAN economies. Singapore is considered to be a developed country, with a population of 3.3 millions and GDP per capita of US$ 25,713.7. Indonesia, Malaysia, Philippines and Thailand are developing countries with incomes in the 'middle range', while Vietnam and Other ASEAN[22] are still classified as least developed countries, reflecting their relatively low GDPs.

Table 2.5: Population, GDP and GDP per capita in 2001

Regions	Population		GDP		GDP per capita
	Millions of people	Share (%)	US$ billion	Share (%)	
ASEAN	529.6	8.6	616.1	1.97	1,163.3
Indonesia	213.3	3.5	145.3	0.46	681.2
Malaysia	23.7	0.4	88.0	0.28	3,714.8
Philippines	79.9	1.3	71.4	0.23	894.1
Singapore	3.3	0.1	84.9	0.27	25,713.7
Thailand	62.8	1.0	114.7	0.37	1,826.1
Vietnam	79.5	1.3	32.7	0.10	411.6
Other ASEAN	67.1	1.1	79.1	0.25	1,178.1
China	1,269.9	20.7	1,159.0	3.71	912.7
Japan	126.8	2.1	4,177.6	13.36	32,946.1
Korea	47.6	0.8	427.6	1.37	8,984.2
NAFTA	409.7	6.7	11,415.0	36.49	27,861.8
EU	376.3	6.1	7,929.5	25.35	21,072.3
CER	23.3	0.4	407.9	1.30	17,507.9
ROW	3,349.5	54.6	5,145.8	16.45	1,536.3
World	**6,132.5**	**100.0**	**31,278.6**	**100.00**	**5,100.5**

Source: Author calculation from GTAP database version 6.

5.1.2 Factor income

Table 2.6 reports the sources of factor income in each region in 2001. Among the East Asian Economies, Japan generates the highest level of total income from factors at US$ 3,320.8 billion, followed by China (US$ 984.5 billion), ASEAN (US$ 560.6 billion) and Korea (US$ 380.2 billion). Except for China, the major source of factor incomes in East Asia is from capital. Following the GTAP data aggregation

[22] GDP and GDP per capita of Other ASEAN may not reflect the status of least developed countries very well in this case, because the region includes the country of Brunei Darussalam.

definition of capital, this also includes land and natural resources; explaining why capital is a major source of income for most regions.

Around 45 percent of total factor income in China is from unskilled labour. In contrast, more than 22 percent of total factor income in Japan is from skilled labour.

Table 2.6: Sources of factor income in 2001

Region	Unskilled		Skilled		Capital		Total
	US$ billion	Share (%)	US$ billion	Share (%)	US$ billion	Share (%)	US$ billion
ASEAN	159.8	28.5	59.6	10.6	341.2	60.9	560.6
Indonesia	36.9	26.5	10.6	7.6	91.8	65.9	139.2
Malaysia	33.3	39.2	10.0	11.8	41.8	49.1	85.1
Philippines	15.9	25.6	6.5	10.4	39.9	64.1	62.2
Singapore	23.3	30.9	14.2	18.8	37.8	50.2	75.3
Thailand	22.3	22.7	8.5	8.6	67.8	68.8	98.6
Vietnam	9.5	33.8	2.3	8.1	16.3	58.2	28.1
Other ASEAN	18.6	25.8	7.7	10.7	45.8	63.6	72.1
China	444.2	45.1	108.3	11.0	432.0	43.9	984.5
Japan	1,226.6	36.9	736.1	22.2	1,358.1	40.9	3,320.8
Korea	132.5	34.9	56.1	14.7	191.6	50.4	380.2
NAFTA	3,605.2	34.3	2,581.2	24.5	4,328.9	41.2	10,515.3
EU	1,841.6	30.0	1,215.4	19.8	3,088.1	50.3	6,145.2
CER	134.1	36.1	86.9	23.4	150.8	40.6	371.8
ROW	1,571.2	34.9	716.9	15.9	2,217.5	49.2	4,505.5
World	**9,115.3**	**34.0**	**5,560.4**	**20.8**	**12,108.2**	**45.2**	**26,783.9**

Source: Author calculation from GTAP database version 6.

The ASEAN economies, as individual countries, earn a reasonably high proportion – over 60 percent – of factor income solely from capital. This is a consequence of most ASEAN nations being agricultural-based economies; so that factor income from land, which is a part of the capital endowment, plays a significant role. Among ASEAN economies, Singapore has the highest proportion of factor income from skilled-labour at almost 19 percent – around twice as much as in other ASEAN economies.

5.1.3 Unemployment

The levels of unemployment, labour force, and unemployment rates are shown in **table 2.7**. Labour is categorized into two main groups by level of education[23] – skilled and unskilled labour. In 2001, the world unemployment rate was approximately 7 percent for both unskilled and skilled labour. Among East Asian economies, ASEAN has the highest unemployment rates for both types of labour – 6.4 percent for unskilled labour and 6.0 percent for skilled labour. The unemployment rates of unskilled labour in China, Japan and Korea are 3.7, 5.8 and 4.1 percent respectively. On the other hand, the unemployment rates of skilled labour in China, Japan and Korea are 5.0, 4.2 and 3.6 percent respectively.

Unemployment rates in ASEAN members vary considerably. The Philippines and Indonesia have the highest rates of unemployment in South East Asia: around 9-11 percent of the labour force is unemployed those two countries. In general, the unemployment rates for both skill types in the other regions – Malaysia, Singapore, Thailand, Vietnam, and Other ASEAN, are fairly moderate, ranging from 2.7 to 4.1

[23] Labour skills are usually categorised either by level of education or occupation. In this study, we choose the level of education as a threshold because information on education is more readily available than information on occupation, especially in the ASEAN member economies.

percent. The outlier is 'Other ASEAN', in which the unemployment rate of skilled labour is 9.3 percent.

Table 2.7: Unemployment, labour force, unemployment rate in 2001

	Unemployment (thousands of people)		Labour force (thousands of people)		Unemployment rate [a] (%)	
	Unskilled [b]	Skilled [c]	Unskilled	Skilled	Unskilled	Skilled
ASEAN	13,358.1	1,812.6	207,287.9	30,038.6	6.4	6.0
Indonesia	7,644.9	422.1	87,765.2	3,760.8	8.7	11.2
Malaysia	310.5	38.0	7,654.4	1,953.2	4.1	1.9
Philippines	2,579.3	644.8	23,740.4	5,935.1	10.9	10.9
Singapore	48.5	22.8	1,254.7	772.5	3.9	3.0
Thailand	716.3	170.2	26,561.9	6,649.3	2.7	2.6
Vietnam	907.6	226.9	31,506.9	7,876.7	2.9	2.9
Other ASEAN	1,150.9	287.7	28,804.4	3,090.8	4.0	9.3
China	21,495.9	5,374.0	575,612.0	107,479.4	3.7	5.0
Japan	2,539.2	837.4	44,124.7	20,029.7	5.8	4.2
Korea	672.6	199.8	16,569.4	5,517.0	4.1	3.6
NAFTA	5,067.7	3,955.5	148,154.3	48,070.1	3.4	8.2
EU	11,234.8	1,858.8	125,474.9	39,246.7	9.0	4.7
CER	652.1	103.0	7,677.4	3,249.3	8.5	3.2
ROW	92,184.4	22,660.1	1,002,838.0	241,880.3	9.2	9.4
World	**147,204.8**	**36,801.2**	**2,127,738.8**	**495,511.1**	**6.9**	**7.4**

Source: World Development Indicators (2004) calculated on base year 2001.

Note: a: unemployment rate is calculated as percentage of labour force.
b and c: unskilled and skilled labour are classified by education level.

5.1.4 Domestic production

Table 2.8 reports the structure of domestic production by sector in each region. The value of domestic production in Japan is the greatest among the East Asian Economies, at US$ 7,331.7 billion, followed by China (US$ 3,135.9 billion), ASEAN (US$ 1,349.7 billion) and Korea (US$ 969.5 billion) in a row.

In general there are two main domestic production sectors, ‘other manufactures’ and ‘other services’, which account for over 70 percent of total value. For example, the ‘other manufactures’ sector accounts for 40.6 percent in China, 34.1 percent in ASEAN and in Korea, and 23.5 percent in Japan. ‘Other services’ accounts for 59.3 percent in Japan, 44.9 percent in Korea, 36.3 in ASEAN, and 28.6 percent in China.

The third important sector of domestic production differs across regions, e.g. they are textile and apparel sector for China (6.9 percent of its total value), transport sector for Japan (5.6 percent of its total value), motor and equipment (5.7 percent of its total value), and plant and products for ASEAN (6.6 percent of its total value).

Within the ASEAN group, the structures of domestic production are markedly different. For example, more than one fourth of domestic production value in the Philippines is from the agricultural sectors, as compared to only 2.1 percent in Singapore, while more than 60 percent of the value domestic production in Malaysia is from the ‘manufactures’ sectors, as compared to 32.7 percent in Vietnam.

Table 2.8: Structure of domestic production by sectors in 2001

Sectors	Regions							
	ASEAN	Indonesia	Malaysia	The Philippines	Singapore	Thailand	Vietnam	Other ASEAN
	US$ billion							
PLPR	88.9	31.0	8.0	16.9	1.1	16.7	6.9	8.2
ANPR	35.0	8.2	2.4	11.1	0.5	7.2	1.3	4.2
OAGR	53.8	16.4	2.8	10.0	3.3	12.5	3.2	5.5
TEXT	61.0	18.0	3.7	5.1	1.9	17.9	2.7	11.7
SHOE	12.1	3.5	0.2	0.5	0.4	3.6	2.5	1.4
MOTR	35.0	7.1	4.0	1.4	4.0	11.0	0.4	7.1
ENER	42.2	22.3	8.6	1.1	0.1	2.7	3.8	3.7
OMAN	460.3	76.6	121.4	47.9	97.6	82.5	12.3	22.0
TRAN	70.8	13.1	9.0	5.3	18.7	14.8	2.1	7.7
SVCS	490.5	93.6	60.0	52.7	100.7	85.8	31.0	66.7
Total	**1,349.7**	**289.8**	**220.2**	**152.2**	**228.1**	**254.8**	**66.2**	**138.3**
	Share (%)							
PLPR	6.6	10.7	3.6	11.1	0.5	6.6	10.5	6.0
ANPR	2.6	2.8	1.1	7.3	0.2	2.8	2.0	3.0
OAGR	4.0	5.7	1.3	6.6	1.4	4.9	4.8	4.0
TEXT	4.5	6.2	1.7	3.3	0.8	7.0	4.1	8.5
SHOE	0.9	1.2	0.1	0.3	0.2	1.4	3.8	1.0
MOTR	2.6	2.4	1.8	0.9	1.7	4.3	0.6	5.1
ENER	3.1	7.7	3.9	0.7	0.1	1.0	5.7	2.7
OMAN	34.1	26.4	55.1	31.5	42.8	32.4	18.5	15.9
TRAN	5.2	4.5	4.1	3.5	8.2	5.8	3.1	5.6
SVCS	36.3	32.3	27.2	34.6	44.1	33.7	46.8	48.2
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: Author calculation from GTAP database version 6.

Note: PLPR is plant and products, ANPR is animal and products, OAGR is other agriculture, TEXT is textile and apparel, SHOE is leather and shoes, MOTR is motor and equipment, ENER is energy, OMAN is other manufactures, TRAN is transports and SVCS is other services.

Table 2.8: Structure of domestic production by sectors in 2001 (continued)

Sectors	Regions						
	China	Japan	Korea	NAFTA	EU	CER	ROW
	US$ billion						
PLPR	212.1	95.9	28.5	203.4	191.9	18.9	646.0
ANPR	122.4	60.5	16.3	414.0	377.8	34.9	449.9
OAGR	119.4	233.4	25.6	546.0	408.5	19.7	399.7
TEXT	217.7	95.0	30.8	310.1	223.0	7.1	332.3
SHOE	56.0	7.8	4.0	25.3	51.6	1.2	53.8
MOTR	82.7	348.7	55.5	791.3	606.9	15.6	253.4
ENER	76.4	11.3	1.7	180.1	52.3	31.1	501.6
OMAN	1,273.0	1,719.9	331.1	3,944.5	3,514.3	121.0	2,260.0
TRAN	79.1	407.9	40.7	870.8	739.8	45.8	722.9
SVCS	897.1	4,351.3	435.2	12,959.7	8,437.1	464.6	4,559.3
Total	**3,135.9**	**7,331.7**	**969.5**	**20,245.3**	**14,603.1**	**759.8**	**10,178.9**
	Share (%)						
PLPR	6.8	1.3	2.9	1.0	1.3	2.5	6.3
ANPR	3.9	0.8	1.7	2.0	2.6	4.6	4.4
OAGR	3.8	3.2	2.6	2.7	2.8	2.6	3.9
TEXT	6.9	1.3	3.2	1.5	1.5	0.9	3.3
SHOE	1.8	0.1	0.4	0.1	0.4	0.2	0.5
MOTR	2.6	4.8	5.7	3.9	4.2	2.0	2.5
ENER	2.4	0.2	0.2	0.9	0.4	4.1	4.9
OMAN	40.6	23.5	34.1	19.5	24.1	15.9	22.2
TRAN	2.5	5.6	4.2	4.3	5.1	6.0	7.1
SVCS	28.6	59.3	44.9	64.0	57.8	61.1	44.8
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: Author calculation from GTAP database version 6.

Note: PLPR is plant and products, ANPR is animal and products, OAGR is other agriculture, TEXT is textile and apparel, SHOE is leather and shoes, MOTR is motor and equipment, ENER is energy, OMAN is other manufactures, TRAN is transports and SVCS is other services.

5.2 Trade Statistics

5.2.1 Bilateral trade flows

Statistics on bilateral trade flows, signifying which regions are the main trading partners for a particular region, are provided in **table 2.9**.

Table 2.9: Bilateral trade flows in 2001

(US$ billion)

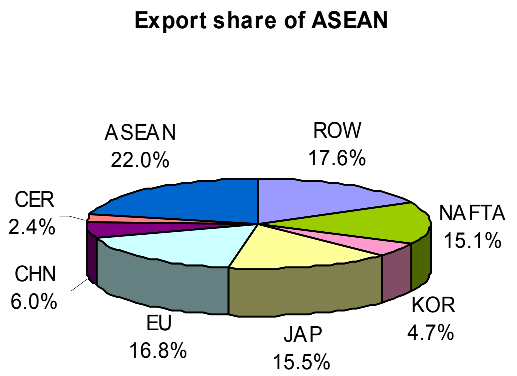
Importer	Exporter							
	ASEAN	China	Japan	Korea	NAFTA	EU	CER	ROW
ASEAN	81.8	29.1	54.8	15.2	96.1	85.3	9.4	75.0
China	22.5	-	57.3	14.0	118.6	70.8	6.6	89.7
Japan	57.9	48.6	-	27.4	139.4	82.0	9.3	88.5
Korea	17.5	27.4	16.5	-	43.5	27.4	2.9	41.6
NAFTA	56.1	34.8	82.0	32.1	574.6	300.0	17.9	224.2
EU	62.6	47.7	78.3	26.1	347.7	1,375.3	22.5	554.5
CER	8.8	6.0	14.8	5.4	14.1	17.4	5.3	19.0
ROW	65.5	77.8	91.1	35.5	306.7	537.8	11.6	388.5

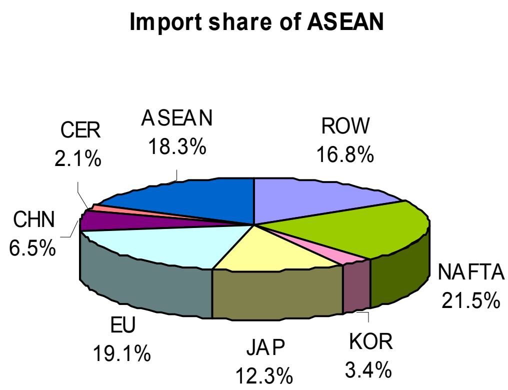
Source: Author calculation from GTAP database version 6.

Bilateral trade flows are best presented in matrix form. The column signifies exporting regions, while the row simply means to importing regions. Diagonal cells show the intra-regional trade in a particular region. These cells are zero for a region, which comprises a single country, e.g. China, Japan, Korea.

The most important trading partners for ASEAN member exports are other ASEAN members. As figure 2.2 shows, the value of its intra-regional exports is US$ 81.8 billion or around 22 percent of total value. The key reason for this is that ASEAN has consisted of a Free Trade Area since 1992. The second and third important trading destinations for ASEAN exports are the Rest of the World and the EU, which account for 17.6 and 16.8 percent of ASEAN's total exports receipts respectively. On the other hand, the main sources of ASEAN imports are NAFTA (21.5 percent of total import value), EU (19.1 percent), and ASEAN themselves (18.3 percent).

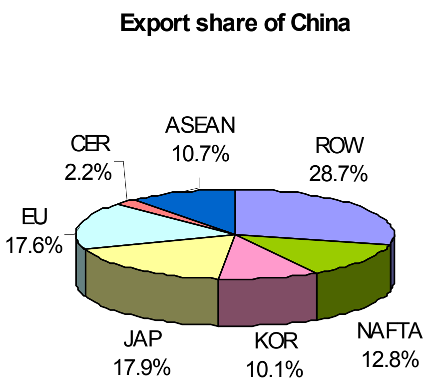
Figure 2.2: Export and import shares of ASEAN in 2001

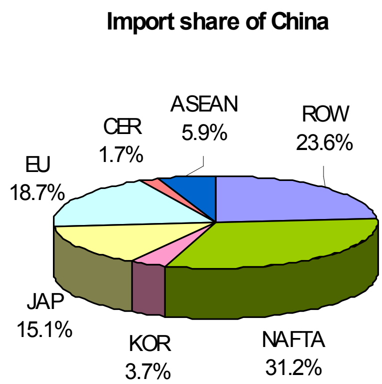




The three most important destinations for Chinese exports (figure 2.3) are Rest of the World (28.7 percent of total export value), Japan (17.9 percent), and EU (17.6 percent). The three most important sources of China's imports are NAFTA (31.2 percent of total import value), Rest of the World (23.6 percent) and EU (18.7 percent).

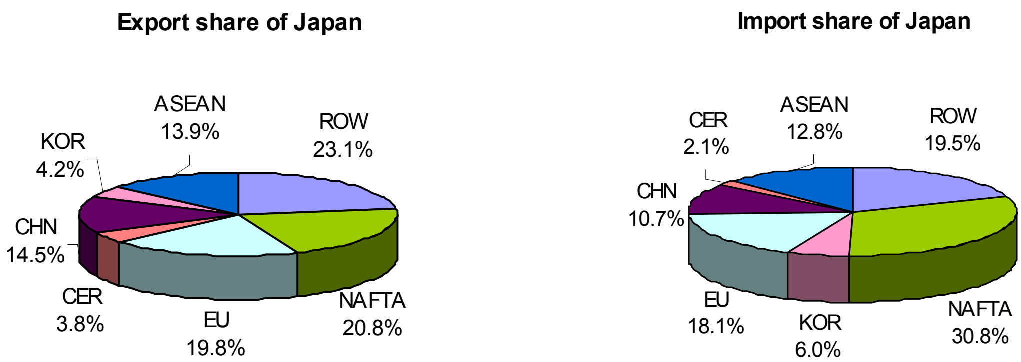
Figure 2.3: Export and import shares of China in 2001





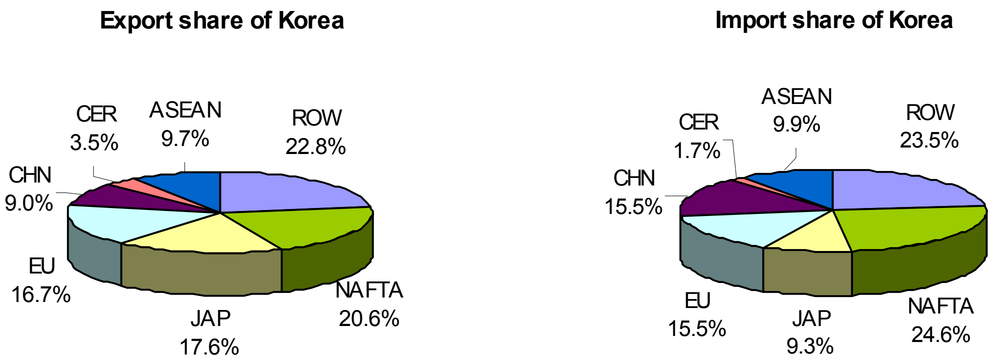
Japan's exports (figure 2.4) are largely to the Rest of the World (23.1 percent of total export value), NAFTA (20.8 percent), and EU (19.8 percent). Japan's imports come mainly from NAFTA (30.8 percent of total import value), Rest of the World (19.5 percent) and EU (18.1 percent) respectively.

Figure 2.4: Export and import shares of Japan in 2001



Exports by Korea (figure 2.5) are mostly to Rest of the World (22.8 percent of total export value), NAFTA (20.6 percent), and Japan (17.6 percent) successively. The three most important sources of Korea's imports are NAFTA (24.6 percent of total import value), Rest of the World (23.5 percent) and China and EU (15.5 percent).

Figure 2.5: Export and import shares of Korea in 2001



5.2.2 Exports

Table 2.10 shows the structure of exports by sectors in each region. Among the East Asian economies, Japan has the greatest value of exports at US$ 453.0 billion, followed by ASEAN (US$ 446.7 billion), China (US$ 379.5 billion) and Korea (US$ 176.9 billion). Remarkably, for every region, the highest export earnings come from one sector – 'other manufactures'. For example, approximately, over 63 percent of East Asian's exports are from this sector.

Other major export sectors in China are mainly labour-intensive sectors such as textile and apparel (14.8 percent of total exports) and leather and shoes (8.4 percent). One of Japan's highest exporting sectors, which is capital-intensive, is motor and equipment (21.6 percent of total exports). Korea's major sectors of exports are from motor and equipment (14.3 percent of total exports) and textile and apparel (9.5 percent).

Table 2.10: Structure of exports by sectors in 2001

Sectors	Regions						
	China	Japan	Korea	NAFTA	EU	CER	ROW
	US$ billion						
PLPR	5.7	1.2	0.6	38.7	42.0	6.6	62.7
ANPR	3.3	0.3	0.1	19.7	53.6	14.0	16.3
OAGR	6.8	2.1	1.8	28.3	81.6	4.4	47.5
TEXT	56.3	9.6	16.8	32.9	89.4	0.9	117.1
SHOE	32.0	0.3	2.3	2.8	27.3	0.6	15.9
MOTR	8.6	97.7	25.3	195.1	331.4	3.6	65.6
ENER	4.8	0.1	0.0	34.3	19.1	14.8	251.2
OMAN	239.4	301.9	112.2	703.9	1,359.5	28.6	627.7
TRAN	6.1	11.0	5.5	63.9	122.1	6.4	90.8
SVCS	16.3	28.7	12.2	202.0	388.6	11.1	219.6
Total	**379.5**	**453.0**	**176.9**	**1,321.7**	**2,514.6**	**91.0**	**1,514.4**
	Share (%)						
PLPR	1.5	0.3	0.3	2.9	1.7	7.2	4.1
ANPR	0.9	0.1	0.1	1.5	2.1	15.4	1.1
OAGR	1.8	0.5	1.0	2.1	3.2	4.8	3.1
TEXT	14.8	2.1	9.5	2.5	3.6	1.0	7.7
SHOE	8.4	0.1	1.3	0.2	1.1	0.6	1.0
MOTR	2.3	21.6	14.3	14.8	13.2	3.9	4.3
ENER	1.3	0.0	0.0	2.6	0.8	16.3	16.6
OMAN	63.1	66.6	63.4	53.3	54.1	31.4	41.4
TRAN	1.6	2.4	3.1	4.8	4.9	7.1	6.0
SVCS	4.3	6.3	6.9	15.3	15.5	12.2	14.5
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: Author calculation from GTAP database version 6.

Note: PLPR is plant and products, ANPR is animal and products, OAGR is other agriculture, TEXT is textile and apparel, SHOE is leather and shoes, MOTR is motor and equipment, ENER is energy, OMAN is other manufactures, TRAN is transports and SVCS is other services.

ASEAN exports as a whole are principally from ‘other services’ (10.9 percent of total exports), ‘textiles and apparel’ (6.1 percent), and energy (4.5 percent). At the individual country level the structure of ASEAN member’s exports varies significantly. For example, Malaysia and Singapore obtain much of their export revenue from the 'other manufactures' and 'other services' sectors. Energy is an important exporting sector in Indonesia and Vietnam, while textiles and apparel is a significant exporting sector in the Philippines, Thailand and Other ASEAN.

Table 2.10: Structure of exports by sectors in 2001 (cont.)

Sectors	Regions							
	ASEAN	Indonesia	Malaysia	The Philippines	Singapore	Thailand	Vietnam	Other ASEAN
	US$ billion							
PLPR	16.3	3.7	3.9	1.1	0.7	4.8	1.5	0.5
ANPR	3.2	0.5	1.0	0.1	0.2	1.3	0.1	0.0
OAGR	14.4	2.6	1.7	1.0	1.9	5.6	1.4	0.2
TEXT	27.2	8.7	2.8	3.0	1.5	6.2	2.0	3.0
SHOE	8.4	3.0	0.2	0.5	0.2	1.9	2.4	0.2
MOTR	7.1	0.7	1.2	0.6	2.1	2.3	0.1	0.1
ENER	20.3	11.0	4.1	0.3	0.1	0.1	2.3	2.5
OMAN	286.5	33.8	89.3	29.1	82.8	47.4	3.1	1.0
TRAN	14.7	1.3	2.8	1.0	3.4	5.4	0.4	0.4
SVCS	48.7	2.9	18.5	1.5	18.5	5.0	1.7	0.7
Total	**446.7**	**68.2**	**125.4**	**38.2**	**111.3**	**80.0**	**15.0**	**8.6**
	Share (%)							
PLPR	3.6	5.4	3.1	3.0	0.6	6.0	9.9	6.1
ANPR	0.7	0.7	0.8	0.3	0.2	1.6	0.7	0.5
OAGR	3.2	3.8	1.3	2.7	1.7	7.1	9.2	2.2
TEXT	6.1	12.8	2.2	7.9	1.3	7.8	13.5	35.2
SHOE	1.9	4.3	0.2	1.2	0.2	2.4	16.1	2.1
MOTR	1.6	1.0	1.0	1.5	1.8	2.9	0.7	0.9
ENER	4.5	16.1	3.2	0.7	0.1	0.1	15.3	29.0
OMAN	64.1	49.6	71.2	76.3	74.4	59.2	20.8	11.6
TRAN	3.3	1.9	2.2	2.5	3.1	6.7	2.7	4.8
SVCS	10.9	4.2	14.7	3.9	16.6	6.3	11.2	7.6
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: Author calculation from GTAP database version 6.

Note: PLPR is plant and products, ANPR is animal and products, OAGR is other agriculture, TEXT is textile and apparel, SHOE is leather and shoes, MOTR is motor and equipment, ENER is energy, OMAN is other manufactures, TRAN is transports and SVCS is other services.

5.2.3 Imports

The structure of imports by sector in each region is reported in **table 2.11**. Japan has got the greatest value of imports at US$ 430.1 billion, followed by ASEAN (US$ 401.3 billion), China (US$ 313.8 billion) and Korea (US$ 176.4 billion).

Again, the most important importing sector for all regions is the 'other manufactures' sector. In the East Asian economies, the proportion of other manufactures imports by ASEAN, China, Korea and Japan are 64.2, 63.9, 52.1 and 44.5 percent of total import respectively.

Apart from the 'other manufactures' sector, the major importing sectors in China are other services (10.9 percent of total import value) and textiles and apparel (7.7 percent). The second and third highest import sectors in Japan and Korea are services (14.1 and 10.0 percent respectively) and energy (11.4 and 14.0 percent respectively).

Unlike its export structure, the import structure in ASEAN, whether considered as a whole or at the individual country level shows a reasonably uniform pattern. The second largest import sectors in ASEAN are 'other services', while the third highest sectors are 'motor and equipment'. The only exceptions appear in the Philippines and Other ASEAN, where the third highest import sectors are energy and textiles and apparel.

Table 2.11: Structure of imports by sectors in 2001

Sectors	Regions						
	China	Japan	Korea	NAFTA	EU	CER	ROW
	US$ billion						
PLPR	11.5	20.0	10.8	28.4	69.3	1.0	70.8
ANPR	4.4	14.4	2.9	17.0	52.9	0.6	29.6
OAGR	3.6	21.9	4.4	36.0	81.0	2.8	52.6
TEXT	24.2	27.1	6.3	105.7	126.6	4.7	97.7
SHOE	2.7	6.8	1.3	28.2	32.8	1.1	27.1
MOTR	15.0	14.7	6.8	260.4	291.7	12.1	150.8
ENER	12.6	49.0	24.6	84.0	112.0	2.6	79.2
OMAN	200.7	191.2	91.9	939.1	1,299.1	51.1	871.3
TRAN	5.2	24.3	9.7	72.9	122.8	5.9	67.8
SVCS	34.1	60.6	17.6	151.9	404.0	10.3	199.2
Total	**313.8**	**430.1**	**176.4**	**1,723.7**	**2,592.3**	**92.1**	**1,646.2**
	Share (%)						
PLPR	3.7	4.7	6.1	1.7	2.7	1.1	4.3
ANPR	1.4	3.4	1.7	1.0	2.0	0.7	1.8
OAGR	1.1	5.1	2.5	2.1	3.1	3.0	3.2
TEXT	7.7	6.3	3.6	6.1	4.9	5.1	5.9
SHOE	0.8	1.6	0.7	1.6	1.3	1.1	1.6
MOTR	4.8	3.4	3.9	15.1	11.3	13.1	9.2
ENER	4.0	11.4	14.0	4.9	4.3	2.8	4.8
OMAN	63.9	44.5	52.1	54.5	50.1	55.5	52.9
TRAN	1.7	5.7	5.5	4.2	4.7	6.4	4.1
SVCS	10.9	14.1	10.0	8.8	15.6	11.2	12.1
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: Author calculation from GTAP database version 6.

Note: PLPR is plant and products, ANPR is animal and products, OAGR is other agriculture, TEXT is textile and apparel, SHOE is leather and shoes, MOTR is motor and equipment, ENER is energy, OMAN is other manufactures, TRAN is transports and SVCS is other services.

Table 2.11: Structure of imports by sectors in 2001 (cont.)

Sectors	Regions							
	ASEAN	Indonesia	Malaysia	The Philippines	Singapore	Thailand	Vietnam	Other ASEAN
	US$ billion							
PLPR	10.9	2.6	3.0	1.5	1.7	1.4	0.5	0.2
ANPR	4.5	0.6	0.8	0.8	1.0	0.8	0.4	0.1
OAGR	10.9	1.0	1.5	1.5	2.0	2.9	1.2	0.7
TEXT	13.7	2.4	1.6	1.8	2.6	2.1	1.9	1.4
SHOE	2.1	0.3	0.3	0.2	0.4	0.4	0.5	0.1
MOTR	22.9	3.7	3.6	1.5	7.2	4.5	2.0	0.5
ENER	17.4	1.6	1.2	2.9	5.9	5.6	0.0	0.0
OMAN	257.5	23.6	55.9	31.0	87.9	43.7	11.8	3.5
TRAN	11.9	1.7	1.7	1.0	3.5	1.7	2.0	0.2
SVCS	49.5	9.4	10.6	2.7	12.1	6.3	7.5	0.7
Total	**401.3**	**47.0**	**80.3**	**45.0**	**124.5**	**69.5**	**27.7**	**7.3**
	Share (%)							
PLPR	2.7	5.6	3.8	3.3	1.4	2.0	1.7	2.6
ANPR	1.1	1.3	1.0	1.8	0.8	1.2	1.3	1.8
OAGR	2.7	2.2	1.9	3.4	1.6	4.2	4.3	9.7
TEXT	3.4	5.1	2.0	3.9	2.1	3.0	6.8	19.1
SHOE	0.5	0.6	0.4	0.3	0.3	0.5	1.8	0.9
MOTR	5.7	7.8	4.4	3.4	5.8	6.5	7.0	6.3
ENER	4.3	3.4	1.5	6.5	4.8	8.1	0.1	0.6
OMAN	64.2	50.1	69.7	69.0	70.6	62.9	42.6	47.5
TRAN	3.0	3.7	2.2	2.2	2.8	2.4	7.3	2.1
SVCS	12.3	20.1	13.3	6.1	9.8	9.1	27.1	9.8
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: Author calculation from GTAP database version 6.

Note: PLPR is plant and products, ANPR is animal and products, OAGR is other agriculture, TEXT is textile and apparel, SHOE is leather and shoes, MOTR is motor and equipment, ENER is energy, OMAN is other manufactures, TRAN is transports and SVCS is other services.

6. Conclusion

This chapter provides information on the background of regionalism based on an East Asian perspective. The characteristics of the economic structure and some of trade statistics are also illustrated. Viewed as the region that is most active in trying to set up bilateral trade agreements in the last five years, the East Asian economies are now trying to achieve the goal of establishing East Asian Free Trade Area (EAFTA). However, in practice, there are some obstacles due to the many differences among members and political pressures from both domestic and international sources. These factors may hamper and delay the foundation of EAFTA.

Other possible bilateral Free Trade Areas – ASEAN-China Free Trade Area (ACFTA), ASEAN-Japan Free Trade Area (AJFTA), and ASEAN-Korea Free Trade Area (AKFTA) – are discussed. Some of these bilateral FTA options have already been implemented. These options are therefore chosen as the simulation scenarios which the model seeks to assess. The structure and calibration of these will be discussed in chapters 4 and 5, while the model results will be reported in chapter 6.

Chapter 3

Literature Review

1. Introduction

Since the WTO was established in the 1990s, many parts of the world have created their own regional trade blocs as a means of promoting intra-regional trade and their economic growth. The three main regional trading arrangements, which cover some seventy percent of world trade, are the North America Free Trade Area (NAFTA), the Asia-Pacific Economic Cooperation organisation (APEC) and the European Union (EU). Many studies have attempted to assess the impacts of trade liberalisation and other policy issues in these regions using Computable General Equilibrium (CGE) models, now widely accepted as an appropriate tool.

There have been many studies based on CGE modelling of regional integration in North America and Europe.[1] However studies of integration between Asian economies are (relatively) less common. Now, the prospects of regionalism in Asia, especially East Asia, have increased dramatically.[2] Therefore, assessing the outcomes of alternative East Asia Free Trade Areas has become more important. This chapter provides a brief history of CGE modelling and an extensive survey of CGE models focusing on the East Asian economies in order to provide the

[1] In a long history, various issues of economic integration in North America Free Trade Area (NAFTA) and the European Union (EU) are comprehensively analysed. For example, see Cox and Harris (1992); Hinojosa-Ojeda, et al. (1992); Lustig, et al (1992); Francois and Shiells (1994); Kehoe (1995); Burfisher, et al. (2001); Diao, et al (2003) for the NAFTA analysis. Also see Winters (1992); Anderson, et al. (1993); Harrison, et al. (1996); Bach, et al. (1997); Capros, et al. (1997); European Commission (2003) for the EU analysis.

[2] Details are provided in Chapter 2: Regionalism in East Asia.

background for the CGE model used in this study, which assesses the economic impact of three potential East Asian regional groupings.

2. Computable General Equilibrium (CGE) models

2.1 Background

Computable General Equilibrium (CGE) models are based on general equilibrium theory. The general equilibrium is achieved when demand equals supply in all markets at prevailing prices, and assuming constant returns to scale, zero profit conditions are satisfied for each industry (Shoven and Whalley, 1992). The main characteristic of a CGE model is that the economy must satisfy rigorous microeconomic constraints, specified by a set of equations that reflect the optimising behaviour of economic agents, i.e. firms, household, and government, subject to technological and budget constraints. Thus such models give an understanding of the whole economy by starting from a solid micro foundation of individual markets and agents' behaviour. While CGE models have at their core production and consumption structures, they also incorporate the standard macroeconomic requirements, e.g. household income must be equal to consumption expenditure and savings, countries must be in balance of payments equilibrium, saving equals investment, and so on.

Given optimisation by economic agents, subject to the firms' technologies (different in each sector within a country/region), household and government preferences, fixed national factor endowments, and implemented policies; the other variables in CGE models may be determined because these variables are all interdependent. The linkages are generated according to sets of accounting identities: for example, each household obtains its income from wages, rents, and government transfers, while household expenditure flows to private consumption, income tax payment, and saving.

The analysis of an economy in general equilibrium is crucially based on the Arrow-Debreu theorem, in what is sometimes called the Arrow-Debreu-McKenzie model.[3] The theorem is important in that it provides a rigorous proof of the existence of a general equilibrium and, further, of the uniqueness of that equilibrium. That is, such an economy does not generate multiple equilibria, some of which may not be stable.

The basic CGE approach is to take cross-sectional data from a single base period, impose changes on the underlying data, and observe how the endogenous variables adjust. The model size can vary from a single country to a global level with many countries. In addition, the models can be designed to capture many complicated economic aspects and to allow or prohibit flexibility in prices and quantities, depending on the purpose of study.

CGE models have been used extensively in the analysis of various policy issues, e.g. fiscal and international trade policy (Shoven and Whalley, 1984), economic integration and other regional trading arrangements (Lloyd and McLaren, 2004), energy and environmental issues (Bhattacharyya, 1996), economic development and the distribution of income (Decaluwé and Martens, 1988), and dynamic models of tax policy evaluation (Pereira and Shoven, 1988).

[3] See Arrow and Debreu (1954) and McKenzie (1981) for more details.

According to a survey by Baldwin and Venables (1995), general equilibrium modelling of trade issues can be categorized into three generations. The first generation models were usually developed using the traditional assumptions of perfect competition and constant returns to scale. A common feature of such models is that consumers in each country/region do not regard imported goods as perfect substitutes for domestic goods, and do not regard imports with different origins as perfect substitutes for one another. This, usually referred to as the 'Armington assumption', is used so that the two-way bilateral trade flows in such goods observed in reality can be modelled as being produced by perfectly competitive sectors in each economy.[4]

In contrast, the second generation models, sometimes known as 'New Trade Models', are built under assumptions of imperfect competition and increasing return to scale. These characteristics are often introduced through monopolistic competition using the Dixit-Stiglitz 'love of variety' utility function. In this class of monopolistic competition models, products are not homogenous, and an increase in the number of varieties available to consumers will, ceteris paribus, increase their welfare.[5] An alternative approach to modelling two-way trade is to specify that firms in some sectors behave as oligopolists.

Finally, the third generation models incorporate dynamic aspects into the models by introducing investment and growth effects. The argument for this type of model is that static models consider only the effects of resource reallocation within a single

[4] More explanation of the Armington assumption is given in Chapter 4: A CGE model for East Asia.
[5] See Dixit and Stiglitz (1977*),* Krugman (1979), Krugman (1980).

period, ignoring the possible long-run accumulation effects.[6] Such models may be fully dynamic, being run over a large but finite number of time periods, or quasi-dynamic in that in each time period the model is solved using the current endowments of factors, as in the earlier models, and then the changes in investment and population growth are carried through to the next time period, and so on.

Even though the structure of the first generation models is relatively less sophisticated than those of the succeeding generations; they are still widely used for trade discrimination analyses. Lloyd and McLaren (2004) argue that such CGE models are very useful tools for assessing the discriminatory effects of Regional Trading Arrangements (RTAs), especially when the predictions of welfare effects of trade discrimination via RTAs on member and non-member countries are still ambiguous.[7] Moreover, in models with many countries and goods the predictions of second generation 'New Trade Models' may be very similar to those from first-generation variants.

2.2 Caveats

Owning to their complexity and the necessary assumptions about economic structures and functional forms, the characteristics of CGE models can generate some limitations, which should be borne in mind when interpreting the results. Schiff and Winters (2003) identified five caveats in the context of CGE modelling.

[6] See Dewatripont and Michel (1987); Pereira and Shoven (1988); Francois et al. (1996); Lau et al. (2002).

[7] See Lloyd and McLaren (2004) for further discussion on the ambiguity of welfare effects from RTAs.

First, the model results should not be viewed as a prediction, but rather as an outcome from simulated policies. Second, unlike econometric models, the results from CGE models are limited in that there are no equivalents to standard errors as an aid to assessing the reliability of the predictions. Third, the model results can be sensitive to the values of the elasticities, which are set exogenously.[8] Fourth, the scope of a study can be limited by the unavailability of relevant data. For example, RTAs usually focus on the reduction/elimination of both tariffs and non-tariffs measures. To convert non-tariffs measures to appropriate 'tariff equivalents' can be technically difficult. A further problem is that RTAs often cover a number of issues beyond trade, i.e. investment facilitation, intellectual property, etc.; however, these issues are always excluded from the analysis. Fifth, the use of the Armington assumption may lead to a bias against finding evidence of trade diversion. Lloyd and MacLaren (2004) offer an explanation of how the common use of CES functions in modelling the Armington assumption may generate such a bias. For example, when the import price exceeds the domestic price, the quantity imported, while approaching zero, will never reach it.

3. CGE models in East Asia

Several studies have explored the possible outcomes of alternative East Asian trading agreements. The focus of studies varies considerably, from a narrowly defined North-East Asia nation group – China, Japan, and Korea – to a broader East Asia group which incorporates the ASEAN economies. Some studies also include India, the justification being that there is an empirical evidence of a strong economic

[8] Hertel et al. (2007) have attempted to improve the econometric estimation of key parameters, i.e. the elasticity of substitution among imports from different countries, for better evaluation outcomes.

relationship between ASEAN and India.[9] At the same time, the methodology used for analysis of Regional Trading Agreements also differs across studies, encompassing, for example, gravity models[10] and cost-efficiency studies,[11] etc. However, to make this chapter concise, the literature survey will mainly focus on approaches that use CGE techniques.

The literature reviewed here is restricted to the use of CGE models that provide a comprehensive analysis of alternative East Asia Free Trade Areas. It should be noted that the outcomes of all these simulations cannot be compared to each other directly. This is because each study is different in terms of policy scenarios, model structures, number of regions and sectors, and the focus regions.

3.1 Scollay and Gilbert Model[12]

The Scollay and Gilbert model is a modified version of Rutherford (1998). The model largely follows the standard Global Trade Analysis Project (GTAP) model formulated by Hertel (1997).[13] Such standard GTAP models may be classified as belonging to the first generation models.

[9] See Ramkishen and Rahul (2005). This trading agreement is sometimes referred to as "ASEAN+4" – ASEAN, China, Japan, Korea and India.

[10] See Roberts, B. A. (2004) for the impacts of an ASEAN-China Free Trade Area. Gilbert et al. (2001) use both a gravity model to analyze the 'natural trading bloc' hypothesis, and a CGE model to estimate welfare effects in each economy.

[11] See Batra, A. (2007) for the calculation of efficiency costs among regional agreement of ASEAN+4 and bilateral agreements between ASEAN and other individual Asian nations (ASEAN+1s).

[12] See Scollay, R. and Gilbert, J.P. (2001).

[13] Currently, the GTAP model and GTAP database are widely accepted and used by many international organizations, institutes, and scholars researching international issues. On a global basis, the GTAP model has played an important role on the analysis of the economic impact of the Uruguay Round Agreement by the Secretariat of the General Agreement on Tariff and Trade (GATT) in 1994. On regional basis, the GTAP model has assisted CGE modellers in assessing the economic effects of policy scenarios in many parts of the world, especially America and Europe. In the East Asia region, the model was employed in the evaluation of economic impact of the Manila Action Plan by the APEC Economic Committee in 1997. The full history of the GTAP model can be found in GTAP website, www.gtap.org

The GTAP model has a neoclassical structure, the basic assumptions being

(1) All sectors/markets are perfectly competitive and all markets are clear;

(2) The production functions have a nested Constant Elasticity of Substitution (CES) functional form, with intermediate goods combined in fixed proportions (i.e. Leontief), with a CES composite of factors producing value-added. Producers maximize their profit, and perfect competition ensures that the zero profit condition holds in every market;

(3) All factors are fully employed since factor payments are flexible. Capital and labour are freely mobile across sectors but immobile across regions. Land is sector-specific;

(4) Goods supplied to the domestic market may differ from those exported, modelled using a Constant Elasticity of Transformation (CET) function;

(5) In each region a representative household maximizes its Cobb-Douglas utility function subject to its income constraint;

(6) Real investment and government expenditure are assumed to be exogenously determined;

(7) All regions are linked through international trade in commodities and capital transfers;

(8) The Armington assumption is specified to allow intra-industry trade;

(9) Each region is in balance of payments equilibrium, with exchange rates adjusting accordingly;

(10) A selected price is specified as the numéraire; all other prices being specified relative to the numéraire price;

(11) The model is static: i.e. there is no explicit time dimension. As capital and labour are mobile, factor returns are endogenously determined;

(12) The results are presented as comparative static from the same base. The dimensions of the model used here are 22 regions and 21 sectors. The main data come from the GTAP database (version 4). Owing to data unavailability, the service sectors are aggregated into a single sector.

This study seeks to provide a comprehensive analysis of the outcomes of possible regional trading arrangements in the Asia-Pacific region. The simulations can be grouped into four main categories: (a) new bilateral and plurilateral agreements; (b) the potential establishment of an East Asian trade bloc; (c) estimation of the consequences of APEC liberalisation; and (d) trading bloc formation in the Asia-Pacific and global contexts. In each simulation, except for APEC liberalisation (which conforms to the MFN requirement), complete tariff removal within each potential economic bloc is applied in all simulations. Although there are many simulation results under various scenarios, the principal focus is on the economic welfare effects under an ASEAN-Japan-Korea FTA and an East Asian equivalent (**Table 3.1**).

The results show that, when China is excluded, an ASEAN-Japan-Korea FTA will bring welfare gains to all member countries except the Philippines. On the other hand, when China is included and the trade bloc becomes an East Asia FTA, most of member countries enjoy higher welfare gains (even the Philippines are better off since their welfare loss is reduced). Among the large economies, China enjoys a welfare of almost 2 percent of GDP, followed by Korea (1.18 percent) and Japan (0.34 percent). The welfare gains to individual ASEAN members are reasonably large. For example, the welfare gains in Singapore, Vietnam and Malaysia would be 4.12, 1.25, and 1.24 percent, respectively.

Table 3.1: Changes in welfare of East Asian economies in the Scollay and Gilbert model

(Percent of GDP)

	ASEAN-Japan-Korea FTA	East Asia FTA
Japan	**0.12**	**0.34**
South Korea	**0.18**	**1.18**
China	-0.21	**1.96**
Taiwan	-0.28	-1.10
Indonesia	**0.76**	**0.69**
Malaysia	**0.03**	**1.24**
Philippines	**-0.31**	**-0.19**
Thailand	**0.82**	**1.00**
Vietnam	**0.63**	**1.25**
Singapore	**4.53**	**4.12**
Australia	-0.08	-0.11
New Zealand	-0.29	-0.36
United States	-0.02	-0.03
Canada	0.02	0.06
Mexico	0.01	0.03
Chile	-0.03	0.02
Argentina	-0.20	-0.52
Brazil	-0.02	-0.05
Other South America	-0.01	-0.02
CACM/Caricom	-0.06	-0.22
European Union	-0.04	-0.02
Rest of the World	-0.09	-0.14
World	0.01	0.11

Source: Scollay and Gilbert (2001): Table 3.2d.
Note: Countries highlighted are member of the FTAs.

3.2 Brown, Deardorff and Stern Model[14]

The CGE model constructed recently by Brown, Deardorff and Stern is based on the Michigan Model of World Production and Trade.[15] This 'Michigan' model is

[14] See Brown et al. (2003).

[15] The Michigan model is a multi-sector, multi-region CGE model first introduced by Deardorff and Stern during the mid-1970s with the intention of analysing the economic effect on employment from Tokyo Round of multilateral agreements with WTO. Subsequently, the model has been developed to assess the effects of the US-Canada Free Trade Agreement and the North American Free Trade Area (NAFTA). The full history of the Michigan model as well as the description of

technically in the second generation models in that the ‘New Trade Theory’ approach is incorporated. The main features include increasing returns to scale, monopolistic competition and product variety. Brown et al. (2003) emphasize that, even though the Michigan model is based on imperfectly competitive market theory, the economic responses to trade liberalisation are still determined, in part, in the same way as those in perfectly competitive models. Thus the welfare change in each economy is affected not only by terms of trade effects and the standard efficiency gains, but also by the additional benefits identified by the New Trade Theory. Once trade is liberalised, these additional gains accrue from lower costs due to increasing return to scale, reduced market monopoly power due to greater competition, and higher utility gains due to an increase in the number of varieties of products.

The Michigan model is static by nature, being based on a single period in equilibrium, and so does not involve variables which could change over time. However, as the elasticities of supply and demand used in the model intrinsically refer to the long run, Brown et al. (2003) argue that the model results are valid over a time horizon of several years. The authors explore the options that the US and Japan could pursue on trade negotiations at the multilateral, regional, and bilateral levels.

The data used in the Brown, Deardorff and Stern model are mainly from the GTAP database (version 4), which reflects the world economy in 1995. The database is aggregated in the model to 20 regions and 18 sectors. The model also requires additional data on number of firms and employment at sectoral level. Many

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the model structure and equations can be found at http://fordschool.umich.edu/rsie/model/, The University of Michigan, School of Public Policy, Department of Economics. The model is solved using the GEMPACK software, which is described in Harrison and Pearson (1996).

simulations have been performed. For example, at the multilateral level, the economic impacts of the Doha Round are simulated on the assumption that the import tariffs on agricultures and manufactures, as well as barriers to services, are reduced by thirty-three percent. At the regional level both the ASEAN+3 Free Trade Area, known as the East Asian Free Trade Area (EAFTA), are simulated.[16] Finally, at the bilateral level, the possible formations of the Japan-Singapore Free Trade Area[17] and Japan-Korea Free Trade Area are also simulated. The simulation results for Japan's multilateral and bilateral agreements are not reported here, as the focus of this thesis is on the specified simulations– ASEAN-China FTA, ASEAN-Japan FTA, ASEAN-Korea, and East Asian FTA.[18]

According to Brown et al. (2003), once ASEAN's and Japan's trade in commodity and services is fully liberalised – a removal of all bilateral import tariffs on agriculture and manufactures and services barriers –global welfare increases by US$ 282.61 billion (**Table 3.2**). In this case, Japan will be a major gainer with an increase in welfare of US$ 170.39 billion. Korea's and China (Hong Kong)'s welfare would rise by US$ 23.94 billion, and US$ 17.66(0.21) billion, respectively.

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[16] ASEAN+3 in this study refers to five former ASEAN nations (Indonesia, Malaysia, Philippines, Singapore and Thailand) and three large North-East Asian nations (China/Hong Kong, Japan, and Korea).

[17] The economic impacts of Japan-Singapore FTA are also evaluated by Hertel et al. (2001), using a dynamic GTAP model. Unlike a conventional assessment, the study takes into account not only bilateral tariff reductions but also the implementation of uniform standards for e-commerce, the liberalisation of rules on trade in services, and the improvement of customs procedures.

[18] As argued in to Chapter 2, since ASEAN has existed as a regional trading bloc since 1992, it is not unreasonable to view ASEAN as a hub initiating and signing the comprehensive economic cooperation with the other three large economies. High possibilities of these options would yield more substantial and interesting outcomes than those of bilateral agreements. (The possibility of multilateral is, of course, possible but it is unlikely to happen in the near future)

The ASEAN member countries also experience an increase in welfare. Ranking from the highest to the lowest gainers, they are Singapore (US$ 7.93 billion), Malaysia (US$ 7.70 billion), Philippines (US$ 6.42 billion), Indonesia (US$ 5.80 billion), and Thailand (US$ 5.36 billion), consecutively. There is some evidence of trade diversion from East Asia FTA in the Rest of Asia (giving a loss of US$ 0.04 billion).

Table 3.2: Global welfare effect of East Asia FTA from the Brown, Deardorff and Stern Model

	East Asia FTA	
	% of GNP	Billion of dollars
Industrialized Countries		
Japan	**2.62**	**170.39**
United States	0.14	12.98
Canada	0.12	0.87
Australia	0.40	1.77
New Zealand	0.42	0.31
EU and EFTA	0.04	4.29
Developing Countries in Asia		
Hong Kong	**0.16**	**0.21**
China	**1.95**	**17.66**
Korea	**4.21**	**23.94**
Singapore	**10.66**	**7.93**
Taiwan	3.08	10.80
Indonesia	**2.29**	**5.80**
Malaysia	**6.44**	**7.70**
Philippines	**7.28**	**6.42**
Thailand	**2.60**	**5.36**
Rest of Asia	-0.04	-0.22
Other		
Chile	0.57	0.46
Mexico	0.00	0.00
Central, Caribbean, South America	0.10	1.66
Middle East and North Africa	0.50	4.29
World		282.61

Source: Brown et al. (2003): Table 3.
Note: Countries highlighted are member of East Asia FTA.

Brown et al. (2003) conclude from the overall simulations that (i) the economic impacts of the multilateral agreement – the Doha Round – are positive and considerable for all regions; (ii) the regional and bilateral agreements are welfare-increasing for the regions involved, but that the FTA would benefit the large industrialised economies much more than the small developing countries; (iii) regional and bilateral agreements can be welfare-decreasing for the non-member countries.

3.3 Lee, Roland-Holst, and van der Mensbrugghe Model[19]

This model is based on the LINKAGE model developed at World Bank.[20] The model is a dynamic global Computable General Equilibrium model, so belonging to the class of third generation models. Dynamics in the LINKAGE model are recursive, with economic agents assumed to be myopic, basing their decisions on adaptive expectations.[21] The model is solved sequentially as a series of equilibria, each representing a single year.[22]

The basic structure of the model still follows a standard neo-classical specification with constant returns to scale in all sectors, perfect competition, and market clearing

[19] See Lee et al. (2004).

[20] The LINKAGE model is gradually developed from the inspiration by RUNS model (Burniaux and van der Mensbrugghe, 1994), and the OECD GREEN model (van der Mensbrugghe, 1994). See van der Mensbrugghe (2003) for the full history and complete description of the LINKAGE' model structure and equations.

[21] The other approach to dynamic modelling is an Inter-temporal Dynamic model, where economic agents are assumed to be far-sighted and to base their expectations on rational expectation. See Devarajan and Go (1998) for example.

[22] In practice, a recursive dynamic model will generate a counterfactual growth path by imposing the dynamic *policy-independent* adjustments including population and labour force growth, capital accumulation, factor productivity changes, and changes in government expenditure. Then policy changes can be expressed in terms of changes in relevant exogenous parameters. After that the model will be solved again for a new series of equilibria. The differences between the *policy-influenced* growth path and the *policy-independent* growth path, or counterfactual, can be interpreted as the economy-wide impact of the simulated policy.

conditions. The Armington assumption is applied to allow two-way trade. Other assumptions remain similar to the basic assumptions employed in a standard GTAP model. However, the distinct feature of the LINKAGE model is the incorporation of dynamic effects into the model. The Dynamic characteristics used in Lee et al. (2004) are generated from three sources: (i) capital accumulation; (ii) technological progress; and (iii) productivity changes.

Capital accumulation is typically modelled as the previous-period total investment generating new total capital stock, some of which replaces depreciated capital. The technology specification assumes that factor substitution possibilities are higher with the new than with the old capital. The productivity changes in agricultural sectors are fixed while those in manufacturing and services sectors are specified as endogenous.

The main objective of Lee et al. (2004) is the assessment of the economic effects of different multiregional and regional trade policies which are relevant to China, Japan, and the United States. Data used in the model come from the GTAP database (version 5.2), which reflects the global economy in 1997.[23] The study focuses on 9 regions and 18 sectors. Simulation results cover a period of twenty four years, from 1997 to 2015.

The authors conducted seven policy simulations, but there are three simulations which are directly relevant to the purposes of this thesis – ASEAN-China FTA,

[23] See Dimaranan and McDougall (2002).

ASEAN-Japan FTA, and East Asian FTA (**Table 3.3**).[24] The results show that, under an ASEAN-China FTA, welfare in ASEAN increases by 2.5 percent, while welfare in China increases by 1.4 percent. The welfare changes in non-member countries are very small. The results for an ASEAN-Japan FTA show the same pattern, with welfare in ASEAN increasing by 2.7 percent whereas welfare of Japan increases by only 0.4 percent. An East Asian FTA would bring the highest welfare gains to the member countries; welfare in China, Japan, Korea and ASEAN welfares rises by 4.0, 1.6, 3.7, and 4.0 percent respectively.

Table 3.3: Welfare effects of the FTAs with and without trade barriers on food and agriculture products from Lee, Roland-Holst, and van der Mensbrugghe Model

(Deviations in EV from the baseline in 2015)

	Without trade barriers			With trade barriers remaining		
	ASEAN China FTA	ASEAN Japan FTA	East Asian FTA	ASEAN China FTA	ASEAN Japan FTA	East Asian FTA
(A) Absolute deviations (US$ billion)						
China and Hong Kong	**34.8**	-3.0	**102.3**	**21.5**	-1.2	**45.8**
Japan	1.4	**18.2**	**66.3**	2.3	**4.7**	**28.7**
Korea	-0.4	1.2	**30.1**	-0.5	-1.7	**12.4**
Taiwan	-1.5	-0.7	-5.4	-1.4	-0.6	-5.2
ASEAN	**26.0**	**28.4**	**41.8**	**17.2**	**12.3**	**25.9**
United States	0.8	-1.4	-0.9	0.7	-0.4	1.0
Canada and ANZ	0.2	-0.4	-0.2	0.3	-0.1	0.2
EU-15	3.9	0.2	6.8	3.4	0.3	6.8
Rest of the world	-3.6	-2.4	-9.8	-1.9	-1.1	-4.4
World	61.8	37.7	231.1	41.6	13.1	111.2

[24] The region 'China' also includes Hong Kong in this study. ASEAN refers to Indonesia, Malaysia, Philippines, Singapore, Thailand and Vietnam. According to GTAP database version 5.2, Brunei, Cambodia, Laos PDR and Myanmar are aggregated into the 'Rest of the World' region.

Table 3.3: Welfare effects of the FTAs with and without trade barriers on food and agriculture products from Lee, Roland-Holst, and van der Mensbrugghe Model (cont.)

(Deviations in EV from the baseline in 2015)

	Without trade barriers			With trade barriers remaining		
	ASEAN China FTA	ASEAN Japan FTA	East Asian FTA	ASEAN China FTA	ASEAN Japan FTA	East Asian FTA
(B) Percentage deviations (%)						
China and Hong Kong	**1.4**	-0.1	**4.0**	**0.9**	-0.1	**1.9**
Japan	0.0	**0.4**	**1.6**	0.1	**0.1**	**0.7**
Korea	-0.1	-0.1	**3.7**	-0.1	-0.1	**1.5**
Taiwan	-0.3	-0.1	-1.0	-0.3	-0.1	-1.0
ASEAN	**2.5**	**2.7**	**4.0**	**1.7**	**1.2**	**2.6**
United States	0.0	0.0	0.0	0.0	0.0	0.0
Canada and ANZ	0.0	0.0	0.0	0.0	0.0	0.0
EU-15	0.0	0.0	0.1	0.0	0.0	0.1
Rest of the world	-0.1	0.0	-0.2	0.0	0.0	-0.1
World	0.2	0.1	0.7	0.1	0.0	0.3

Source: Lee et al. (2004): Table 1 and table 2.
Note: Countries highlighted are members of the FTAs.

The welfare gains under the absence of agricultural liberalisation are much smaller than those under the existence of agriculture liberalisation. This policy scenario could be likely to happen, especially with Japan where agriculture sectors are highly protected.

3.4 Other CGE models of East Asia

As noted earlier, unlike NAFTA or the EU, the study of the economic impact of trade liberalisation in East Asia using CGE modelling began in the late 1990s. Since many countries in East Asia are now considering Regional Trading Arrangements as a way to boost their regional economic integration and to promote growth in their countries, there are many possible East Asian regional trade blocs that should be taken into consideration. Among the many uncertainties, we have not known until recently how

ASEAN Free Trade Area (AFTA) might unify with the rest of Northeast Asia and so form an East Asia Free Trade Area (EAFTA). The literature survey on the following studies, [25] which use CGE modelling to evaluate the economic impacts of various economic integration options in East Asia, can perhaps provide more insight about evolution in this region. The survey is displayed in chronological order in **table 3.4** for convenience.

Table 3.4: Survey of other CGE models of East Asia

(1)	Details
Authors	Kong-Yam Tan, Innwon Park, and Mun-Heng Toh (1999)
Aim of study	To examine the strategic interests of ASEAN countries within APEC when forming Regional Trading Arrangements.
Data, sectors and regions	GTAP database version 3. There are 9 regions and 10 sectors.
CGE modelling	A standard GTAP model with a dynamic specification. Even though there is a substantial theoretical and empirical literature arguing that the dynamic effects of trade liberalisation are larger than the static effects; there is still controversy about the channels of dynamic influence. In order to avoid these problems, the authors adapt the potential dynamic effects of trade liberalisation by including three positive externalities into the model –for imported intermediate goods, for exports, and for capital goods. These are incorporated in the model equations as elasticities attached to production functions and the capital stock equation.
Simulations	All simulations assume that tariff and non-tariff barriers within the group are reduced by 50 percent. (1) ASEAN-US FTA (2) ASEAN-Japan-Korea FTA (3) ASEAN-China-Hong Kong-Taiwan FTA (4) ASEAN-Japan-Korea-China-Hong Kong-Taiwan (EAEC – East Asian Economic Caucus) (5) ASEAN in APEC
Results	The more the countries/regions involve in FTA, the larger benefits would accrue to the member countries. In this study, the simulation of ASEAN in APEC yield higher benefit than EAEC because two key countries in ASEAN – Philippines and Indonesia – would suffer from trading blocs that exclude the US and Japan.
Note	The value of elasticities of positive externalities are, as the authors acknowledge, largely based on 'guesstimates'. Therefore, the results are inevitably sensitive to these values.

(2)	Details
Author	Inkyo Cheong (2003)
Aim of study	To examine the background of the recent actions on trade agreements by China, Japan, and Korea, and to estimate the economic effects of possible East Asian FTAs.
Data, sectors and regions	GTAP database version 5. There are 5 regions and 15 sectors.
CGE modelling	A standard GTAP model with and without the incorporation of capital accumulation.
Simulations	There are eight potential FTAs in East Asia evaluated; (1) China-Japan FTA (2) China-Korea FTA (3) Japan-Korea FTA (4) Northeast Asia FTA (5) ASEAN-China FTA (6) ASEAN-Korea FTA (7) ASEAN-Japan FTA (8) East Asia FTA

[25] See Tan et. Al (1999); Cheong (2003); Kawasaki (2003); Innwon Park (2003); Bchir and Fouquin (2006); and Zhang (2006).

Results	The option of an East Asia FTA which covers the whole region is economically more favourable than any bilateral or sub-regional FTA. As expected, the economic effects of trade liberalisation alone are moderate. However, when capital accumulation is included the impacts are greater. The author proposes that the route towards regional integration is to establish Northeast Asia FTA first, and then unify this with ASEAN. Argues that if China, Japan and Korea compete in pursuing bilateral FTAs with ASEAN, there may be major disadvantages, e.g. spaghetti bowl effects, hub-and-spoke dilemmas, etc.
Note	Northeast Asia FTA covers China, Japan and Korea.

(3)	Details
Author	Kenichi Kawasaki (2003)
Aim of study	To quantify the impact of Japan's FTAs in Asia using a CGE model of global trade.
Data, sectors and regions	GTAP database version 5. There are 23 regions and 16 sectors.
CGE modelling	A dynamic GTAP model based on Francois, McDonald and Nordstrom (1996)
Simulations	Simulations of possible bilateral and regional integrations are performed: 1. Bilateral 1.1 Japan-China FTA 1.2 Japan-Korea FTA 1.3 Japan-Indonesia FTA 1.4 Japan-Malaysia FTA 1.5 Japan-Philippines FTA 1.6 Japan-Thailand FTA 2. Regional 2.1 Japan-ASEAN 2.2 China-ASEAN 2.3 Japan, China, ASEAN
Results	The impact of a regional FTA likely to be determined by trade patterns, the degree of import liberalisation by sectors and by dynamic effects. The estimated impacts of Japan's FTA options vary in terms of both the size of macroeconomic gains and the direction of structural change across partners. Larger welfare improvements and more efficient resource allocation are generated by global and non-discriminatory trade liberalisation. However, due to difficulty of reaching agreement under multilateral trade liberalisation and the higher cost of non-members in FTA networks, regional trading arrangements are unavoidable
Note	Liberalisation of trade in services is not included. Tariffs are only form of protection. Although resource reallocation involves adjustment costs, these are not considered.

(4)	Details
Author	Innwon Park (2003)
Aim of study	To assess the feasibility of economic cooperation between China, Japan and Korea.
Data, sectors and regions	GTAP database version 5. There are 14 regions and 10 sectors.
CGE modelling	A standard GTAP model with a dynamic specification. The CGE model used in this study is static by nature; however, there are three externality parameters included – for imported intermediates, for exports, and for capital goods – to represent the dynamic gains from free trade.
Simulations	There are 5 simulations which are; (1) China-Korea FTA to reduce tariffs by 50%, (2) Korea-Japan FTA to reduce tariffs by 50%, (3) China-Japan FTA to reduce tariffs by 50%, (4) China-Japan-Korea FTA to reduce tariffs by 50% (5) China-Japan-Korea FTA to reduce tariffs by 100%.
Results	The establishment of a China-Japan-Korea FTA would be the ideal solution because it leads to an outcome that is Pareto superior to other bilateral FTAs. A China-Japan-Korea FTA would raise the real GDP of all three countries. Free trade would benefit China and Korea as they have a large proportion of intra-regional trade, a strong dependence on intra-regional imports of intermediates, and high tariff rates.
Note	The region 'China' also includes Hong Kong in the simulations.

(5)	Details
Author	Mohamed Hedi Bchir and Michel Fouquin (2006)
Aim of study	To explore the possible consequences of various Asian integration agreements.
Data, sectors and regions	Tariff and non-tariff barrier data sre taken from the MacMaps database, while the data on trade barrier are taken from GTAP database version 6. There are18 regions and 28 sectors.
CGE modelling	The MIRAGE model The model uses an oligopolistic framework. The distinctive features of the model are: (1) FDI is modelled explicitly (2) Vertical product differentiation is introduced.
Simulations	There are 4 simulations under ASEAN+4 conducted; (1) Bilateralism with full liberalisation (2) Full regional integration with full liberalisation (3) Bilateralism without sensitive products (4) Full regional integration without sensitive products
Results	Asian countries have divergent interests. ASEAN and China would prefer scenario 1, Japan would prefer scenario 2, while Korea and India would choose scenario 4. The rankings are based on summation of GDP growth with Real Effective Exchange Rate.
Note	Due to a lack of information on actual 'sensitive lists', those used are based on the assumption that 10% of the tariff lines will be defined as sensitive products. Asian integration covers ASEAN, China, Japan, Korea and India (ASEAN+4).

(6)	Details
Author	Yunling Zhang (2006)
Aim of study	To analyse China's economic interest in East Asia, its regional strategy and its role in East Asian cooperation process.
Data, sectors and regions	n.a.
CGE modelling	n.a.
Simulations	There are 4 simulations: (1) ASEAN-China FTA (2) ASEAN-China-Japan FTA (3) ASEAN-China-Korea FTA (4) East Asia FTA
Results	China is more confident about an FTA with ASEAN than with Japan or Korea since it has greater similarity with the ASEAN countries. A broad FTA can generate more benefits than a narrow one. Simulation results show that benefits of an East Asia FTA exceed those of any other FTA, either bilateral FTA, or AFTA, or any "10+1" FTA. The author suggests a practical approach is to negotiate an East Asia FTA on the basis of three FTAs, China-ASEAN, Japan-ASEAN, and Korea-ASEAN, the combination of which are likely to serve the modality of the future East Asian FTA. Eventually, these three separate agreements would need to be integrated into one by harmonizing various degrees of liberalisation of agricultural sectors, labour mobility, rules of origin and other factors.
Note	In this study, the CGE simulation results shows only GDP and welfare changes.

4. Conclusion

CGE models are widely used in the quantitative evaluation of the economic effects of changes in various policies. The history of CGE modelling dates back to the 1980s. In general CGE models can be categorized into three generations. The first generation CGE models conform to the traditional neo-classic assumptions of perfect competition and market clearing. In contrast, the effects of imperfect competition and increasing returns to scale provide a new area for the development of the second generation models. Lastly, the third generation models focus on the dynamic impacts of policy changes.

The literature on CGE models in East Asia Free Trade Areas is relatively recent and scarce when compared to those concerned with the North America Free Trade Area (NAFTA) or the European Union (EU). This is largely because countries in the East Asia region have started to be active in negotiating and forming Regional Trading Arrangements only in the last five years. At the moment, there are no concrete recommendations about how the region might establish an East Asia Free Trade Area (EAFTA), although there is some consensus that sub-regional trade blocs may be formed first and then extended to cover the rest of the region.

The literature surveyed in this chapter gives an overview of alternative FTAs which could be formed in the near future as well as their estimated economic effects. However, it should be noted that the results of these simulations cannot be compared to each other directly, largely because the policy scenarios, model structures, number of regions and sectors and the sub-regions on which they focus differ markedly in each study.

Chapter 4

A CGE Model for East Asia

1. Introduction

In this chapter a static multi-region, multi-sector CGE model is constructed to examine the economic impacts of different East Asia Free Trade Areas.[1] The specification of the regions and sectors in the model reflects its focus on East Asia. One important feature of the model, which makes it differ from a 'standard' CGE model,[2] is the relaxation of the assumption of full employment of labour. The structure of the model and the modelling of labour market imperfections are discussed in this chapter. The construction of the Social Accounting Matrix (SAM), which conforms to the sectoral and regional specification, and to which the model is calibrated, is presented in Chapter 5.

2. Model Description

2.1 General outline

The data for a CGE model for East Asia are taken from the GTAP database version 6, which reflects the global economy in 2001. The data are aggregated into fourteen regions, fourteen sectors, and three primary factors.[3] The fourteen regions are China, Japan, Korea, Indonesia, Malaysia, Philippines, Singapore, Thailand, Vietnam, Rest

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[1] The CGE model reported in this chapter was presented at the International Conference on Policy Modeling, Sao Paulo, Brazil in July 11-13, 2007.

[2] According to literature review, a standard CGE model is constructed under neoclassic assumption; for example, perfect competition, full employment, etc.

[3] The details of the data aggregation are provided in Appendix 4A.

of Southeast Asia, North America Free Trade Area (NAFTA), European Union (EU), the Australia-New Zealand Closer Economic Relations group (CER), and Rest of the World (ROW).

The fourteen tradable sectors are a land-intensive sector, processed food, a natural resource intensive sector, textile and apparel, leather and shoes, wood and paper, petroleum coal and metals, rubber and plastic, motor and equipment, electronic equipment, machinery, other manufactures, transports, and other services.

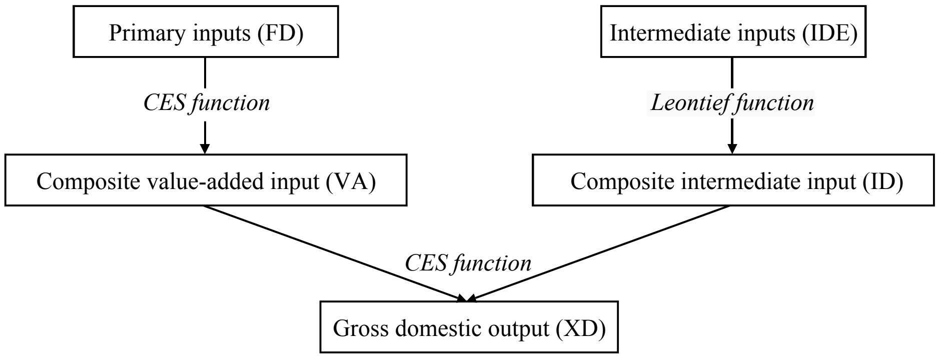
The three factors are unskilled labour, skilled labour, and capital, with each group assumed to be homogenous. Both types of labour and capital are perfectly mobile between sectors in each region, but immobile internationally. This implies that factor returns may differ across regions. The capital markets are assumed to be perfect, while the labour markets are imperfect, so that there may be unemployment.

All regions are linked by bilateral trade flows, with all trade subject to transportation costs. The policy instruments are classified as import tariffs, export subsidies, production taxes, consumption taxes, factor taxes, income taxes, and all tax/tariff/subsidy rates are ad valorem.

2.2 Production

Each firm maximises its profit under perfect competition subject to a constant returns to scale technology. The problem is equivalent to minimizing production costs subject to the production technology. Production is characterized by a two-level nest. At the top level, a composite of value-adding factors and a composite of intermediate inputs are smoothly substitutable in a CES function. At the bottom level, the primary input factors of production are also assumed to substitute smoothly through a CES composite value-added function,[4] while the composite of intermediate inputs is Leontief. The structure of production is illustrated in Figure 4.1.

Figure 4.1: Structure of production activities



The factor demand functions of each primary factor are specified as

$$FD_{fir} = \left(\frac{1}{aV_{ir}}\right)^{1-\sigma V_{ir}} \cdot \left(\gamma V_{fir} \cdot \frac{PVA_{ir}}{(1+\tau f_{fir}) \cdot PF_{fr}}\right)^{\sigma V_{ir}} \cdot VA_{ir}$$

where $\sum_{f} \gamma V_{fir} = 1$

where FD_{fir} is the factor demand for primary input f used in sector i in region r.

VA_{ir} is the demand for the composite value-added input of sector i in region r.

PF_{fr} is the price of primary input f in region r.

τf_{fir} is the factor tax rate of factor f used in sector i in region r.

PVA_{ir} is the price of aggregated value added input of sector i in region r.

aV_{ir} is the unit parameter in the composite value-added function.

[4] This assumption is made under the *Single Primary Factor Nest* approach, which implies that all factors are direct substitutes (Rutherford and Paltsev, 2000 and Winchester et al, 2006). Therefore, all three primary input factors are nested under one prevailing substitution elasticity.

γV_{fir} is the factor share in the composite value-added function.

σV_{ir} is the elasticity of substitution in the composite value-added function.

The demand functions for composite value added and intermediate inputs are specified as

$$VA_{ir} = \left(\frac{1}{aP_{ir}}\right)^{1-\sigma P_{ir}} \cdot \left((1-\gamma P_{ir}) \cdot \frac{PD_{ir}}{PVA_{ir}}\right)^{\sigma P_{ir}} \cdot XD_{ir}$$

$$ID_{ir} = \left(\frac{1}{aP_{ir}}\right)^{1-\sigma P_{ir}} \cdot \left(\gamma P_{ir} \cdot \frac{PD_{ir}}{PID_{ir}}\right)^{\sigma P_{ir}} \cdot XD_{ir}$$

where XD_{ir} is the gross domestic output i in region r.

PD_{ir} is the price of gross domestic output i in region r (before production tax).

ID_{ir} is the intermediate input for i in region r.

PID_{ir} is the price of intermediate input i in region r

aP_{ir} is the unit parameter in the first level of the total cost function

γP_{fir} is the share parameter in the first level of the total cost function.

σP_{ir} is the elasticity of substitution between the composite value-added input and the composite intermediate input.

The associated zero-profit condition, where the total revenue of gross domestic output equals the total cost of production, is

$$PP_{ir} \cdot XD_{ir} = PVA_{ir} \cdot VA_{ir} + PID_{ir} \cdot ID_{ir} + \tau p_{ir} \cdot PP_{ir} \cdot XD_{ir}$$

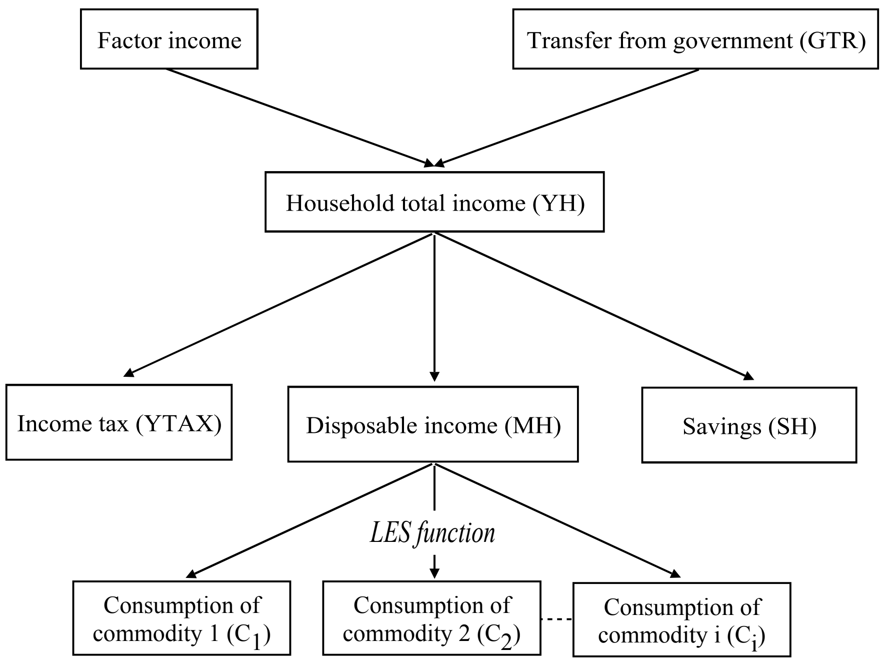
where PP_{ir} is the price of domestic output i in region r (after production tax).

τp_{ir} is the production tax rate for sector i in region r.

2.3 Households

There is a representative household in each region. Each regional household owns the factors of production, and obtains income from selling those factors and through receiving lump-sum government transfers. Household disposable income is its total income less income taxes and saving, and is spent on the consumption of commodities and services. Household saving is modelled as a fixed proportion of post-tax income. The household then makes the optimal allocation between consumption of commodities by maximising a Stone-Geary Utility function (a Linear Expenditure System (LES) function) subject to the constraint of its disposable income. The structure of household activities is shown in figure 4.2.

Figure 4.2: Structure of household activities



Household total income, disposable income and saving can be written as:

$$YH_r = \sum_f PF_{fr} \cdot FS_{fr} - DEP_r + CPI \cdot GTR_r$$

$$MH_r = YH_r - YTAX_r - SH_r$$

$$SH_r = mps_r \cdot (YH_r - YTAX_r)$$

where YH_r is the household total income in region r.

PF_{fr} is the price of factor f in region r.

FS_{fr} is the supply of factor f in region r.

DEP_r is the value of capital depreciation in region r.

GTR_r is the lump sum government transfer in region r.

MH_r is the household disposable income in region r.

$YTAX_r$ is the household income tax in region r.

SH_r is the household saving in region r.

mps_r is the marginal propensity to save in region r.

The household then makes the optimal allocation between consumption of commodities by maximizing Stone-Geary Utility function or Linear Expenditure System (LES) function[5] subject to its budget constraint, which is the disposable income spent on consumption. The optimisation problem is thus:

$$\text{Max} \quad UC_r \; (C_{1r}, \ldots, C_{ir})$$

$$UC_r = \prod_i (C_{ir} - MINC_{ir})^{\alpha C_{ir}} \text{, Where } \sum_i \alpha C_{ir} = 1$$

$$\text{Subject to} \quad \sum_i PC_{ir} \cdot C_{ir} = MH_r$$

Therefore, the demand for household consumption for commodity i is:[6]

[5] See Stone (1954).
[6] The derivation of LES utility function is presented in Appendix 4B.

$$C_{ir} \quad = \quad MINC_{ir} + \frac{\alpha C_{ir}}{PC_{ir}} \cdot (MH_r - \sum_i PC_{ir} \cdot MINC_{ir})$$

where C_{ir} is the household consumption demand of good i in region r.

$MINC_{ir}$ is the subsistence consumption of good i in region r.

PC_{ir} is the consumer price of good i in region r.

αC_{ir} is the consumption expenditure share of good i in region r.

Due to the lack of subsistence consumption data, the expenditure share of consumption can be obtained by making use of the income elasticity of demand.

$$\alpha C_{ir} \quad = \quad \frac{\varepsilon_{ir} \cdot PC_{ir} \cdot C_{ir}}{MH_r}$$

Where ε_{ir} is the income elasticity of demand for good i in region r.

Further, the level of subsistence consumption can be derived when the Frisch parameter is known:

$$MINC_{ir} \quad = \quad C_{ir} + \frac{\alpha C_{ir}}{PC_{ir}} \cdot \left(\frac{MH_r}{frisch_r} \right)$$

where $frisch_r$ is the Frisch parameter.

Summarising, the exogenous parameters required for calibrating the level of subsistence consumption are the income elasticity of demand and Frisch parameters.[7] The values of the income elasticities used in this study are adapted from the income elasticities provided in GTAP database (Dimaranan B. V. et al, Ch. 20, 2006) under the assumption that the income elasticities of demand for agricultural products are relatively inelastic, while the income elasticities of demand for manufactured products are more elastic.

[7] Values of the income elasticity of demand and the Frisch parameters are given in Appendix 4C.

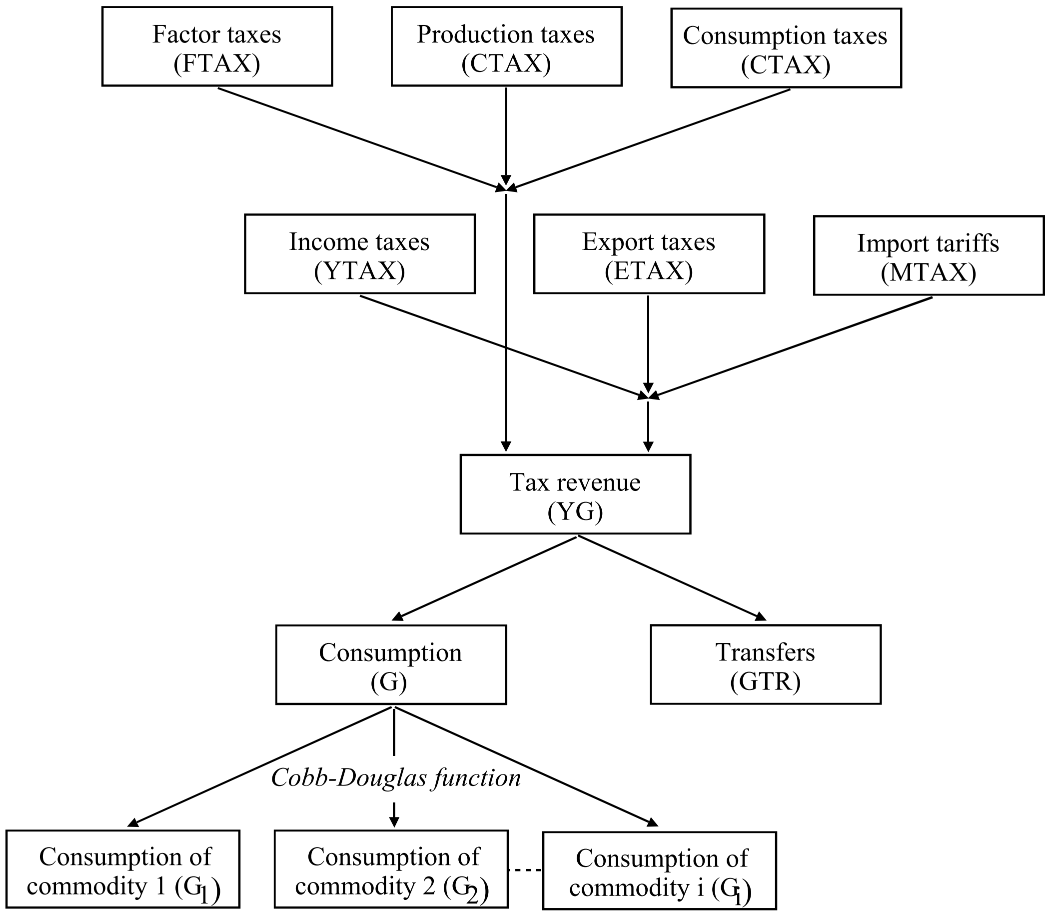
The Frisch parameters for some regions are obtained from reviewing the literature and, for other regions, from estimation. Taylor (1979) suggests that the Frisch parameter is approximately -2.0 for developing countries, as the supernumerary income is about 0.5 for most consumer groups.

However, Taylor's study is largely based on high-income countries. Lluch, C., et al. (1977) argued that the Frisch parameters for low-income countries are much lower. Therefore, in this model, the Frisch parameters for Japan, Korea, Singapore, EU, CER, and NAFTA are assumed to be -2.0. The Frisch parameters for China, Indonesia, and Philippines are taken from Hertel et al. (1997). For Thailand, Malaysia, Vietnam, Rest of ASEAN, and Rest of the World, the Frisch parameters used are based on personal judgement.

2.4 Government

The government in each region is an institutional sector and acts as a consumer. It receives revenue from taxes and tariffs. The government's expenditure, which is assumed to be a fixed proportion of its total revenue, is on the consumption of commodities and services. Government consumption demand is determined by maximising a Cobb-Douglas utility function subject to its expenditure constraint. The residual between government revenues and expenditures is used to make a lump-sum transfer to the region's household. The structure of the government's activities is presented in Figure 4.3.

Figure 4.3: Structure of government activities



We assume that this real government transfer is paid to the household in the form of unemployment benefit. The government allocates the same per capita benefit to each unemployed individual regardless of their level of skill. We assume further that the unemployment benefit per capita is fixed under all policy simulations. Therefore, under this specification, the total level of unemployment benefit payment must depend on the total unemployment level, e.g. unemployment of both skilled and unskilled labour.

Trade liberalisation tends to expand the level of domestic production among FTA member countries, leading to increases in labour demand and thus real wages for both types of labour. Under the Wage Curve assumption used in this study, higher real wages will be associated with lower unemployment in both skilled and unskilled labour.[8] In other words the model would predict that, once trade is liberalised, there will be a residual in the government transfer due to a reduction in total unemployment.[9]

As the unemployment is only specified by types of labour and the unemployment benefit is paid as a lump-sum transfer to a single representative household, the model equations calculate the level of the reduction in both skilled and unskilled unemployment, as well as the reduction in the total government transfer paid through unemployment benefit in each counterfactual compared to the benchmark level.

When the single (regional) household is replaced by highly disaggregated household data to allow the analysis at individual household level reported in chapter 7, the model still predicts the changes in total unemployment level by labour types. However, the model does not seek to identify ‘which’ individual household would be employed more and thus lose unemployment benefit under the counterfactuals. This implies that changes in total unemployment level and total unemployment benefit are determined in such a way that they are smoothly allocated within a single representative household or among individual households.[10]

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[8] The details of the Wage Curve specification are given in section 2.11.2.
[9] The calculation of government transfer residuals is provided in section 2.11.3.
[10] When household is highly-disaggregated, the effects are adjusted for each individual household by specifying fixed share parameters. More explanation of the role of fixed share parameters and how they would affect to the model results are given in section 2 of chapter 7.

The government total revenue in region r is given by:

$$YG_r = FTAX_r + PTAX_r + CTAX_r + MTAX_r + ETAX_r + YTAX_r$$

The model assumes that all tax rates are ad valorem. The regional revenues from taxes that are collected from economy are as follows:

$$FTAX_r = \sum_f \sum_i \tau f_{fir} \cdot PF_{fr} \cdot FD_{fir}$$

$$PTAX_r = \sum_i \tau p_{ir} \cdot PP_{ir} \cdot XD_{ir}$$

$$CTAX_r = \sum_i \tau c_{ir} \cdot PX_{ir} \cdot (C_{ir} + G_{ir} + IV_{ir})$$

$$MTAX_r = \sum_i \sum_s \tau m_{isr} \cdot ER_r \cdot PWM_{isr} \cdot BIT_{isr}$$

$$ETAX_r = \sum_i \sum_s \tau e_{irs} \cdot PE_{ir} \cdot BIT_{irs}$$

$$YTAX_r = \tau y_{ir} \cdot \sum_f PF_{fr} \cdot FS_{fr}$$

where YG_r is the government total revenue in region r.

$FTAX_r$ is the revenue from factor taxes in region r.

$PTAX_r$ is the revenue from production taxes in region r.

$CTAX_r$ is the revenue from consumption taxes in region r.

$MTAX_r$ is the revenue from import tariffs in region r.

$ETAX_r$ is the revenue from export taxes in region r.

$YTAX_r$ is the revenue from income taxes in region r.

Government expenditure is modelled as a fixed proportion of total government revenue.

$$MG_r = shmg_r \cdot YG_r$$

Government transfers to households are then the residual between government revenues and government expenditure:[11]

$$CPI_r \cdot GTR_r \quad = \quad YG_r - MG_r$$

where GTR_r is the lump sum government transfer in region r.

MG_r is the government expenditure in region r.

$shmg_r$ is the government expenditure share in region r.

This government specification implies that lump sum government transfer is also a fixed proportion of total government revenue.

The real government transfer is the nominal government transfer deflated by the Consumer Price Index.

$$RGTR_r \quad = \quad \frac{GTR_r}{CPI_r}$$

The optimal allocation between government purchases of goods and services in region r is derived from maximising the government Cobb-Douglas Utility function:

$$\text{Max} \qquad UG_r\ (G_{1r},\ldots,G_{ir})$$

$$\text{Subject to} \qquad MG_r \quad = \quad \sum_{i=1} PC_{ir} \cdot G_{ir}\,,$$

the CD utility function being $UG_r = \prod_i G_{ir}^{\alpha G_{ir}}$, where $\sum_i \alpha G_{ir} = 1$

Therefore, the demand for government consumption for commodity i is:

$$G_{ir} \quad = \quad \frac{\alpha G_{ir} \cdot MG_r}{PC_{ir}}$$

[11] To make the required model data be consistent with the GTAP database, it is assumed that there is no government saving. The saving in the economy stems from private (household) saving and foreign saving, which will be explained in more detail in section 2.5.

where G_{ir} is government consumption demand for commodity i in region r.

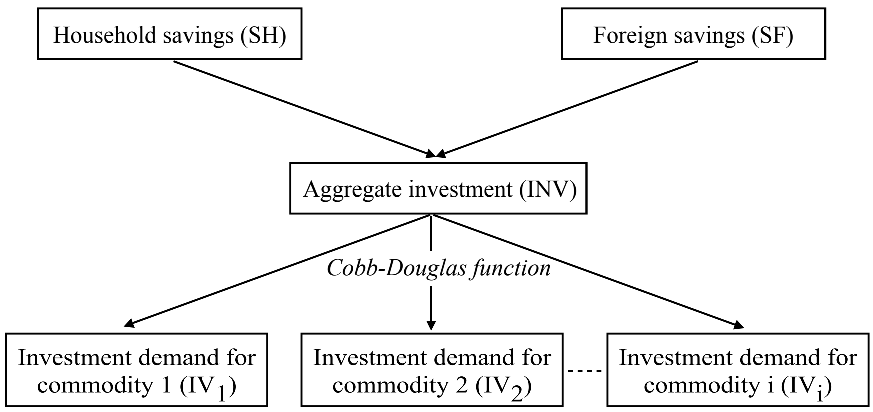
PC_{ir} is the consumer price of commodity i in region r.

αG_{ir} is the government expenditure share of commodity i in region r.

2.5 Investment demand

The investment demand is determined by maximising a Cobb-Douglas utility function subject to the budget constraint of total regional saving, i.e. regional household saving plus foreign saving. The capital endowment is assumed to be fixed at all times.[12] The value of capital depreciation is determined exogenously. The structure of investment is shown in figure 4.4.

Figure 4.4: Structure of investment



The aggregate investment in region r is assumed to equal the total available regional saving, determined by household saving and foreign saving, as follows:

$$INV_r = DEP_r + SH_r - ER_r \cdot SF_r$$

12 Under a static framework, the capital stock is fixed in each region. In contrast, in a dynamic framework, the capital stock is endogenously accumulated through time which would capture the capital accumulation effect due to higher saving and investment. Therefore it should be noted that the results from a static model may underestimate the actual impacts as the dynamic effects are not modelled.

where INV_r is the aggregate investment in region r.

DEP_r is the capital depreciation in region r.

SH_r is the household saving in region r.

SF_r is the foreign saving in region r.

ER_r is the exchange rate in region r.

The value of capital depreciation is modelled as a fixed proportion of capital endowment.

$$DEP_r = \delta k_r \cdot FS_{capital,r}$$

where δk_r is the depreciation rate in region r.

$FS_{capital,r}$ is the total capital endowment in region r.

The investment demand of goods and services i in region r is determined by maximising a Cobb-Douglas utility function:

$$\text{Max} \quad UI\,(IV_{1r}, \ldots, IV_{ir})$$

$$\text{subject to} \quad INV_r = \sum_{i=1} PC_{ir} \cdot IV_{ir}$$

the CD utility function being $UI = \prod_{i=1}^{N} IV_{ir}^{\alpha I_{ir}}$, where $\sum_{i} \alpha I_{ir} = 1$

Therefore the investment demand for commodity i in region r is:

$$IV_{ir} = \frac{\alpha I_{ir} \cdot INV_r}{PC_{ir}}$$

where IV_{ir} is the investment demand for commodity i in region r.

PC_{ir} is the consumer price of commodity i in region r.

αI_{ir} is the investment expenditure share of commodity i in region r.

2.6 International shipping industry

We assume that there is an agent, the international shipping industry,[13] that transports products between regions. The cost of this international transport is paid by the importing country to the international shipping industry. The model assumes that each region allocates a fraction of the output of its transport sector to meet the demand for shipping.

The demand for international shipping of commodity i in region r is determined by a Leontief function, which implies that the transport costs/margins are route- and commodity-specific. The international shipping industry then allocates transport services to each region according to a Cobb-Douglas function. The overall structure of the international shipping industry is shown in figure 4.5. The demand of international shipping of commodity i in region r is generated by fixed coefficients which are commodity and route specific.

$$TRD_{ir} = \frac{1}{PT} \cdot \left(\sum_{s} \tau tr_{irs} \cdot PWE_{irs} \cdot BIT_{irs}\right)$$

where TRD_{ir} is the demand for transports services of commodity i in region r.

BIT_{irs} is the bilateral trade between exporting region r and importing region s.

PT is the price of transport.

PWE_{irs} is the world export price (f.o.b.) from region r to s.

τtr_{irs} is the transport cost/margin of commodity i from region r to region s.

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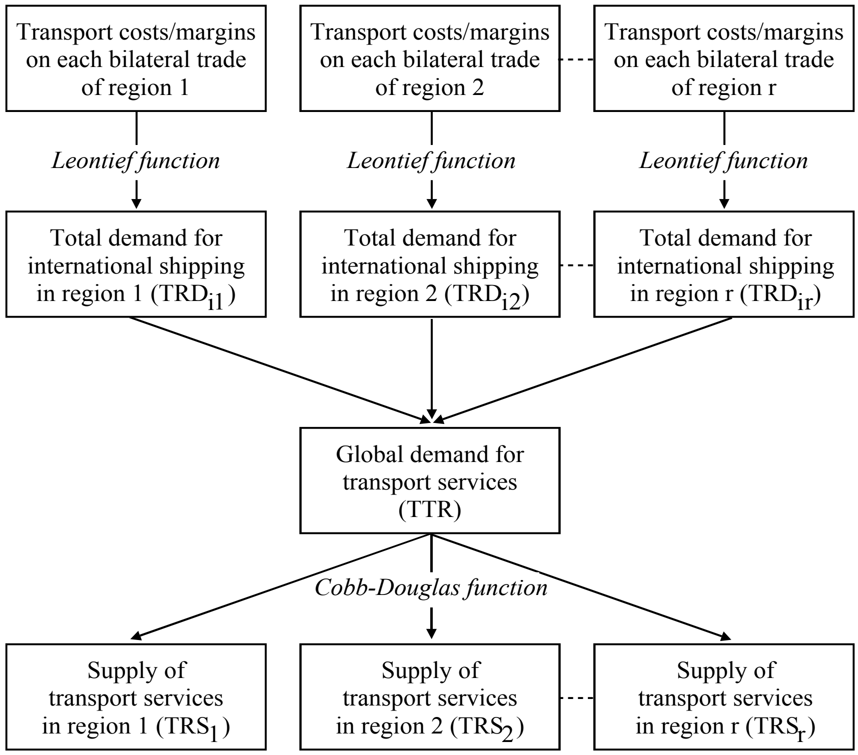
13 The concept of an international shipping industry is based on the same concept of the global pool for trade and transport margins in the GTAP model. This pool supplies all the demands for (the import of) trade and transport margins, and then purchases all the supply of (the export of) trade and transport margins to balance the transport market. Of course, it is not necessary for the transport balance in each region to be zero. However, the global pool for transport balance must clear. (McDonald and Thierfelder, 2004).

Figure 4.5: Structure of international transports



The supply of transports services is allocated to each region using a Cobb-Douglas. The value of regional supply is, therefore, a share of the value of global supply.

$$TRS_r = \frac{shtr_r \cdot ER_r}{PP_{tran,r}} \cdot PT \cdot TTR$$

where TRS_r is the supply of transport services in region r.

TTR is the global supply of transport services.

$PP_{trn,r}$ is the domestic price of transport commodity in region r.

ER_r is the exchange rate in region r.

$shtr_r$ is the share parameter of transport services in region r.

When all prices are normalized to unity, the share parameter of transport services in each region is simply a fixed proportion to global services:

$$shtr_r = \frac{TRS_r}{TTR}$$

The total demand of international shipping in every region must equal its global supply in the equilibrium:

$$TTR = \sum_r \sum_i TRD_{ir}$$

Thus the associated zero profit condition for the international shipping industry is that the value of global returns equals the sum of regional costs.

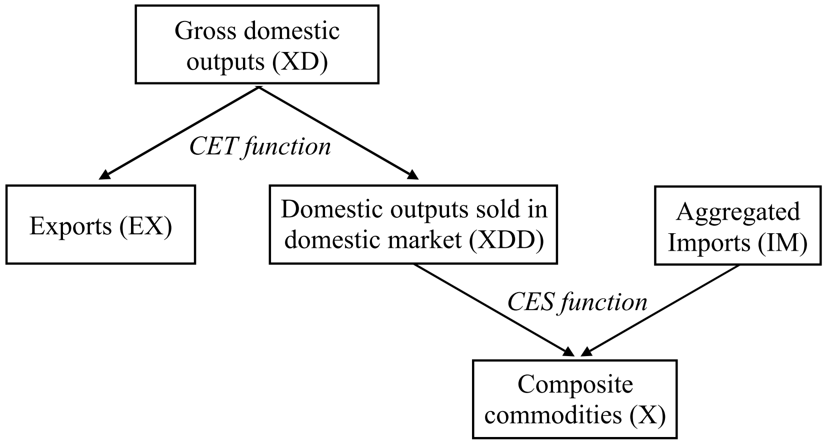
$$TTR = \frac{1}{PT} \cdot \sum_r \frac{PP_{tran,r}}{ER_r} \cdot TRS_r$$

2.7 Foreign trade

The standard approach to modelling international trade in CGE models is to make "the Armington assumption", which differentiates otherwise identical products by their country of origin (Armington, 1969). Therefore, on the supply side, outputs for the domestic market and for exports are imperfectly transformable; while, on the demand side, the domestic product sold on the domestic market and imports to that market are imperfectly substitutable.

The assumption is widely adopted because (1) it accommodates 'cross-hauling' or 'two-way' trade, which better reflects the reality of most countries' trade patterns, and (2) it is still consistent with the perfect competition assumption. Here, the composite commodities are produced by the use of domestically produced and imported goods via a CES production function, while domestic production is allocated to the domestic market and to exports using a CET function. The structure of foreign trade is shown in Figure 4.6.

Figure 4.6: Structure of foreign trade



To produce the composite commodity, a firm has to minimise its total cost subject to the CES production function:

$$\text{Min} \qquad TC_{ir} = PM_{ir} \cdot IM_{ir} + PDD_{ir} \cdot XDD_{ir},$$

$$\text{subject to } X_{ir} = aD_{ir} \cdot \left(\gamma D_{ir} \cdot XDD_{ir}^{\frac{\sigma D_{ir}-1}{\sigma D_{ir}}} + (1-\gamma D_{ir}) \cdot IM_{ir}^{\frac{\sigma D_{ir}-1}{\sigma D_{ir}}} \right)^{\frac{\sigma D_{ir}}{\sigma D_{ir}-1}}$$

where IM_{ir} is the aggregated imports of good i by region r.

XDD_{ir} is the domestically production of good i in region r.

X_{ir} is the composite commodity i in region r.

PM_{ir} is the price of imported good i in region r.

PDD_{ir} is the price of domestically produced good i in region r.

PX_{ir} is the price of composite commodity i in region r.

aD_{ir} is the unit parameter in the first level of the Armington aggregation.

γD_{ir} is the share parameter in the first level of the Armington aggregation

σD_{ir} is the elasticity of substitution between domestic and imported goods.

The first order condition for this problem is:

$$\frac{\gamma D_{ir}}{1-\gamma D_{ir}} \cdot \left(\frac{XDD_{ir}}{IM_{ir}}\right)^{-1/\sigma D_{ir}} = \frac{PM_{ir}}{PDD_{ir}}$$

This condition ensures that an increase in the domestic-import price ratio causes an increase in the import-domestic demand ratio. In other words, the demand shifts away from the more expensive source.

The demand equations for domestically produced and imported goods are:

$$XDD_{ir} = \left(\frac{1}{aD_{ir}}\right)^{1-\sigma D_{ir}} \cdot \left(\gamma D_{ir} \cdot \frac{PX_{ir}}{PDD_{ir}}\right)^{\sigma D_{ir}} \cdot X_{ir}$$

$$IM_{ir} = \left(\frac{1}{aD_{ir}}\right)^{1-\sigma D_{ir}} \cdot \left((1-\gamma D_{ir}) \cdot \frac{PX_{ir}}{PM_{ir}}\right)^{\sigma D_{ir}} \cdot X_{ir}$$

The associated zero profit condition is:

$$PX_{ir} \cdot X_{ir} = PDD_{ir} \cdot XDD_{ir} + PM_{ir} \cdot IM_{ir}$$

The imperfect transformation assumption is applied to goods produced for the domestic market and for exports. Thus, each firm maximises its total revenue subject to the CET function constraint:

$$\text{Max} \quad TR_{kr} = PE_{kr} \cdot EX_{kr} + PDD_{kr} \cdot XDD_{kr}$$

$$\text{Subject to } XD_{kr} = aT_{kr} \cdot \left(\gamma T_{kr} \cdot XDD_{kr}^{\frac{\sigma T_{kr}-1}{\sigma T_{kr}}} + (1-\gamma T_{kr}) \cdot EX_{kr}^{\frac{\sigma T_{kr}-1}{\sigma T_{kr}}}\right)^{\frac{\sigma T_{kr}}{\sigma T_{kr}-1}}$$

where XD_{kr} is the gross domestic output of k in region r.

XDD_{kr} is the supply of the domestic good k in region r.

EX_{kr} is the export of good k in region r.

PP_{kr} is the price of gross domestic output k in region r.

PDD_{kr} is the price of domestic good k in region r.

PE_{kr} is the price of export good k in region r.

aT_{kr} is the unit parameter in the CET function.

γT_{kr} is the share parameter in the CET function.

σT_{kr} is the elasticity of transformation between domestic and export goods.

Note: Set "k" refers to all tradable goods except the transport good. The optimality problem for transport sector is derived separately from other goods, since we assumed in section 2.6 that each region will allocate a fraction of the output of transports sector to satisfy the demand for shipping.

Then the demand equations for domestically produced and exports are derived as:

$$EX_{kr} = \left(\frac{1}{aT_{kr}}\right)^{1-\sigma T_{kr}} \cdot \left((1-\gamma T_{kr}) \cdot \frac{PP_{kr}}{PE_{kr}} \right)^{\sigma T_{kr}} \cdot XD_{kr}$$

$$XDD_{kr} = \left(\frac{1}{aT_{kr}}\right)^{1-\sigma T_{kr}} \cdot \left(\gamma T_{kr} \cdot \frac{PP_{kr}}{PDD_{kr}} \right)^{\sigma T_{kr}} \cdot XD_{kr}$$

The associated zero profit condition is:

$$PP_{kr} \cdot XD_{kr} = PE_{kr} \cdot EX_{kr} + PDD_{kr} \cdot XDD_{kr}$$

According to section 2.6, based on the same principles as above, the optimal provision of transportation goods is determined by:

$$\text{Max} \quad TR_{tran,r} = PE_{tran,r} \cdot EX_{tran,r} + PDD_{tran,r} \cdot XDD_{tran,r}$$

$$\text{Subject to } (XD_{tran,r} - TRS_r) = aT_{tran,r} \cdot \left(\gamma T_{tran,r} \cdot XDD_{tran,r}^{\frac{\sigma T_{tran,r}-1}{\sigma T tran,r}} + (1-\gamma T_{tran,r}) \cdot EX_{tran,r}^{\frac{\sigma T_{tran,r}-1}{\sigma T tran,r}} \right)^{\frac{\sigma T_{tran,r}}{\sigma T_{tran,r}-1}}$$

Note: Set "tran" refers to the transport good.

The demand equations for domestic and export outputs are:

$$EX_{tran,r} = \left(\frac{1}{aT_{tran,r}}\right)^{1-\sigma T_{tran,r}} \cdot \left((1-\gamma T_{tran,r}) \cdot \frac{PP_{tran,r}}{PE_{tran,r}}\right)^{\sigma T_{tran,r}} \cdot (XD_{tran,r} - TRS_r)$$

$$XDD_{tran,r} = \left(\frac{1}{aT_{tran,r}}\right)^{1-\sigma T_{tran,r}} \cdot \left(\gamma T_{tran,r} \cdot \frac{PP_{tran,r}}{PDD_{tran,r}}\right)^{\sigma T_{tran,r}} \cdot (XD_{tran,r} - TRS_r)$$

and the associated zero profit condition is:

$$PP_{tran,r} \cdot XD_{tran,r} = PE_{tran,r} \cdot EX_{tran,r} + PDD_{tran,r} \cdot XDD_{tran,r} + PP_{tran,r} \cdot TRS_r$$

Both model specifications lead to the first order condition:

$$\frac{\gamma T_{ir}}{1-\gamma T_{ir}} \cdot \left(\frac{XDD_{ir}}{EX_{ir}}\right)^{-1/\sigma T_{ir}} = \frac{PE_{ir}}{PDD_{ir}}$$

This condition ensures that an increase in the export-domestic price ratio causes an increase in the export-domestic demand ratio. In other words, the demand shifts towards the higher return source.

The balance of trade in a particular region is the value of exports in commodity and trade margins minus the value of imports. The regional trade balance can be in deficit or surplus, depending upon the imports and exports demand. However, the global trade balance must be zero to ensure that the values of bilateral trade flows are cleared.

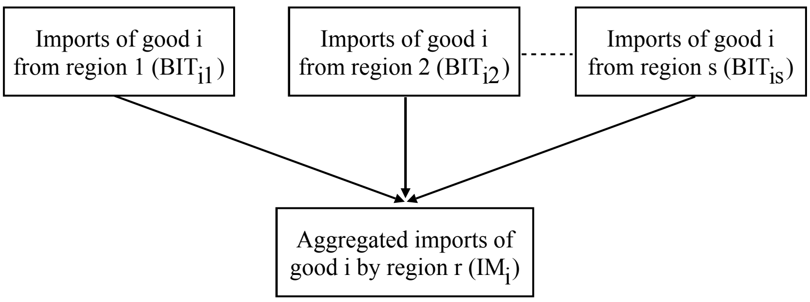
$$SF_r = \sum_i \sum_s PWE_{irs} \cdot BIT_{irs} + \frac{1}{ER_r} \cdot PP_{tran,r} \cdot TRS_r - \sum_i \sum_s PWM_{isr} \cdot BIT_{isr}$$

$$\sum_r SF_r = 0$$

2.8 Aggregate import and export demand

Products are differentiated according to their region of origin. On the demand side, the domestic consumers discriminate between the domestically produced and imported goods in the first level of Armington aggregation. They then discriminate between imported products from different sources in the second level of Armington aggregation; i.e. imports from different regions are imperfect substitutes. On the supply side, the domestic outputs delivered to domestic market are differentiated from products produced for export by the same sector. However, producers only differentiate output sold in domestic and foreign markets, i.e. they do not differentiate exports by destination. The structure of aggregate import and export demand is shown in figure 4.7.

Figure 4.7: Structure of aggregate import and export demand



The imports of good i from region s to r are represented in a CES functional form as:

$$\mathrm{BIT}_{isr} = \left(\frac{1}{aM_{ir}}\right)^{1-\sigma M_{ir}} \cdot \left(\gamma M_{isr} \cdot \frac{PM_{ir}}{(1+\tau m_{isr})\cdot ER_r \cdot PWM_{isr}}\right)^{\sigma M_{ir}} \cdot IM_{ir}$$

where $\sum_{s} \gamma M_{isr} = 1$

and $\quad BIT_{isr}$ is the imports of good i from region s to r.

$\quad IM_{ir}$ is the aggregated imports of good i in region r.

PM_{ir} is the price of the aggregated imports of good i in region r.

PWM_{isr} is the world import price (c.i.f.) of good i from region s to region r.

ER_r is the exchange rate in region r.

τm_{isr} is the import tariff rate of good i from region s to region r.

aM_{ir} is the unit parameter in the second level of the Armington aggregation

γM_{ir} is the share parameter in the second level of the Armington aggregation

σM_{ir} is the elasticity of substitution between imported goods.

The associated zero profit condition is that the total value of aggregated imports of good i in region r must equal the total value of imports of good i from region s to region r.

$$PM_{ir} \cdot IM_{ir} = \sum_s \left((1+\tau m_{isr}) \cdot ER_r \cdot PWM_{isr} \cdot BIT_{isr} \right)$$

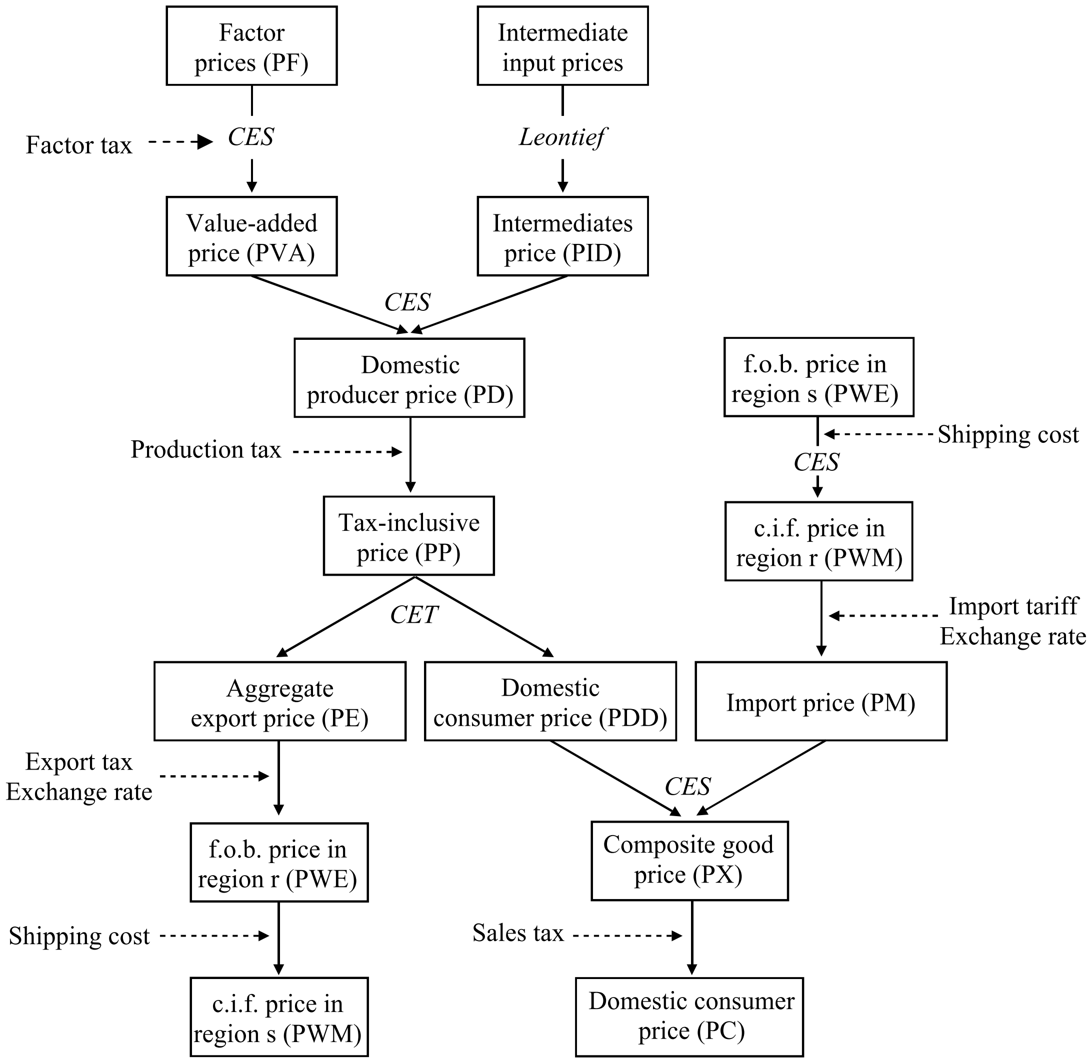
Similarly, we know that the total value of the aggregated exports of commodity i by region r must equal the total value of exports of good i from region r to region s, and that producers differentiate output sold in domestic and foreign markets, but do not differentiate exports by destinations, giving the following equation.

$$EX_{ir} = \frac{1}{PE_{ir}} \cdot \sum_s \left(\frac{ER_r}{(1+\tau e_{irs})} \cdot PWE_{irs} \cdot BIT_{irs} \right)$$

2.9 Price system

There are eight prices associated with each good in each region: average output price, composite good price, domestic consumer price, domestic producer price, export price, import price, f.o.b. price, and c.i.f. price. The average output price is a tax-inclusive CET aggregation of domestic and export prices. The composite good price is a tax-inclusive CES aggregation of domestic and import prices, which in turn is an aggregation of tariff-inclusive import prices from different sources. The domestic consumer price is the composite good price, i.e. including the sales tax.

Figure 4.8: Structure of the price system



The f.o.b. price of each Armington good is the export price plus any export taxes or less any export subsidies, the producers receiving this price. The f.o.b. price plus the appropriate international transportation margin gives the c.i.f. price. Finally, the exchange rate acts as the converter between world market prices and domestic prices.

The relationships between these prices are illustrated in figure 4.8, where

PF	is the factor price
PVA	is the aggregated value-added input price
PID	is the intermediate input price
PD	is the domestic output price
PP	is the tax inclusive domestic output price
PE	is the aggregated exports price
PWE	is the f.o.b. price
PDD	is the domestic price
PM	is the imports price
PWM	is the c.i.f. price
PX	is the composite good price
PC	is the domestic consumer price

The aggregated value added price of good i in region r is specified as:

$$PVA_{ir} = \frac{1}{aV_{ir}} \left(\sum_f \gamma V_{fir}^{\sigma V_{ir}} \cdot (1 + \tau f_{fir})\, PF_{fr}^{1-\sigma V_{ir}} \right)^{\frac{1}{1-\sigma V_{ir}}} \quad (1)$$

The domestic output price of good i in region r is specified as:

$$PD_{ir} = \frac{1}{aP_{ir}} \left(\gamma P_{ir}^{\sigma P_{ir}} \cdot PID_{ir}^{1-\sigma P_{ir}} + (1-\gamma P_{ir})^{\sigma P_{ir}} \cdot PVA_{ir}^{1-\sigma P_{ir}} \right)^{\frac{1}{1-\sigma P_{ir}}} \quad (2)$$

The tax inclusive domestic output price of good i in region r is specified as:

$$PP_{ir} = \frac{1}{aT_{ir}} \left(\gamma T_{ir}^{\sigma T_{ir}} \cdot PDD_{ir}^{1-\sigma T_{ir}} + (1-\gamma T_{ir})^{\sigma T_{ir}} \cdot PE_{ir}^{1-\sigma T_{ir}} \right)^{\frac{1}{1-\sigma T_{ir}}} \quad (3)$$

The composite commodity price of good i in region r is specified as:

$$PX_{ir} = \frac{1}{aD_{ir}} \left(\gamma D_{ir}^{\sigma D_{ir}} \cdot PDD_{ir}^{1-\sigma D_{ir}} + (1-\gamma D_{ir})^{\sigma D_{ir}} \cdot PM_{ir}^{1-\sigma D_{ir}} \right)^{\frac{1}{1-\sigma D_{ir}}} \quad (4)$$

Equations (1), (2) and (4) are unit cost functions, while equation (3) is the unit revenue function. Where CES and CET functional forms are used in the model, their quantity aggregator function is homogenous of degree one. Therefore, the total costs can be written as the total quantity multiplied by the unit cost. This implies that the average cost, under cost minimisation (or revenue maximisation), is independent of the number of units produced or purchased. These unit costs equal the corresponding producer prices of the commodities in the long-run perfectly competitive equilibrium.

The price of an aggregated intermediate input is the sum of the values of its composite commodity content weighted by the appropriate input-output coefficients.

$$PID_{ir} = \sum_{ii} ioc_{i,ii,r} \cdot PX_{ir}$$

The gap between composite commodity price and consumer price of good i in region r is determined by the sales tax.

$$PC_{ir} = (1 + \tau c_{ir}) \cdot PX_{ir}$$

The export price reflects the price received by the domestic producers for selling their output on the foreign market, while the world export price is the f.o.b. price that already included export tax/subsidy within.

$$PWE_{isr} = (1 + \tau e_{irs}) \cdot \frac{1}{ER_r} \cdot PE_{ir}$$

The difference between the world export price (f.o.b.) of good i from region s to r and the world import price (c.i.f.) of the same good of region r from s is transportation costs/margins.

$$PWM_{isr} = (1 + \tau tr_{isr}) \cdot PWE_{isr}$$

The Consumer Price Index (CPI) used is of the Laspeyres form and is defined as:

$$CPI_r = \frac{\sum_i PC_{ir} \cdot C0_{ir}}{\sum_i PC0_{ir} \cdot C0_{ir}}$$

where "0" signifies the initial period.

The real wages of skilled- and unskilled labour are defined as nominal wage deflated by Consumer Price index:

$$REALWAGE_{FL,r} = \frac{PF_{FL,r}}{CPI_r}$$

The wage differential between skilled labour and unskilled labour in region r is specified as:

$$WAGEDIFF_r = \frac{PF_{sklab,r}}{PF_{uklab,r}} - 1$$

2.10 Market clearing conditions

The commodity markets clear, i.e. demand for each commodity must equal its supply at the prevailing prices. Regional factor endowments are exogenously determined, and the factor markets must clear if full capital usage and full employment are assumed.

2.10.1 Commodity markets

The clearing of the commodity markets requires that demand for each type of commodity is equal to supply at the specified prices. The commodity market clearing equation is given by:

$$X_{ir} = C_{ir} + G_{ir} + IV_{ir} + \sum_{ii} ioc_{i,ii,r} \cdot ID_{ii,r}$$

where X_{ir} is the composite commodity i in region r.

C_{ir} is the household consumption demand of commodity i in region r.

G_{ir} is the government consumption demand of commodity i in region r.

IV_{ir} is the investment demand of commodity i in region r.

ID_{ir} is the intermediate demand of commodity i in region r.

$ioc_{i,ii,r}$ is the input-output coefficient of intermediate demand for commodity i used in sector ii in region r.

2.10.2 Factor markets

CGE modelling routinely assumes that capital and labour endowments are exogenously determined. The factor markets clear under the assumptions of full capital usage and full employment. Therefore, based on the same principle as factor markets, the aggregate factor demand for factor f used in sector i must equal the total factor supply of factor f in each particular region, i.e.

$$\sum_i FD_{fir} = FS_{fr}$$

where FD_{fir} is the demand for factor f used in sector i in region r.

FS_{fr} is the supply of factor f in region r.

2.11 Introducing the labour market imperfection

2.11.1 Imperfect labour markets

The standard factor market assumption leaves no room for the possibility of unemployment. However, in reality, there is unemployment in all countries, whether voluntary or involuntary. Incorporating unemployment in the CGE model yields two major advantages. First, the specification of the labour market better reflects reality. Second, it enriches the analysis of the impact of a Free Trade Area on employment for each type of labour in a particular region. We would expect that the formation of a Preferential Trading Area, although discriminatory, will tend to promote convergence between the wages of both skilled and unskilled labour in the member countries, and reduce unemployment, particularly of the unskilled.

2.11.2 Wage Curve

Unemployment is incorporated into the model by using the 'wage curve', first introduced by Blanchflower and Oswald (1994). The wage curve for each type of labour implies a negative relationship between the real wage rate and the unemployment rate.

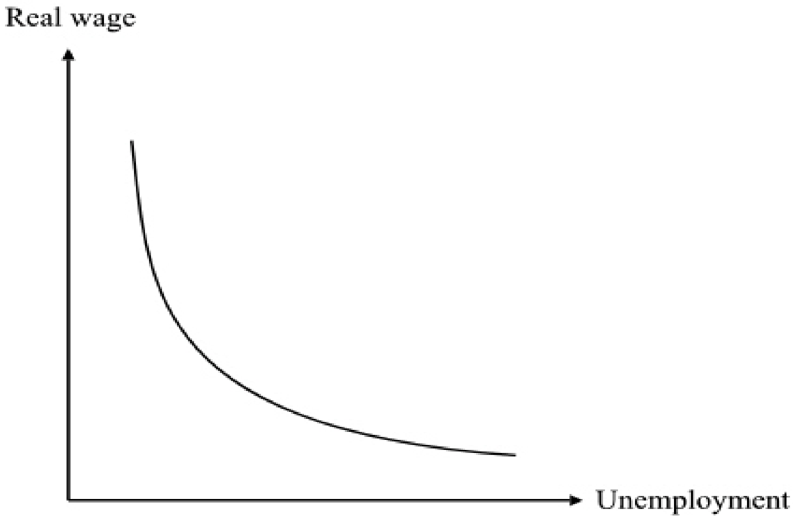
The authors argue that the conventional unemployment theories illustrated by Phillips curve and Harris-Todaro model are misleading, and that stable (and common) wage curves are a better representation of the wage-unemployment relationship. The wage curve formula is logarithmic in form:

$$\ln w = -0.1 \ln U$$

where *w* is the real wage rate, *U* is the unemployment rate, and -0.1 is the (constant) elasticity of the real wage with respect to unemployment.[14]

[14] There are two main criticisms of the wage curve concept. First, do country data would any evidence that is consistent with the wage curve relationship. Second, is a uniform elasticity of -0.1 robust. Blanchflower and Oswald (2005) point out that since the introduction of the wage curve in 1994 it has been reported to exist in 43 countries around the world, both developed and developing. They showed that wage curve does exist even in the most controversial case of USA data. In addition, the authors are very positive about the estimation of the regular and uniform value of -0.1 of the elasticity in different countries during different time periods. Recently, Nijkamp and Poot (2005) reported on a meta-analysis of 208 elasticities and found that the 'unbiased' wage curve elasticity is about -0.07. Blanchflower and Oswald then concluded that "Most economists are unlikely to feel strongly about the possible difference between a wage curve elasticity estimate of -0.07 and one of

Figure 4.9: The wage curve



Blanchflower and Oswald (1995) argue that the effect of unemployment upon wage should be based on efficiency wage theory, in which firms set a rate of pay that is high enough to maintain a motivated workforce.

In the equilibrium, firms maximise their profits while workers decide on how much effort they will use when working. In a situation where the unemployment rate is high, firms can reduce the rate of pay because the workers are afraid of losing their jobs. Therefore the workers will still put a high effort to working even though the wage is relatively low.

Since the introduction of wage curve, there are a growing number of studies which have adopted the wage curve in a CGE framework in many areas. For example, Cury et al. (2004); Davies and Rattso (2000); Humphreys (2000); and Magubu and Chitiga (2007) all use the wage curve in the context of poverty and the distribution of

-0.1. What matters more is whether there are countries in which a wage curve cannot reliably be found…"(p.4).

income. Models that use the wage curve specification in the analysis of trade and labour market linkages can be found in Carneiro and Abbache (2003) and De Santis (2003). The wage curve has also been used in the analysis of energy policy and sustainability by Böhringer and Löschel (2006) and Küster et al. (2007).

2.11.3 Incorporating unemployment in the CGE model

In order to incorporate the concept of wage curve and unemployment, the model is modified as follows.

(1) *Total household income:*

$$YH_r = PF_{capital,r} \cdot FS_{capital,r} - DEP_r + \sum_{FL} PF_{FL,r} \cdot (FS_{FL,r} - UNEMP_{FL,r}) + CPI_r \cdot GTR_r$$

(N.B. uklab and sklab $\in$ FL $\in$ F)

where YH_r is total household income

PF_{fr} is the factor price

FS_{fr} is the supply of labour (or the labour endowment)

DEP_r is the value of capital depreciation

CPI_r is the consumer price index

GTR_r is the lump sum government transfer

and $UNEMP_{FL,r}$ is the level of unemployment of labour

The total household income comprises income from the capital and employed-labour endowments plus the lump sum transfer from the government.

(2) *Labour market clearing conditions:*

$$\sum_i FD_{uklab,i,r} = FS_{uklab,r} - UNEMP_{uklab,r}$$

$$\sum_i FD_{sklab,i,r} = FS_{sklab,r} - UNEMP_{sklab,r}$$

In the traditional CGE framework the endowment must be fully employed. Since the full employment assumption has been relaxed, the definition of labour endowment is redefined in such a way that part of that endowment can be unemployed, so that in each region, the sum of sectoral labour demands is equal to the employed labour endowment in that region. The unemployment data are exogenously specified using data taken from the World Development Indicators compiled by the World Bank.

(3) ***Wage curves:***

The level of unemployment in each region is as an exogenous variable in the benchmark equilibrium, and the unemployment level in a simulated equilibrium is endogenously determined by the wage curve.

As the model has two types of labour, unskilled and skilled, there are two wage curves:[15]

$$\left[\frac{PF_{uklab,r}\,/\,CPI_r}{PF0_{uklab,r}\,/\,CPI0_r}-1\right] = -0.1 \times \left[\frac{UNEMP_{uklab,r}\,/\,FS_{uklab,r}}{UNEMP0_{uklab,r}\,/\,FS0_{uklab,r}}-1\right]$$

$$\left[\frac{PF_{sklab,r}\,/\,CPI_r}{PF0_{sklab,r}\,/\,CPI0_r}-1\right] = -0.1 \times \left[\frac{UNEMP_{sklab,r}\,/\,FS_{sklab,r}}{UNEMP0_{sklab,r}\,/\,FS0_{sklab,r}}-1\right]$$

where $PF_{FL,r}$ is the wage rate, $Fs_{FL,r}$ is the supply of labour, $UNEMP_{FL,r}$ is the level of unemployment, and CPI_r is the consumer price index

(N.B. the "0" denotes the initial equilibrium)

[15] The derivation of the Wage Curve is presented in Appendix 4D.

(4) ***Unemployment benefit per head and Government transfer residual***

As it has been assumed that the real government transfer is paid to the household in the form of unemployment benefit, the unemployment benefit per capita is calculated as

$$\mathrm{BENEFIT}_{\mathrm{uklab,r}} \quad = \quad \frac{\mathrm{shulb}_{\mathrm{uklab,r}} \cdot \mathrm{RGTR}_{\mathrm{r}}}{\mathrm{UNEMP}_{\mathrm{uklab,r}}}$$

$$\mathrm{BENEFIT}_{\mathrm{sklab,r}} \quad = \quad \frac{\mathrm{shslb}_{\mathrm{sklab,r}} \cdot \mathrm{RGTR}_{\mathrm{r}}}{\mathrm{UNEMP}_{\mathrm{sklab,r}}}$$

The unemployment benefit per head is assumed to be fixed throughout the simulations, so that there will be a government transfer residual as a result of unemployment reduction in member economies:

$$\mathrm{LGTR}_{\mathrm{r}} \quad = \quad \mathrm{RGTR}_{\mathrm{r}} - \sum_{\mathrm{FL}} (\mathrm{UNEMP}_{\mathrm{FL,r}} \cdot \mathrm{BENEFIT}_{\mathrm{FL,r}})$$

where $\mathrm{BENEFIT}_{\mathrm{FL,r}}$ is the benefit paid to unemployed workers, $\mathrm{shulb}_{\mathrm{uklab,r}}$ is the unemployment rate for unskilled labour, $\mathrm{shslb}_{\mathrm{sklab,r}}$ is the unemployment rate for skilled labour, $\mathrm{RGTR}_{\mathrm{r}}$ is the real government transfer, $\mathrm{LGTR}_{\mathrm{r}}$ is the government transfer residual, and $\mathrm{UNEMP}_{\mathrm{FL,r}}$ is the level of unemployment.

It should be noted that the residual of the government transfer does not explicitly enter into the set of model equations. It can however be calculated once the model equations have been solved, so that the modeller can calculate the payment of unemployment benefits compared to the initial level. To ensure that there will not be any leakage of money flow from the government sector, we then assume that the government residual will be transferred back to the household in general, which can be viewed as an additional benefit or as an income tax abatement.

2.12 Macroeconomic indicators (GDP)

According to the model, Gross Domestic Products at fixed prices and at current prices are defined as:

$$GDPR_r = \sum_i PC0_{ir} \cdot (C_{ir} + G_{ir} + IV_{ir}) + ER0_r \cdot SF_r$$

$$GDPC_r = \sum_i PC_{ir} \cdot (C_{ir} + G_{ir} + IV_{ir}) + ER_r \cdot SF_r$$

where GDP_r is GDP at fixed prices in region r.

$GDPC_r$ is GDP at current prices in region r.

C_{ir} is the household consumption of commodity i in region r.

G_{ir} is the government consumption of commodity i in region r.

IV_{ir} is the investment demand of commodity i in region r.

SF_r is the current account balance in region r.

$PC0_{ir}$ is the initial consumer price of commodity i in region r.

$ER0_r$ is the initial exchange rate in region r.

2.13 Welfare evaluation

The Equivalent Variation (EV) is used to evaluate the overall change in consumer welfare, and is expressed in terms of billions of US dollars. The equivalent variation, based on a money metric indirect utility function,[16] can be expressed as:

$$EV_r = \frac{SN_r}{PINDEX_r} - SN0_r$$

[16] The derivation of the Equivalent Variation (EV) is given in Appendix 4E.

$$PINDEX_r = \frac{\prod_i PC_{ir}^{\alpha C_{ir}}}{\prod_i PC0_{ir}^{\alpha C_{ir}}}$$

$$SN_r = MH_r - \sum_i PC_{ir} \cdot MINC_{ir}$$

$$SN0_r = MH0_r - \sum_i PC0_{ir} \cdot MINC_{ir}$$

where EV_r is the equivalent variation.

SN_r is the supernumerary income.

$PINDEX_r$ is the index of the prices in the counterfactual scenario relative to the initial prices.

PC_{ir} is the consumer price.

(N.B. the subscript "0" denotes the initial equilibrium)

2.14 Numéraire and model closure

The model must be solved under the condition that the number of endogenous variables equals the number of equations. To fulfil this requirement, we need to specify the model closure in such a way that it will accommodate the mathematical solving and reflect reality reasonably.

2.14.1 Saving-investment balance

Household saving is assumed to be a fixed proportion of disposable income. Assuming that there is no government saving, domestic investment is therefore determined by household saving plus foreign saving, which is exogenous.

2.14.2 Government balance

The value of government expenditure is a fixed proportion of government revenue. The difference between government revenue and expenditure is then a lump sum transfer paid to the household in the form of unemployment benefit. Under the assumed revenue neutral policy, the government funds any loss in import tariff revenue by adjusting income tax rates to maintain the balance. Thus, the income tax rate is endogenous.

2.14.3 External balance

The external balance, which is defined by the current account balance in foreign currency, is fixed. This implies that the exchange rate must adjust. The current account balance in each region can be positive or negative, but the global current account balance or global external balance must be zero.

2.14.4 Numéraire

The Consumer Price Index (CPI) in each region is selected as the numéraire price for that region. We also fix the exchange rate of China as an 'international' numéraire.[17]

$$ER_{china} = 1$$

[17] The 'standard GTAP model' specifies the exchange rate as the numéraire for each region. However, Lewis, Robinson and Thierfelder (1999) have proposed that, in models in which regional trade balances at equilibrium are not zero, it is important to define a regional numéraire in each region, usually the consumer price index, and an 'international' numéraire of a reference country/region. The advantage of this technique is that it will yield the solution values of the exchange rate in each region in real terms and can be viewed as equilibrium price-level-deflated exchange rates. More discussion of the role of real exchange rate can be found in De Melo and Robinson (1989) and Devarajan, Lewis, and Robinson (1993).

2.14.5 Variables forced to be zero

As the data used in this multi-country, multi-sector CGE model are actual data, some trade-related variables may appear as zero in the national accounts. This simply means that there is no international trade in some particular bilateral flows. Hence, the world export and import prices of these non-traded goods are set to zero. The quantities of exports and imports, as well as export and import prices, of the non-traded goods are also set to zero.

2.14.6 Walras law

Global external balance is set to ensure that the sum of regional trade balances must be zero – the value of global exports must equal the value of global imports. In order to avoid the model redundancy problem, this equation will be dropped. According to Walras' law if (n-1) markets are cleared then the n^{th} market is also cleared; hence, the zero global current account balance is guaranteed through the system of equations.

3. Conclusion

The objective of this chapter is to develop a static 14-region, 14-sector Computable General Equilibrium (CGE) model for assessing and comparing the quantitative economic impacts in both domestic and international level of four different possible FTA options for East Asian economies. The main distinctive feature is the incorporation of unemployment into the CGE model with the intention of assessing the changes in the real wage and unemployment in each region under each of those options. Incorporating unemployment in the CGE model yields two major advantages: (a) the specification of the labour market better reflects reality; (b) it enriches the analysis of the impact of a Free Trade Area on employment for each type of labour in a particular region. The model is calibrated to GTAP database version 6, which reflects the global economy in 2001. The details of model calibration and SAM construction are presented in Chapter 5. The analysis of the results derived from the use of the model is provided in Chapter 6.

Chapter 5

Model calibration and construction of the SAM

1. Introduction

This chapter presents the sources of data and the description of sets and parameters used in this thesis. The benchmark data used are taken mainly from the GTAP database version 6, based on the global economy in 2001. Explanations of the model calibration and the construction of the SAM are also given. Since we assume that the world economy and the regions represented by the benchmark data are in equilibrium; the calibrated parameters should (and do) reproduce the initial data in each case.

2. Data sources and the software

2.1 The GTAP Database

GTAP[1] (Global Trade Analysis Project) is a global network of researchers and policy makers conducting quantitative analysis of international policy issues. As well as providing both technical support and publications related to the quantitative analysis of global economic issues, GTAP also provides a consistent global database and related documentation which is considerably helpful for a CGE modeller seeking to analyse the impact of policy under a global or multi-country framework. The database used in the East Asia CGE model is based on the latest GTAP database (version 6), which was released in 2006. The database corresponds to the global economy in 2001, and covers a wide range of 87 regions and 57 sectors.

[1] Visit www.gtap.org

2.2 Unemployment data

Conventionally the labour endowment will be fully employed in the CGE framework. Since the full employment assumption has been relaxed here, we use additional data on unemployment, taken from the World Development Indicators (compiled by the World Bank)[2] in constructing the SAM and calibrating the model.

2.3 Thai household data

To evaluate the economic impacts of trade liberalisation on poverty and the distribution of income in Thailand (in Chapter 7), additional data on income and expenditure pattern of individual household are used. These data are compiled by the National Statistic Office (NSO) of Thailand, which has conducted the Thailand Socio-Economic Survey (SES) every two years since 1984. The household data for 2000 are used, since data for 2001 are unavailable.[3] General information on poverty and the income distribution in Thailand can be found on the website of the National Economic and Social Development Board (NESDB) of Thailand.[4]

2.4 Software and computer codes

The computer software used in this study is the General Algebraic Modeling System (GAMS).[5] The software is popular and very powerful when handling complex linear, nonlinear, and mixed integer optimisation problems. GAMS is an appropriate computer software for applied general equilibrium modelling, because the model

[2] Types of labour are in practice usually classified by either occupation or education. The International Labour Organization (ILO) provides a rich source of numbers of workers classified by occupation. However, these data are not available for many countries in ASEAN. Therefore, in this study, we choose to categorized data types by education level.
[3] Details of the data reconciliation are provided in section 4 of Chapter 7: Poverty and Income Inequality in Thailand.
[4] Visit www.nesdb.go.th
[5] Visit www.gams.com

specifications always relate to making the optimal choice under specified constraints. Furthermore, the GAMS computer code is very user-friendly and flexible.

In the context of poverty and income inequality in Thailand, the Distributive Analysis/Analyze Distributive (DAD) software[6] is used for computing the poverty and income inequality indices, i.e. FGT indices, Gini coefficients, Atkinson indices.

3. Sets and model parameters from the GTAP database

3.1 Sets

3.1.1 Sectors

J Produced commodities

[LINT, FOOD, NRTS, TEXT, SHOE, WOPA, PECO, PLAS, MOTR, ELEC, MACH, OMCH, TRAN, SVCS, CGDS]

I(J) Traded commodities

[LINT, FOOD, NRTS, TEXT, SHOE, WOPA, PECO, PLAS, MOTR, ELEC, MACH, OMCH, TRAN, SVCS]

K(I) Traded commodities excluding transport

[LINT, FOOD, NRTS, TEXT, SHOE, WOPA, PECO, PLAS, MOTR, ELEC, MACH, OMCH, SVCS]

Note $K \in I \in J$, Alias (I,II)

where LINT is he land-intensive sector, FOOD is processed food, NRTS is the natural resource intensive sector, TEXT is textile and apparel, SHOE is leather and shoes, WOPA is wood and paper, PECO is petroleum coal and metals, PLAS is rubber and plastic, MOTR is motor and equipment, ELEC is electronic equipment,

[6] Visit www.mimap.ecn.ulaval.ca

MACH is machinery, OMCH is other manufactures, TRAN is transport, SVCS all other services.

3.1.2 Factors

F   Primary factor inputs

[CAPITAL, UKLAB, SKLAB]

FL   Labour

[UKLAB, SKLAB]

Note $FL \in F$, Alias (F,FF)

where CAPITAL is capital, UKLAB is unskilled labour, SKLAB is skilled labour.

3.1.3 Regions

R   All regions

[MYS, PHL, IDN, THA, SGP, VNM, XSE, CHN, JAP, KOR, NAFTA, EU, CER, ROW]

RT   All regions excluding ROW

[MYS, PHL, IDN, THA, SGP, VNM, XSE, CHN, JAP, KOR, NAFTA, EU, CER]

Note $RT \in R$, Alias (R, RR, S, SS)

where MYS is Malaysia, PHL is Philippines, IDN is Indonesia, THA is Thailand, SGP is Singapore, VNM is Vietnam, XSE is other ASEAN, CHN is China, JAP is Japan, KOR is Korea, NAFTA is the North American Free Trade Area, EU is the European Union, CER is the Australia-New Zealand Closer Economic Relations, ROW is Rest of the World.

3.1.4 Households

H Households[7]

3.2 Parameters read from GTAP database

$VDFA_{ijr}$ Value of domestic purchases by firms at agents' prices.

$VIFA_{ijr}$ Value of import purchases by firms at agents' prices.

$VDFM_{ijr}$ Value of domestic purchases by firms at market prices.

$VIFM_{ijr}$ Value of import purchases by firms at market prices.

$EVOA_{fr}$ Endowment commodity value of output at agents' prices.

$EVFA_{fjr}$ Endowment commodity value of purchases by firms at agents' prices.

VFM_{fjr} Value of factor demand at market prices.

$VDPA_{ir}$ Value of domestic purchases by household at agents' prices.

$VIPA_{ir}$ Value of import purchases by household at agents' prices.

$VDPM_{ir}$ Value of domestic purchases by household at market prices.

$VIPM_{ir}$ Value of import purchases by household at market prices.

$VDGA_{ir}$ Value of domestic purchases by government at agents' prices.

$VIGA_{ir}$ Value of import purchases by government at agents' prices.

$VDGM_{ir}$ Value of domestic purchases by government at market prices.

$VIGM_{ir}$ Value of import purchases by government at market prices.

$VIMS_{irs}$ Value of imports at market prices of importing region.

[7] A set of households is used for the analysis of poverty and income inequality in Thailand. Details are provided in Chapter 7.

$VXMD_{irs}$ Value of exports at market prices of exporting region.

$VIWS_{irs}$ Value of imports at c.i.f prices.

$VXWD_{irs}$ Value of exports at f.o.b prices.

VST_{ir} Value of sales of international transport.

$SAVE_{r}$ Household saving in region r.

$VDEP_{r}$ Value of capital depreciation in region r.

VKB_{r} Value of beginning-of-period capital stocks.

3.3 Parameters calculated from GTAP database

3.3.1 Aggregate parameters

$VIDA_{ijr}$ Producer cost of intermediate inputs i by industry j in region r at agents' prices:

$$VIDA_{ijr} = VDFA_{ijr} + VIFA_{ijr}$$

$VIDM_{ijr}$ Producer cost of intermediate inputs i by industry j in region r at market prices:

$$VIDM_{ijr} = VDFM_{ijr} + VIFM_{ijr}$$

VDA_{ir} Domestic sales of commodity i in region r at agents' prices:

$$VDA_{ir} = VDPA_{ir} + VDGA_{ir} + \sum_{j} VDFA_{ijr}$$

VDM_{ir} Domestic sales of commodity i in region r at market prices:

$$VDM_{ir} = VDPM_{ir} + VDGM_{ir} + \sum_{j} VDFM_{ijr}$$

VOA_{jr} Total production cost of industry j in region r at agents' prices:

$$VOA_{jr} = \sum_{i} VIDA_{ijr} + \sum_{f} EVFA_{fjr}$$

VOM_{jr} Total value of output j in region r at market prices:

$$VOM_{CGDS,r} = VOA_{CGDS,r}$$

$$VOM_{ir} = VDM_{ir} + \sum_{s} VXMD_{irs} + VST_{ir}$$

$EVOM_{fr}$ Total value added for factor f at market prices:

$$EVOM_{fr} = \sum_{j} VFM_{fjr}$$

VPA_{ir} Household expenditure on of commodity i in region r at agents' prices:

$$VPA_{ir} = VDPA_{ir} + VIPA_{ir}$$

VPM_{ir} Household expenditure of commodity i in region r at market prices:

$$VPM_{ir} = VDPM_{ir} + VIPM_{ir}$$

VGA_{ir} Government expenditure on of commodity i in region r at agents' prices:

$$VGA_{ir} = VDGA_{ir} + VIGA_{ir}$$

VGM_{ir} Government expenditure of commodity i in region r at market prices:

$$VGM_{ir} = VDGM_{ir} + VIGM_{ir}$$

$HEXP_r$ Household consumption expenditure in region r:

$$HEXP_r = \sum_{i} VPA_{ir}$$

$GEXP_r$ Government consumption expenditure in region r:

$$GEXP_r = \sum_{i} VGA_{ir}$$

VIM_{ir} Value of total imports of commodity i by region r:

$$VIM_{ir} = \sum_{j} VIFM_{ijr} + VIPM_{ir} + VIGM_{ir}$$

VTW_{irs} International transport cost of commodity i from region r to s:

$$VTW_{irs} = VIWS_{irs} - VXWD_{irs}$$

VT Total cost of international transport services:

$$VT = \sum_i \sum_r \sum_s VTW_{irs}$$

3.3.2 Tax parameters

$DPTAX_{ir}$ Value of consumption tax on domestic goods by household in region r:

$$DPTAX_{ir} = VDPA_{ir} - VDPM_{ir}$$

$IPTAX_{ir}$ Value of consumption tax on import goods by household in region r:

$$IPTAX_{ir} = VIPA_{ir} - VIPM_{ir}$$

$DGTAX_{ir}$ Value of consumption tax on domestic goods by government in region r:

$$DGTAX_{ir} = VDGA_{ir} - VDGM_{ir}$$

$IGTAX_{ir}$ Value of consumption tax on import goods by government in region r:

$$IGTAX_{ir} = VIGA_{ir} - VIGM_{ir}$$

$DFTAX_{ir}$ Value of consumption tax on domestic goods by firms in region r:

$$DFTAX_{ir} = VDFA_{ir} - VDFM_{ir}$$

$IFTAX_{ir}$ Value of consumption tax on import goods by firms in region r:

$$IFTAX_{ir} = VIFA_{ir} - VIFM_{ir}$$

$EXPTAX_{irs}$ Value of export tax on good i shipped from r to s:

$$EXPTAX_{irs} = VXWD_{irs} - VXMD_{irs}$$

$IMPTAX_{isr}$ Value of import tariff on good i from s to r:

$$IMPTAX_{isr} = VIMS_{isr} - VIWS_{isr}$$

$FACTAX_{fr}$ Value of factor tax on factor f in region r:

$$FACTAX_{fr} = \sum_{i}(EVFA_{fir} - VFM_{fir})$$

$INCTAX_{r}$ Value of household income tax in region r:

$$INCTAX_{r} = \sum_{f}(EVOM_{fr} - EVOA_{fr})$$

$PRDTAX_{jr}$ Value of production tax on good j in region r:

$$PRDTAX_{jr} = VOM_{jr} - VOA_{jr}$$

$CONTAX_{ir}$ Value of consumption tax on good i in region r:

$$CONTAX_{ir} = DPTAX_{ir} + IPTAX_{ir} + DGTAX_{ir} + IGTAX_{ir} + IFTAX_{i,CGDS,r} + DFTAX_{i,CGDS,r}$$

$INTTAX_{ir}$ Value of firm intermediate input tax on good i in region r:

$$INTTAX_{ir} = \sum_{ii}(IFTAX_{i,ii,r} + DFTAX_{i,ii,r})$$

$INDTAX_{ir}$ Value of indirect tax on good i in region r:

$$INDTAX_{ir} = PRDTAX_{ir} + INTTAX_{ir}$$

3.4 Checking the benchmark data for consistency

$PROFIT_{jr}$ Profit of sector j in region r: *(should be zero)*

$$PROFIT_{jr} = VOA_{jr} - \sum_{i} VIDA_{ijr} - \sum_{f} EVFA_{fjr}$$

$SURPLUS_{r}$ Economic surplus in region r: *(should be zero)*

$$\begin{aligned} SURPLUS_{r} = {} & \sum_{f} EVOA_{fr} - VDEP_{r} + \sum_{i}(INDTAX_{ir} + CONTAX_{ir}) + \\ & \sum_{i}\sum_{s}(EXPTAX_{irs} + IMPTAX_{isr}) + \sum_{f} FACTAX_{fr} + \\ & INCTAX_{r} - \sum_{i}(VPA_{ir} + VGA_{ir}) - SAVE_{r} \end{aligned}$$

$RESPRD_{ir}$ Residual of production i in region r: *(should be zero)*

$$RESPRD_{ir} = VOM_{ir} - VDM_{ir} - \sum_{s} VXMD_{irs} - VST_{ir}$$

$DIFFIM_r$ Difference between total imports and domestic absorption of import goods: *(should be zero)*

$$DIFFIM_r = VIM_{ir} - \sum_{s} VIMS_{irs}$$

TSR Residual of international transport shipping industry: *(should be zero)*

$$TSR = \sum_{i}\sum_{r} VST_{ir} - VT$$

BOT_r Current account in region r:

$$BOT_r = \sum_{i} VST + \sum_{i}\sum_{s}(VXWD_{irs} - VIWS_{irs})$$

RESBOT Residual of global current account: *(should be zero)*

$$RESBOT = \sum_{r} BOT_r$$

GTR_r Government transfer to household:

$$\begin{aligned} GTR_r = {} & \sum_{i}(INDTAX_{ir} + CONTAX_{ir}) + \sum_{i}\sum_{s}(IMPTAX_{isr} + EXPTAX_{irs}) \\ & + \sum_{f} FACTAX_{fr} + INCTAX_r - GEXP_r \end{aligned}$$

4. Model calibration

4.1 The principles of calibration

CGE models, even in a single country framework, require substantial information on economic data. CGE modellers often use a single base year as an observation year, and assume that that particular year represents a 'benchmark' equilibrium. Then all unknown parameters can be calibrated on the assumption that there are no stochastic disturbances in the equation sets.

Adams and Higgs (1990) explain that a CGE model can be viewed as a system of equations containing a set of parameters (θ), exogenous variables (Z) and endogenous variables (Y) such that: $F(\theta, Z, Y) = 0$. Unlike econometric estimation, CGE modelling follows a non-stochastic approach, and therefore there is no error term in the equation. The authors explain further that CGE modelling is a systematic response of economic variables to exogenous shocks in which parameters and given exogenous variables 'produce' a non-random endogenous variable.

The calibration approach has become a routine method for overcoming the problem of insufficient data. Calibrating a CGE model yields parameter values which guarantee that the benchmark data set is an equilibrium solution of the model. Nevertheless, there are some parameters that cannot be obtained from the calibration approach, e.g. elasticities. These parameter values thus are either obtained from econometric estimates, the literature or set by personal judgement.

4.2 Model calibration of East Asia

4.2.1 Price initialization

$PF0_{fr}$ Initial prices of primary inputs:

$$PF0_{fr} = 1$$

$PVA0_{ir}$ Initial prices of aggregated value-added input:

$$PVA0_{ir} = 1$$

$PP0_{ir}$ Initial prices of domestic output after production taxes:

$$PP0_{ir} = 1$$

$PDD0_{ir}$ Initial prices of domestic products sold in domestic market:

$$PDD0_{ir} = 1$$

$PX0_{ir}$ Initial prices of composite goods:

$$PX0_{ir} = 1$$

$PT0$ Initial price of international transport services:

$$PT0 = 1$$

$PM0_{ir}$ Initial prices of aggregated imported goods:

$$PM0_{ir} = 1$$

$PE0_{ir}$ Initial prices of domestic goods for export:

$$PE0_{ir} = 1$$

$CPI0_r$ Initial consumer price index:

$$CPI0_r = 1$$

$ER0_r$ Initial exchange rate:

$$ER0_r = 1$$

4.2.2 Calibration of production and associated tax rates

$FD0_{fir}$ Initial factor demand:

$$FD0_{fir} = \frac{VFM_{fir}}{PF0_{fr}}$$

$FS0_{fr}$ Initial factor supply:

$$FS0_{fr} = \frac{\sum_i VFM_{fir}}{PF0_{fr}}$$

$VA0_{ir}$ Initial aggregated value-added input:

$$VA0_{ir} = \frac{\sum_f (1+\tau f_{fir}) \cdot PF0_{fr} \cdot FD0_{fir}}{PVA0_{ir}}$$

where τf_{fir} is the factor tax rate:

$$\tau f_{fir} = \frac{EVFA_{fir}}{VFM_{fir}} - 1$$

τy_r is the income tax rate:

$$\tau y_r = \frac{INCTAX_r}{\sum_f PF0_{fr} \cdot FS0_{fr}}$$

$ID0_{ir}$ Initial aggregated intermediate input:

$$ID0_{ir} = \frac{\sum_{ii} VIDM_{i,ii,r}}{PX0_{ir}}$$

$XD0_{ir}$ Initial domestic output:

$$XD0_{ir} = \frac{\sum_{ii} VIDM_{i,ii,r} + \sum_f EVFA_{fir} + INDTAX_{ir}}{PP0_{ir}}$$

$XDD0_{ir}$ Initial domestic products delivered to domestic market:

$$XDD0_{ir} = \frac{PP0_{ir} \cdot XD0_{ir} - PE0_{ir} \cdot EX0_{ir}}{PDD0_{ir}}$$

$$XDD0_{tran,r} = XDD0_{tran,r} - VST_{tran,r}$$

$X0_{ir}$ Initial composite goods demand:

$$X0_{ir} = \frac{PDD0_{ir} \cdot XDD0_{ir} + PM0_{ir} \cdot IM0_{ir}}{PX0_{ir}}$$

$BIT0_{irs}$ Initial bilateral trade flows:

$$BIT0_{irs} = \frac{VXWD_{irs}}{PWE0_{irs}}$$

where $PWE0_{irs}$ are the initial f.o.b. prices:

$$PWE0_{irs} = (1 + \tau e_{irs}) \cdot PE0_{ir}$$

where τe_{irs} are the export tax/subsidy rates:

$$\tau e_{isr} \quad = \quad \frac{VXWD_{isr}}{VXMD_{isr}} - 1$$

$EX0_{ir}$ Initial domestic goods produced for export:

$$EX0_{ir} \quad = \quad \frac{\sum_{s} BIT0_{irs}}{PE0_{ir}}$$

$IM0_{ir}$ Initial aggregated imports

$$IM0_{ir} \quad = \quad \frac{\sum_{s} (1 + \tau m_{isr}) \cdot PWM0_{isr} \cdot BIT0_{isr}}{PM0_{ir}}$$

where τm_{isr} are the import tariff rates:

$$\tau m_{irs} \quad = \quad \frac{VIMS_{irs}}{VIWS_{irs}} - 1$$

where $PWM0_{isr}$ are the initial c.i.f prices:

$$PWM0_{isr} \quad = \quad (1 + \tau tr_{isr}) \cdot PWE0_{isr}$$

where τtr_{isr} are the international transport rates:

$$\tau tr_{isr} \quad = \quad \frac{VIWS_{isr}}{VXWD_{isr}} - 1$$

4.2.3 Calibration of demand

$C0_{ir}$ Initial household consumption demand:

$$C0_{ir} \quad = \quad \frac{VPA_{ir}}{PC0_{ir}}$$

$G0_{ir}$ Initial government consumption demand:

$$G0_{ir} \quad = \quad \frac{VGA_{ir}}{PC0_{ir}}$$

$IV0_{ir}$ Initial investment demand:

$$IV0_{ir} \quad = \quad \frac{VIDA_{i,CGDS,r}}{PC0_{ir}}$$

where $PC0_{ir}$ are the initial consumer prices

$$PC0_{ir} = (1 + \tau c_{ir}) \cdot PX0_{ir}$$

where τc_{ir} are the consumption tax rates

$$\tau c_{ir} = \frac{CONTAX_{ir}}{PX0_{ir} \cdot (C0_{ir} + G0_{ir} + IV0_{ir})}$$

$IDE0_{i,ii,r}$ Initial intermediate demand:

$$IDE0_{i,ii,r} = \frac{VIDM_{i,ii,r}}{PX0_{ir}}$$

4.2.4 Calibration of tax and tariff revenue

$FTAX0_r$ Initial revenue from factor taxes:

$$FTAX0_r = \sum_f FACTAX_{fr}$$

$PTAX0_r$ Initial revenue from indirect taxes:

$$PTAX0_r = \sum_i INDTAX_{ir}$$

$CTAX0_r$ Initial revenue from consumption taxes:

$$CTAX0_r = \sum_i CONTAX_{ir}$$

$YTAX0_r$ Initial revenue from income taxes:

$$YTAX0_r = INCTAX_r$$

$MTAX0_r$ Initial revenue from import tariffs:

$$MTAX0_r = \sum_i \sum_s IMPTAX_{isr}$$

$ETAX0_r$ Initial revenue/expenditure from export taxes/subsidies:

$$ETAX0_r = \sum_i \sum_s EXPTAX_{irs}$$

4.2.5 Calibration of income and expenditure

$YH0_r$ Initial household total income:

$$YH0_r = \sum_f PF0_{fr} \cdot FS0_{fr} + GTR0_r$$

where $GTR0_r$ is the initial government transfer

$$GTR0_r = GTR_r$$

$MH0_r$ Initial household disposable income spent on consumption:

$$MH0_r = HEXP_r = \sum_i PC0_{ir} \cdot C0_{ir}$$

$YG0_r$ Initial total government revenue:

$$YG0_r = FTAX0_r + PTAX0_r + CTAX0_r + YTAX0_r + MTAX0_r + ETAX0_r$$

$MG0_r$ Initial government expenditure on consumption:

$$MG0_r = GEXP_r = \sum_i PC0_{ir} \cdot G0_{ir}$$

$GTR0_r$ Initial government transfer:

$$GTR0_r = GTR_r$$

$RGTR0_r$ Initial real government transfer:

$$RGTR0_r = \frac{GTR0_r}{CPI0_r}$$

4.2.6 Calibration of investment and saving

$INV0_r$ Regional investment:

$$INV0_r = VOA_{CGDS,r} = \sum_i PC0_{ir} \cdot IV0_{ir}$$

$SH0_r$ Initial household saving:

$$SH0_r = SAVE_r$$

$DEP0_r$ Depreciation value of the capital stock:

$$DEP0_r = VDEP_r$$

4.2.7 Calibration of external sector

$SF0_r$ Foreign saving:

$$SF0_r = TRS0_r + \sum_i \sum_s PWE0_{irs} \cdot BIT0_{irs} - \sum_i \sum_s PWM0_{isr} \cdot BIT0_{isr}$$

4.2.8 Calibration of international shipping industry

$TRS0_r$ Initial supply of international shipping services:

$$TRS0_r = VST_{tran,r}$$

$TRD0_{ir}$ Initial demand of international shipping services:

$$TRD0_{ir} = \sum_s \tau tr_{irs} \cdot PWE0_{irs} \cdot BIT0_{irs}$$

$TTR0$ Initial global international shipping services:

$$TTR0 = \sum_r TRS0_r$$

$DIFFTR0_r$ Initial difference between demand and supply of international shipping services:

$$DIFFTR0_r = TRS0 - \sum_i TRD0_{ir}$$

4.2.9 Calibration of coefficients and share parameters

Production

γV_{fir} Share parameters in value added input function:

$$\gamma V_{fir} = \frac{1}{1 + \sum_{ff} \left(\frac{(1 + \tau f_{ff,i,r}) \cdot PF0_{ff,r}}{(1 + \tau f_{fir}) \cdot PF0_{fr}} \cdot \left(\frac{FD0_{ff,i,r}}{FD0_{fr}} \right)^{1/\sigma V_{ir}} \right)}$$

aV_{ir} Scale coefficients in value added input function:

$$aV_{ir} = \frac{VA0}{\left(\sum_f \gamma V_{ir} \cdot FD0_{fir}{}^{\sigma V_{ir} - 1/\sigma V_{ir}} \right)^{\sigma V_{ir} / \sigma V_{ir} - 1}}$$

γP_{ir} Share parameters in total cost functions:

$$\gamma P_{ir} = \frac{1}{1+\left(\left(\frac{PID0_{ir}}{PVA0_{ir}}\right)\cdot\left(\frac{ID0_{ir}}{VA0_{ir}}\right)^{\frac{-1}{\sigma P_{ir}}}\right)}$$

aP_{ir} Scale coefficients in total cost functions:

$$aP_{ir} = \frac{XD0_{ir}}{\left(\gamma P_{ir}\cdot ID0_{ir}^{\frac{\sigma P_{ir}-1}{\sigma P_{ir}}} + (1-\gamma P_{ir})\cdot VA0_{ir}^{\frac{\sigma P_{ir}-1}{\sigma P_{ir}}}\right)^{\frac{\sigma P_{ir}}{\sigma P_{ir}-1}}}$$

γT_{ir} Share parameters in transformation functions:

$$\gamma T_{ir} = \frac{1}{1+\left(\frac{PDD0_{ir}}{PE0_{ir}}\right)\cdot\left(\frac{XDD0_{ir}}{EX0_{ir}}\right)^{\frac{-1}{\sigma T_{ir}}}}$$

aT_{ir} Scale coefficient parameters in transformation functions:

$$aT_{ir} = \frac{XD0_{ir}}{\left(\gamma T_{ir}\cdot XDD0_{ir}^{\frac{\sigma T_{ir}-1}{\sigma T_{ir}}} + (1-\gamma T_{ir})\cdot EX0_{ir}^{\frac{\sigma T_{ir}-1}{\sigma T_{ir}}}\right)^{\frac{\sigma T_{ir}}{\sigma T_{ir}-1}}}$$

$$aT_{tran,r} = \frac{XD0_{trn,r} - TRS0_{r}}{\left(\gamma T_{trn,r}\cdot XDD0_{trn,r}^{\frac{\sigma T_{tran,r}-1}{\sigma T_{tran,r}}} + (1-\gamma T_{trn,r})\cdot EX0_{trn,r}^{\frac{\sigma T_{tran,r}-1}{\sigma T_{tran,r}}}\right)^{\frac{\sigma T_{tran,r}}{\sigma T_{trans,r}-1}}}$$

γD_{ir} Share parameters in the first level of Armington aggregation functions:

$$\gamma D_{ir} = \frac{1}{1+\frac{PDD0_{ir}}{PM0_{ir}}\cdot\left(\frac{XDD0_{ir}}{IM0_{ir}}\right)^{\frac{-1}{\sigma D_{ir}}}}$$

aD_{ir} Scale coefficients in the first level of Armington aggregation functions:

$$aD_{ir} = \frac{X0_{ir}}{\left(\gamma D_{ir}\cdot XDD0_{ir}^{\frac{\sigma D_{ir}-1}{\sigma D_{ir}}} + (1-\gamma D_{ir})\cdot IM0_{ir}^{\frac{\sigma D_{ir}-1}{\sigma D_{ir}}}\right)^{\frac{\sigma D_{ir}}{\sigma D_{ir}-1}}}$$

γM_{ir} Share parameters in the second level of Armington aggregation functions:

$$\gamma M_{ir} = \frac{1}{1+\sum_{r}\left(\left(\frac{PPM0_{irs}}{PPM0_{isr}}\right)\cdot\left(\frac{BIT0_{irs}}{BIT0_{isr}}\right)^{\frac{1}{\sigma M_{ir}}}\right)}$$

where $PPM0_{isr} = (1+\tau m_{isr})\cdot PWM0_{isr}$

aM_{ir} Scale coefficients in second level of Armington aggregation functions:

$$aM_{ir} = \frac{IM0_{ir}}{\left(\sum_{s}\gamma M_{isr}\cdot BIT0_{isr}^{\frac{\sigma M_{ir}-1}{\sigma M_{ir}}}\right)^{\frac{\sigma M_{ir}}{\sigma M_{ir}-1}}}$$

Demand

$IOC_{i,ii,r}$ Input-output coefficients of intermediate demands:

$$IOC_{i,ii,r} = \frac{IDE0_{i,ii,r}}{ID0_{ii,r}}$$

From which we can obtain the initial price of intermediate inputs:

$$PID0_{ir} = \sum_{ii} IOC_{i,ii,r}\cdot PX_{ii,r}$$

αC_{ir} Household expenditure shares on consumption:

$$\alpha C_{ir} = \frac{\varepsilon_{ir}\cdot PC0_{ir}\cdot C0_{ir}}{MH0_{r}}$$

where ε_{ir} is the income elasticity of demand

αG_{ir} Government expenditure shares on consumption:

$$\alpha G_{ir} = \frac{PC0_{ir}\cdot G0_{ir}}{MG0_{r}}$$

αI_{ir} Investment expenditure shares:

$$\alpha I_{ir} = \frac{PC0_{ir}\cdot IV0_{ir}}{INV0_{r}}$$

Other share parameters

mps_r Household marginal propensity to save:

$$mps_r = \frac{SH0_r}{YH0_r - YTAX0_r}$$

$shmg_r$ Share parameters of government expenditure in government revenue:

$$shmg_r = \frac{MG0_r}{YG0_r}$$

$shtr_r$ Share parameters of regional transport services in global transport services:

$$shtr_r = \frac{TRS0_r}{TTR0}$$

$shulb_{uklab,r}$ Share parameters of unskilled unemployment to overall unemployment:

$$shulb_{uklab,r} = \frac{UNEMP0_{uklab,r}}{UNEMP0_{uklab,r} + UNEMP0_{sklab,r}}$$

$shslb_{sklab,r}$ Share parameters of skilled unemployment to overall unemployment:

$$shslb_{sklab,r} = \frac{UNEMP0_{sklab,r}}{UNEMP0_{uklab,r} + UNEMP0_{sklab,r}}$$

4.3 Model calibration for an extension on labour

4.3.1 Calibration of unemployment

$UNEMP0_{FL,r}$ Levels of unemployment by labour skill and by region:

$$UNEMP0_{uklab,r} = ulbrate_{uklab,r} \cdot FS0_{uklab,r}$$

$$UNEMP0_{sklab,r} = slbrate_{sklab,r} \cdot FS0_{sklab,r}$$

Note uklab and sklab $\in$ FL $\in$ F

Where $ulbrate_{uklab,r}$ is the unemployment rate for unskilled labour in region r

$slbrate_{uklab,r}$ is the unemployment rate for skilled labour in region r

The unemployment rate is defined as a percentage of the labour force, and is calculated exogenously from outside data,[8] i.e. the World Development Indicators. After calibrating for the unemployment level, the labour endowment has to be redefined as:

$FS0_{FL,r}$ Labour force by labour skill and by region:

$$FS0_{FL,r} = \sum_{i} FD0_{FL,i,r} + UNEMP0_{FL,r}$$

$YH0_{r}$ Household total income:

$$\begin{aligned} YH0_{r} = {} & PF0_{capital,r} \cdot FS0_{capital,r} - DEP0_{r} + \\ & \sum_{FL} PF0_{FL,r} \cdot (FS0_{FL,r} - UNEMP0_{FL,r}) + CPI0_{r} \cdot GTR0_{r} \end{aligned}$$

The initial level of unemployment benefit per head is defined so that each unemployed individual receives the same payment regardless of skill level:

$$BENEFIT0_{uklab,r} = \frac{shulb_{uklab,r} \cdot RGTR0_{r}}{UNEMP0_{uklab,r}}$$

$$BENEFIT0_{sklab,r} = \frac{shslb_{sklab,r} \cdot RGTR0_{r}}{UNEMP0_{sklab,r}}$$

where $RGTR0_{r}$ is the initial level of the real government transfer.

$LGTR0_{r}$ Government transfer residual:

$$LGTR0_{r} = RGTR0_{r} - \sum_{FL} (UNEMP0_{FL,r} \cdot BENEFIT0_{FL,r})$$

[8] The unemployment rates used in this model are presented in section 4.1.3 of Chapter 2: Regionalism in East Asia.

4.4 Elasticities

The values of elasticities used in the CGE model of East Asia cannot be obtained by using calibration techniques. These values therefore have to be taken from outside sources. The GTAP database provides the values of trade elasticities – the elasticities of substitution between domestic and imported goods, and the elasticities of substitution among imported goods from various sources, and also provides the values of elasticities of substitution among primary factors. As these elasticities are given in the database by sector (originally 57 sectors), and there is information on the weights to be given to the elasticities in each sector, we can calculate the values of elasticities of our aggregated sectors. Knowledge of the values of elasticities of transformation between domestic and export goods and the elasticity of substitution between primary and intermediate inputs is very limited. We assume that the value of elasticity of transformation between domestic and export goods is equal to -3 for all sectors.[9]

5. The SAM (Social Accounting Matrix)

5.1 SAM definition

A SAM presents in matrix form the economic accounts of a national income and expenditure balance. It is an efficient method of organising the data in a consistent manner. The size of a SAM can be augmented to incorporate more detail, or reduced to a smaller dimension, depending on the purpose of a particular study. Fundamentally, in a SAM incomes are shown in the rows while expenditures are shown in the columns. The intersection of a row with a column identifies a transaction flow between relevant agents/institutions in an economy.

[9] The values of elasticities used in this study are presented in Appendix 5A.

The information given in a SAM[10] can be considered as a starting point for a general equilibrium model, because the balance between rows and columns reflects the equilibrium for each economic agent/institution as well as factor and commodity markets. The Input-Output (IO) matrix for an economy shows the production and use of commodities, differentiated by sectors, and is an integral part of a SAM. Beyond the IO tables, a SAM contains information on the interactions between economic activities, including those of the government, the household, and interregional trade (Pyatt, 1999). In other words, the SAM records transactions such as government tax revenue and expenditure, household income and expenditure, saving and investment, as well as external balance from international trade.

5.2 Building an aggregate SAM from the GTAP database

There are two main characteristics of a SAM. First, the layout of SAM is normally a square matrix of equal number of rows and columns. A SAM can be algebraically represented as (Pyatt, 1988):

$$T = \lfloor t_{ij} \rfloor$$

where t_{ij} is the value of all receipts (or income) to account i from payments (or expenditure) of account j.

Secondly, the row-sums and column-sums should be equal signifying a consistent SAM which can be written as:

$$\sum_j t_{ij} = \sum_i t_{ji}$$

[10] See Pyatt and Round (1985) for more detail on the development and interpretation of SAMs.

An aggregate SAM consists of eight accounts:[11] the activity, commodity, factor or value added, household, government, saving-investment, trade margins, and the rest of the world accounts.

5.2.1 Activity account

The receipt of activity account, which is shown in the first row, records the value of sales of domestic goods. The sales consist of sales to the domestic market and as exports. The first column represents payments for the domestic activities, i.e. for intermediate inputs, value added and production taxes.

5.2.2 Commodity account

Commodity account receipts, in the second row, are the income from composite commodity sales including sales of intermediate goods, of consumption goods to the household and government, and of investment goods. The payment or expenditure side of the commodity account, which is in the second column, comprises sales of domestic goods delivered to the domestic market and imported goods.

5.2.3 Factor account

Total factor income from the different types of factor, e.g. capital and labour, is represented by sales of primary factors in the third row. In the opposite direction, in the third column, the total of factor expenditure appears as income paid to household and as factor taxes.

[11] There are no restrictions on the number of accounts (rows and columns) in a SAM. It entirely depends on how detailed a SAM a modeller requires. For example, the factor or value added account can be disaggregated further in terms of factor type. The household account also can be disaggregated further by type of household.

5.2.4 Household account

The fourth row represents the sources of household income received from its factor endowment net of capital depreciation, and from the lump sum government transfer. The household's income is allocated between consumption expenditure, saving and income tax payments.

5.2.5 Government account

Government receives its revenue from taxes, which include taxes on production, consumption, factors and income, as shown in the fifth row. Government payments, in the fifth column, are spent on consumption and the lump sum transfer made to the household.

5.2.6 Saving-investment account

The saving and investment account reports the saving-investment balance of an economy. The total saving element in the sixth row is from household saving and foreign saving, while the investment in the sixth column is solely on purchases of investment goods.

5.2.7 Trade margins account

The trade margin account shows that the demand and supply of international transport services are balanced and consistent with the model specification in chapter 4. The global shipping company receives its income, presented in the seventh row, from the commodity account in the form of the value of a country's demand for international services. It makes payments to the activity account, in the seventh column, in the form of the value of a country's exports of international services.

5.2.8 Rest of the world account

In the eighth row, the rest of the world receives its income from the commodity account in the form of the value of the country's imports of tradable commodities. The rest of the world makes payments to the activity account in accordance with the value of a country's exports of tradable commodities, and to the investment account in the form of foreign saving.

Table 5.1 shows the aggregate Social Accounting Matrix, while **Table 5.2** identifies the transaction relationships among commodities and economics agents.

5.3 Checking the consistency of a SAM

A consistency check is typically required after constructing a SAM table.[12] This procedure helps a modeller to be confident in the data contained in the SAM. When a SAM is balanced, we generally assume that it replicates the benchmark equilibrium, in which the equilibrium in each institution/market is reached. If the SAM is not balanced then a modeller can find the error(s) and make the necessary corrections before investigating policy changes using the model.

[12] Macro-SAM tables of 14 regions, which aggregate among commodity activity and factor accounts, are presented in Appendix 5B. Micro-SAM tables of 14 regions, which disaggregate among commodity, activity and factor accounts, are shown in Appendix 5C.

Table 5.1: Aggregate Social Accounting Matrix (SAM) for a particular region

	Activities	**Commodities**	**Factors**	**Household**	**Government**	**Investment**	**International transport**	**Rest of the world**	**Total**
Activities		Domestic supply					Exports of transport services	Exports of commodities	**Total income of domestic output**
Commodities	Intermediate use			Household consumption	Government consumption	Investment consumption			**Total income of composite commodities**
Factors	Primary input use								**Total factor income**
Household			Factor incomes		Government transfer				**Total household income**
Government	Taxes on production	Taxes on commodities	Taxes on factors	Income taxes					**Total government income**
Investment				Saving Capital depreciation			Trade balance of transport services	Trade balance	**Total saving**
International transport		Transport margins on imports							**Total income from inter transport**
Rest of the world		Imports of commodities							**Total income from imports**
Total	**Total expenditure on domestic output**	**Total expenditure on composite commodities**	**Total factor expenditure**	**Total household expenditure**	**Total government expenditure**	**Total investment**	**Total expenditure on inter transport**	**Total expenditure on exports**	

Table 5.2: Transaction relationships in aggregate Social Accounting Matrix (SAM)

	Activities	**Commodities**	**Factors**	**Household**	**Government**	**Investment**	**International transport**	**Rest of the world**
Activities		$\sum_i PDD_{ir} XDD_{ir}$					TRS_r	$\sum_i \sum_s PWE_{irs} BIT_{irs}$
Commodities	$\sum_{ii} PID_{ii,r} ID_{ii,r}$			$\sum_i PC_{ir} C_{ir}$	$\sum_i PC_{ir} G_{ir}$	$\sum_i PC_{ir} IV_{ir}$		
Factors	$\sum_i PVA_{ir} VA_{ir}$							
Household			$PF_{uklab,r} \cdot FS_{uklab,r}$ $+PF_{sklab,r} \cdot FS_{sklab,r}$ $PF_{capital,r} \cdot FS_{capital,r}$		GTR_r			
Government	$PTAX_r + ETAX_r$	$MTAX_r + CTAX_r$	$FTAX_r$	$YTAX_r$				
Investment				$SH_r + DEP_r$			$-DIFFTR_r$	$-SF_r + DIFFTR_r$
International transport		$\sum_i TRD_{ir}$						
Rest of the world		$\sum_s \sum_i PWE_{isr} BIT_{isr}$						

There are two simple ways usually used for checking consistency in a SAM. Checking the production and consumption identities ensures that the national accounts have been correctly recorded. First, domestic production in a sector can be calculated via supply to the domestic market and to exports. Next, domestic consumption of a commodity can be calculated via final demand, investment and government purchases and imports. If the accounts are consistent, the differences in production and consumption identities should yield a small number.[13]

$$\begin{aligned}
CHECK1_{ir} &= \sum_{i} PID0_{ir} \cdot IOC_{i,ii,r} \cdot ID0_{i,r} + \sum_{f} (1+\tau f_{fir}) \cdot PF0_{fr} \cdot FD0_{fir} \\
&\quad + \tau p_{ir} \cdot PP0_{ir} \cdot XD0_{ir} - PDD0_{ir} \cdot XDD0_{ir} - \sum_{s} PE0_{ir} \cdot BIT0_{irs} \\
CHECK2_{ir} &= \sum_{i} PID0_{ir} \cdot IOC_{i,ii,r} \cdot ID0_{ir} + PX0_{ir} \cdot (C0_{ir} + G0_{ir} + IV0_{ir}) \\
&\quad - PDD0_{ir} \cdot XDD0_{ir} - \sum_{s} (1+\tau m_{isr}) \cdot PWM0_{isr} \cdot BIT0_{isr}
\end{aligned}$$

where $CHECK1_{ir}$ is the difference in the production identity.

$CHECK2_{ir}$ is the difference in the consumption identity.

6. Conclusion

As, by its nature, a CGE model requires substantial data, there is always the possibility of data unavailability for a region or a particular account. The procedure of calibration offers the possibility for a CGE modeller to obtain information on values of relevant parameters based on one period data. The model calibration has been presented in detail, as has been the construction of the Social Accounting Matrix for all fourteen regions. Since the SAM is built from GTAP database version 6, in which the global trade and national accounts are adjusted to ensure consistency, the SAM in each region is already balanced.

[13] Rutherford T. and Light M. (2001) suggested that 1e-6 is considered to be fairly small, and 1e-10 is small enough to be a result of computer tolerances.

Chapter 6

Policy Simulations[1]

1. Introduction

East Asia is probably the region that has been most active over the last decade in seeking the rapid expansion of Preferential Trade Agreements (PTAs). Establishing the East Asian Free Trade Area Agreement (EAFTA), which includes ASEAN (the Association of South East Asian Nations), China, Japan and Korea, is the major goal for the whole region.

Regionalism in East Asia has proliferated for three main reasons: (1) the failure of the Asia Pacific Economic Cooperation (APEC) group and the World Trade Organization (WTO) to have a substantial impact at either the continental and global levels; (2) the need of the East Asia economies to establish their own institutional identity in order to strengthen mutual co-operation following the adverse impacts on their economies of the Asian financial crisis in 1997; (3) the continued highly discriminatory nature of intra-regional trade in East Asia, which remains a major obstacle to expanding trade within the region.

Since 2000, there have been many attempts to negotiate a number of Free Trade Area (FTA) agreements within the region. However progress in the negotiation of the bilateral FTAs between ASEAN-Korea and ASEAN-Japan has proved to be fairly

[1] Results from the policy simulations reported in this chapter were presented at the International Conference on Policy Modeling, Sao Paulo, Brazil in July 11-13, 2007.

slow.[2] In the meantime ASEAN and China have pursued their own trade agreement, their ambition being to remove import tariffs on commodity trade with each other by 2010. The proposed ASEAN-China Free Trade Area (ACFTA) is the most ambitious and active initiative in East Asia at the moment. Its economic effects on both trading partners are expected to be substantial due to the increasing importance of China in world trade.[3]

The intention of this chapter is to analyse the economic effects of four different possible FTA options for the East Asian economies, using a 14-country, 14-sector Computable General Equilibrium (CGE) model as a tool. The chapter reports the model results under different policy simulations, chosen to reflect the preferred strategy for each region, and then discusses the sensitivity analysis conducted to test for model robustness. Finally, the conclusions are presented in section 5.

2. Policy simulations and economic impacts of East Asia Free Trade Areas

This study estimates the quantitative economic impacts of different Free Trade Area agreements in East Asia under four scenarios: (1) ASEAN-China, (2) ASEAN-Japan, (3) ASEAN-Korea and (4) "EAFTA", i.e. an ASEAN, China, Japan and Korea FTA.

[2] As explained in Chapter 2: Regionalism in East Asia, Japan has concluded bilateral agreements with six individual nations of ASEAN. Each bilateral agreement varies in the details of product coverage. It is still uncertain when the rest of ASEAN nations, CLMV, will be included in the FTA arrangement. And, more importantly, it is uncertain whether the ASEAN-Japan Free Trade Area (AJFTA) will be become the single main agreement or whether various bilateral agreements will be kept under the umbrella of a so-called AJFTA.

[3] Even though the ASEAN-Korea FTA (AKFTA) has already been implemented with some ASEAN members, the scope of product coverage under AKFTA is less than that under ACFTA. In addition, technically, the agreement should not be called as 'ASEAN'-Korea FTA because Thailand has not been included in the program due to the rice issue. More explanation can be found in section 3.5 of Chapter 2: Regionalism in East Asia.

The elimination of import tariffs among member countries covers *all* trade in commodities and services based on a current implementation of the ACFTA agreement.[4] A particular aspect of the ACFTA is the inclusion of agriculture products in the tariff-elimination scheme.[5] Hence the other simulations, for ASEAN-Japan, ASEAN-Korea, and EAFTA, are conducted in the same environment.[6] Due to time and data limitations, this study will ignore other aspects of economic cooperation among member countries under the proposed FTA agreement, e.g. the elimination of non-tariff barriers, investment facilitation, liberalisation of trade in services, etc.

2.1 Macro effects

2.1.1 Trade Creation, trade diversion and the terms of trade

The analysis of the results from the CGE model provides information on changes in trade with trading partners and in prices under each policy simulation. These data,

[4] There are more than 40,000 tariff lines at the 6 digit Harmonized Code under the tariff elimination scheme by 2010 for ASEAN-6 and China, and by 2015 for CLMV countries. There are permanent exclusion lists, and sensitive and highly-sensitive lists of products proposed by each member country. The import tariffs for products on the sensitive list will be reduced to zero by 2018 for ASEAN-6 and China, and by 2020 for CLMV, while the tariff for the highly-sensitive items will be reduced to 50% of the initial rates by 2015 for ASEAN-6 and China, and by 2018 for CLMV. Although the other 50% of tariff rates for highly sensitive items will remain after 2018, 99% of tariffs will be liberalised in the ACFTA (ASEAN Secretariat, 2004).

[5] Although most of the products on the sensitive and highly-sensitive lists are agricultural, their importance in terms of number of tariff lines and import share is almost insignificant. Each member country is allowed a maximum ceiling of 400 tariff lines at the 6 digit Harmonized Code and 10% of total import value. For example, China has 161 items on its sensitive list and 100 items on its highly-sensitive list, which account for 4.7 and 2.6 percent of its total imports from ASEAN. Indonesia has 349 items on its sensitive list and 50 items on its highly-sensitive list, which account for 10.7 and 1.7 percent of its total imports from China. Singapore has only 1 item on each list, which is almost zero percent of its total imports from China. (ASEAN Secretariat, 2004; Lee C. J. et al, 2006).

[6] Historically, Korea and Japan are very protective of their agriculture products, and so negotiations in this area may prove to be very difficult in practice. However, this study seeks to show how much the two countries would gain under the different FTA scenarios based solely on the economic point of view.

therefore; allow us to evaluate the trade creation, trade diversion and terms of trade effects.[7]

Trade creation and trade diversion

Table 6.1 presents the world trade flow adjustments resulting from different East Asia FTAs. The table reports the extent of trade creation and trade diversion at the regional and the global level. It is clear from the results that exports and imports within the FTA member countries tend to expand (indicating trade creation effects), and those with the non-member countries tend to fall (indicating trade diversion effects). The impacts of the adjustment of trade flows under each FTA also vary across the member countries.

In general, FTAs result in both trade creation and trade diversion for member countries. The more countries/regions join in the FTA, the larger are these two effects. However, considering both exports and imports, all four possible East Asia Free Trade Areas imply net trade-creating effects for member countries. For example, under the ASEAN-China FTA, ASEAN enjoy net export creation of US$ 22.53 billion and net import creation of US$ 24.61 billion, while China benefits from net export creation of $US 16.10 billion and net import creation of US$ 14.68 billion. The benefits to the member countries in each FTA are at the expense of non-member

[7] In this study, we assumed that the products are differentiated by their countries of origin – The Armington assumption. Thus the demand and imported prices for non-member commodities heavily depends on the elasticities of substitution among domestically produced goods and imported goods from non-members. Lloyd and MacLaren (2004) pointed out that the Armington assumption, which facilitates modelling of two-way trade, can create two biases in estimates of the welfare effects of non-member countries. First, trade diversion effects, or the possible welfare losses to non-member countries, can be understated. Second, the deterioration in non-member's terms of trade, generating welfare losses, can be overstated. Therefore, the sign of net welfare effects from non-member countries maybe ambiguous depending on these two sources. The explanation of how the Armington assumption adopted into a construction of a CGE model is given in Chapter 4: A CGE model of East Asia.

countries, i.e. non-member countries would suffer from net trade-diverting effects. For example, under the ASEAN-China FTA, all non-member counties would suffer aggregate net export diversion of US$ 9.41 billion and net import diversion of US$ 10.06 billion. However, at a global level, all of these FTAs still show evidence of net trade-creating outcomes. For example, under ASEAN-China, net trade creation of US$ 29.22 billion and net trade diversion of US$ 29.23 billion are reported at the global level.

Under the EAFTA, China would suffer from large import diversion effects (US$ 28.58 billion) because the substantial increase in China's imports from other member countries leads to significant reductions in China's imports from non-member countries. The value of import diversion in Japan (US$ 4.23 billion) is relatively much lower than that in China, however; Japan would suffer from substantial export diversion (US$ 27.15 billion). The effects on Korea are reasonably high net trade creation without there being large trade diversion, its export and import diversion losses being US$ 4.33 billion and US$ 4.36 billion respectively. The impact of trade diversion on non-member countries under the regional agreement is greater than under any of the bilateral agreements. However, at the global level, net trade creation in both exports and imports sides is still observed.

Terms of trade

The economic impacts on the terms of trade under the various East Asia FTAs are shown in **Table 6.2.** The effects are presented in terms of the percentage change from the benchmark. The terms of trade in each countries/regions are calculated from the relative weighted prices of exports and imports. If a country's terms of trade are positive, it mean the prices of exports relative to imports are increasing. Therefore, at certain levels of exports and imports, a country can enjoy relatively cheaper prices of imports. This suggests welfare-enhancement.

In general, member countries in each FTA tend to enjoy improvements in their terms of trade, while non-member countries tend to suffer from worsening terms of trade. For example, under the ASEAN-Japan FTA, ASEAN's and Japan's terms of trade improve by 0.25 and 0.29 percent respectively. However, the non-members' terms of trade worsen by 0.02 – 0.15 percent. A similar outcome is observed under the ASEAN-Korea FTA, in which ASEAN's and Korea's terms of trade improve by 0.24 and 0.42, respectively, while the non-members' terms of trade worsen by 0.02 – 0.11 percent.

However, such terms of trade-improvements for member countries do not apply to China. Under the ASEAN-China FTA, China's terms of trade worsen by 0.11 percent, while under the EAFTA, the effect is even more pronounced, in that China's terms of trade fall by 0.43 percent. This is a consequence of the strong increase in China's imports from and exports to other members.

2.1.2 Real GDP and real absorption

Table 6.3 reports the percentage changes in real GDP and real absorption under different East Asia FTAs. All four FTAs would result in an increase in real GDP in the member economies, while the non-member countries would experience a decrease in their real GDP. The magnitudes of the changes in real GDP vary according to which trading partners are involved.

If we consider the ASEAN countries as a single region, the bilateral trade agreement would make ASEAN's real GDP increase the most among the other members. In this study the ASEAN-China agreement would yield the highest change in real GDP at 1.15 percent, compared with a change in real GDP at 0.70 percent under the ASEAN-Japan option and at 0.50 percent under an ASEAN-Korea agreement. Conversely, under the regional agreement, Korea would experience the highest change in real GDP at 4.09 percent, followed by ASEAN at 1.09 percent, Japan at 0.30 percent, and China at 0.29 percent.

The increases in the real GDP of individual ASEAN members also differ in magnitude under the various scenarios. All, except Thailand, Vietnam and 'Other-ASEAN', enjoy their highest changes in real GDP under the ASEAN-China agreement. At this stage, the three regions identified above would prefer to pursue EAFTA, which brings about the highest change in real GDP at 2.46, 2.79 and 0.07 percent respectively, in their economies.

China, Japan and Korea also benefit from higher real GDP level when liberalising bilateral trade within ASEAN. However, without exception, the changes in real GDP would be greatest under the regional agreement: for example, China's real GDP will increase by 0.07 percent under ASEAN-China, but by 0.29 percent under EAFTA. Similarly, Japan's real GDP would increase by 0.07 under ASEAN-Japan but this would rise to 0.30 percent under EAFTA. Finally, Korea's real GDP would increase by 0.28 percent under ASEAN-Korea, but would (remarkably) increase up to 4.09 percent under EAFTA. Real absorption, which is defined as the change in household consumption, government consumption and investment at fixed prices, follows a similar pattern.

2.1.3 Total regional welfare and welfare decomposition

The economic welfare effects, measured by the equivalent variation (EV) in each region, are reported in **table 6.4**. The EV is reported in terms of US$ billion and as a percentage of real GDP. The pattern of welfare changes for member and non-member countries is very similar to that of changes in real GDP. Member countries would gain, while non-member countries would lose. Overall, ASEAN, as a whole, would make the highest welfare gain of US$ 4.94 billion under the ASEAN-China agreement, compared to US$ 3.0, US$ 2.5, and US$ 4.9 billion under ASEAN-Japan, ASEAN-Korea, and EAFTA, respectively. However, at the individual country level, Malaysia, Thailand, Vietnam and Other-ASEAN would consider EAFTA the most favoured choice.

For the large trading partners, i.e. China, Japan and Korea, the regional agreement would yield substantial welfare gains. According to the simulation results, Korea makes the highest gain, US$ 18.21 billion, followed by Japan (US$ 13.91 billion), and China (US$ 1.43 billion).

Considering the impacts of economic welfare as a percentage of GDP, small individual countries in ASEAN tend to enjoy a higher proportionate welfare gain than do the large trading partners. For example, under the ASEAN-China FTA, Singapore and Vietnam are the major gainers, with their welfare increasing by almost 2 percent of their GDPs, whereas China's welfare gain is only 0.04 percent of its GDP. This pattern is quite similar to those under the ASEAN-Japan and ASEAN-Korea FTAs, in which Singapore and Vietnam make welfare gains of around 1 percent of their GDPs, while the large trading partners' welfare gains are smaller (0.08 and 0.21 percent of GDPs respectively for Japan and Korea).

However, this is not the case for Korea under the EAFTA regional agreement. Korea's welfare gain is notably high at 4.09 percent of its GDP. This results from a combination of reasonably high net-trade creation with significantly low export and import diversion, together with an improvement in its terms of trade. China's welfare gain is quite small due to a marked deterioration in its terms of trade. Japan and ASEAN's welfare gains would be better if they could reduce their trade diversion losses.

Table 6.5 reports the total regional welfare and the welfare decomposition in each country/region under the various East Asia FTAs. The assessment of the welfare gains or losses is enriched with its decomposition effects, which analyse from which source the gains or losses come. The results show that the main source of welfare gains for FTA member countries is from improved allocative efficiency. Similarly, the main source of welfare losses for non-member countries is from reductions in allocative efficiency.

Generally, the welfare gains for FTA member countries come from both allocative efficiency and terms of trade effects. However, China is the exception, because part of its allocative efficiency gain is offset by terms of trade losses. This reflects China's status as a major importer in a global economy. Liberalisation of East Asian's trade induces a strong import demand in China. Reflecting the model closure, i.e. a fixed external balance, China must adjust by reducing its supply prices relative to other countries/regions. Therefore, its terms of trade deteriorate.

In general, welfare losses for non-member countries are also coupled with allocative efficiency and terms of trade losses. However, the NAFTA is an exception, as part of its allocative efficiency loss is offset by a terms of trade gain, which reflects NAFTA's status as a major exporter. Liberalisation of East Asia's trade generates an increase in the demand for some inputs, especially those that are capital-intensive, which must be imported from non-member regions, and in particular from NAFTA. Again, reflecting the specification of the model closure as a fixed external balance, the NAFTA must react by raising its supply prices relative to other countries/regions. Thus its terms of trade are enhanced.

2.1.4 Real wages

As trade liberalisation generates higher level of real GDP in member economies, there will be a higher demand for both skilled and unskilled labour, typically increasing real wage rates. **Table 6.6** shows that real wage rates of both unskilled and skilled labour rise in all member countries. The opposite applies in non-member countries. The average real wages of unskilled and skilled labour of all member countries reach the highest level under EAFTA.

The magnitudes of the changes in the wage rate of both skill types determine for each country whether it will experience greater or lesser wage inequality following trade liberalisation. We would expect that in countries which are abundant in unskilled labour, the pattern of sectoral production will shift towards the more unskilled-intensive sectors, implying that the gap between the wage rates of skilled and unskilled labour will be reduced.

This situation may be observed in ASEAN and China. For example, the ASEAN unskilled wage rises by 2.10 percent, whereas the skilled wage increases by 1.83 percent. In contrast, Japan and Korea, which are abundant in skilled labour, experience greater wage inequality.

2.1.5 Unemployment

The wage curve suggests that, due to both types of labour having the same elasticities, the greater proportionate fall in unemployment of unskilled labour should be associated with a greater proportionate rise in the real wage of unskilled labour compared to skilled labour.

The various free trade agreements have a direct and beneficial impact on unemployment levels. As expected, **table 6.7** shows that the unemployment level drops dramatically in all member countries, while the opposite may occur in non-member countries. The magnitude of the decreases in unemployment level for both unskilled and skilled labour shows a similar pattern to the rises in their real wage rates.

EAFTA would bring the most desirable outcome in unemployment. ASEAN unemployment of unskilled labour under this regional agreement would fall by 20.97 percent, compared to unemployment reductions of 16.37 percent under ASEAN-China, 14.95 percent under ASEAN-Japan and 10.89 percent under ASEAN-Korea. The most striking result appears in Korea, when unemployment of unskilled labour under EAFTA would fall by 60.75 percent, compared to a reduction of just 4.47 percent under the ASEAN-Korea scenario.

The changes in unemployment are highly correlated with the changes in real wages. According to the wage curve formula, a one percent rise in the real wage rate will be associated with a ten percent drop in unemployment. Since member countries would experience different rates of change in unskilled-real wage rates, varying from 0.41 percent in Japan to 6.08 percent in Korea, it is unsurprising that the reductions in unemployment rates vary even more considerably, ranging from 4.08 percent in Japan to 60.75 percent in Korea.

The consequences for skilled labour are broadly similar to those for unskilled labour. For example, in China the unemployment of skilled labour under EAFTA would be reduced by 9.37 percent, compared to a reduction of only 4.51 percent under ASEAN-China. Again, the most notable result is for Korea, where unemployment of skilled labour under EAFTA would be reduced by 75.14 percent, but by only 4.30 percent under ASEAN-Korea.

In summary, economic expansion biased towards unskilled-labour intensive sectors would lead to greater increases in the real wage rate and employment of the unskilled than those of skilled labour, so that the wage gap problem would be mitigated. The exception appears in Japan and Korea, where skilled labour tends to receive higher increases in its real wage rate than does the unskilled, and suffers less from unemployment.

2.1.6 Government transfer residual

Government transfer residual is presented in **table 6.8.** Once trade is liberalised, all government transfers, which are paid to the household in the form of unemployment benefit, will be leftover because of a large reduction in the level of unemployment. As expected, the governments of FTA member regions have a budget leftover due to the decreasing burden of unemployment benefit payment. In contrast, the governments of regions outside the FTA would experience the opposite outcome.

Under the ASEAN-China agreement the government transfer residuals in ASEAN and China would be US$ 7.12 and US$ 2.60 billion respectively. The ASEAN-Japan agreement would allow the ASEAN and Japan governments to save up more than US$ 6.16 and US$ 7.70 billion respectively, while ASEAN-Korea would allow the ASEAN and Korea governments to save up to US$ 4.62 and $1.56 billion. However, the greatest saving would be under EAFTA, in which the ASEAN, China, Japan and Korea governments could save up to US$ 8.95, US$ 9.55, US$ 25.70 and US$ 22.81 billion respectively.

The government transfer residuals vary considerably across ASEAN members. The highest residual is in Thailand, followed in order of size by those in Malaysia, Vietnam, Indonesia, Philippines, Other-ASEAN, and Singapore. It should be noted that countries with the higher reductions in unemployment may not necessarily enjoy the greatest transfer residuals, due to each country's unemployment benefit per head being paid at a different rate.

It is apparent that any Free Trade Area would probably reduce the unemployment pressure in all members; so that governments could reduce unemployment benefit payments. The reduction in government expenditure is eventually transferred back to the household. This can be thought of as an extra household benefit or as an income tax abatement.

2.1.7 Real investment

Table 6.9 presents the economic impacts on real investment under different East Asia FTAs. Reflecting the specified model closure of a fixed trade balance, and that domestic saving is directly linked to the household income, real investment must adjust. Once trade is liberalised, household income rises due to an increase in factor returns. This results in an increase in levels of saving and investment in the member countries.

The magnitude of the expansion in real investment in large member countries under bilateral agreements is, in general, smaller than that under the regional agreement. For example, China's real investment increases by 0.10 percent under ASEAN-China FTA and by 0.28 percent under the EAFTA. Japan's real investment expands by 0.09 percent under ASEAN-Japan FTA and by 0.34 percent under the EAFTA. Lastly, Korea's real investment rises by 0.42 percent under ASEAN-Korea FTA and by 4.89 percent under the EAFTA. The exception is ASEAN, in which real investment would increase the most under the ASEAN-China FTA at 1.79 percent, compared to 0.92, 0.77 and 1.41 under ASEAN-Japan FTA, ASEAN-Korea FTA and the EAFTA, respectively.

It should be noted that capturing the dynamic effects of the East Asia trade liberalisation from the CGE model of East Asia constructed in this study is beyond the scope and nature of a static model. However, the model results on the change in real investment do implicitly suggest that economic growth from capital accumulation may be stimulated by trade liberalisation in East Asia.

2.1.8 International trade

Tables 6.10 and 6.11 report the absolute and proportional changes in each region's total exports and imports relative to the benchmark level. Overall, under all FTA options member countries would expand their exports and imports of agricultural and manufactured products. Conversely, in the services sectors the member countries would experience reduced total exports but increased total imports. This is because the services sectors are effectively tariff-free in the initial state; so that the FTA agreements have no direct effect on these sectors.

The magnitudes of changes in total exports and imports are higher under EAFTA than under any other of the FTAs considered. For example, Korea's total exports of agriculture products would expand by 316.41 percent, while its total imports would also rise substantially, by 207.57 percent. Agriculture exports by China increase markedly, by 139.25 percent, while its imports increase by 15.57 percent. ASEAN and Japan experience moderate increases in both exports and imports of agriculture products, at around 20 to 30 percent.

The proportionate changes in trade in manufactured products are lower than those of trade in agricultural products. However, in terms of value, the total exports and imports of manufacture are much greater than those of agricultural products. For example, Japan would expand its exports of manufactured products by 6.97 percent, i.e. to US$ 438.23 billion. In contrast, ASEAN's imports of manufactured products would increase by 7.78 percent to US$ 337.98 billion. Overall, under EAFTA, the member countries that would experience high percentage changes in both exports and imports are Korea, followed by China, ASEAN and Japan respectively.

2.2 Sectoral effects

2.2.1 Intra-regional trade

The more interesting issue is how the composition of intra-regional trade will be affected by the various FTAs. Of course, the aim of Free Trade Area establishment is to boost trade among member countries by removing tariff barriers between members. Thus we should expect an increase in intra-regional trade when a FTA is introduced.

A prediction of economic effects on intra-regional trade, measured by exports, under the different East Asia FTAs is given in **table 6.12**. Under the ASEAN-China FTA, China would increase its exports in all products to ASEAN, with significant expansions in processed food (143.07 percent) and motor and equipment (385.91 percent). ASEAN would increase its exports to China, especially in other manufactures (262.45 percent) and rubber and plastic (241.70 percent).

However, ASEAN's exports to China from the natural-resource intensive sector, transport and other services sectors would decrease by 15.68, 3.74 and 5.93 percent, respectively. In the other sectors there would be an expansion of intra-regional trade among ASEAN countries, ranging from 20 to 90 percent, the exception being in electronics with a small expansion of 3.71 percent.

Changes in the composition of intra-regional trade under ASEAN-Japan and ASEAN-Korea differ slightly, depending on the trading partners involved. Japan's exports of textiles and apparel and of motor and equipment to ASEAN expand markedly, while ASEAN's exports of processed food, and leather and shoes to Japan would increase significantly under the ASEAN-Japan FTA. Korea's exports of motor and equipment and processed food to ASEAN would rise substantially, while ASEAN's export of processed food, and land intensive products to Korea would grow significantly under the ASEAN-Korea FTA.

Under EAFTA the pattern of change in intra-regional trade is more complex. ASEAN would experience a reduction in exports by the natural-resource intensive sector to China and Japan, but would export more to the Korean market. Japan's exports of land-intensive products to Korea would drop significantly; however this opens the opportunity to China and ASEAN to be new export markets for Japan. A reduction in Korea's exports of wood and paper products, motor and equipment, electronic, and machinery to Japan is counteracted by a rise of exports to China and ASEAN, for example.

In general, the magnitude of changes in intra-regional trade under the regional agreement is greater than under any of the bilateral agreements. ASEAN would expand its exports mainly to the China market, while China would increase its imports from Japan and Korea. Japan would find China a more favourable market for its exports, while Korea would reduce its exports to Japan, but expand exports to China and ASEAN instead.

2.2.2 Domestic production

Table 6.13 reports changes in domestic production across sectors. Under the ASEAN-China FTA, those of ASEAN's industries that would expand are in the land-intensive sector, processed food, textiles and apparel, petroleum and coal products, rubber and plastic, electronics, machinery and 'other services'. The ASEAN industries that would contract are the natural-resource intensive sector, leather and shoes, wood and paper, motor and equipment, 'other manufactures' and transport.

The model predicts that China's domestic production would expand in processed food, the natural-resource intensive sector, textiles and apparel, leather and shoes, petroleum and coal products, motor and equipment, electronics, machinery, transports and 'other services'. Contraction would occur in the land-intensive sector, wood and paper, rubber and plastics and the 'other machinery' industries.

The magnitudes of changes in domestic production under the regional agreement are, in general, greater than under the bilateral agreements. Korea would expand its domestic production of leather and shoes by 83.30 percent, of textile and apparel by 37.62 percent, and of processed food by 32.26 percent. Japan would expand its domestic production of textiles and apparel by 2.90 percent, of machinery by 2.44 percent, and of motor equipment by 2.12 percent. China would expand its domestic production in electronics by 7.84 percent, in land-intensive products by 7.42 percent, and in processed food by 3.46 percent. Last, ASEAN would expand its domestic production of rubber and plastics by 13.40 percent, of machinery by 10.82 percent, and of processed food by 7.30 percent.

In some sectors the domestic production of some member countries will shrink, but will expand in the remaining member countries. However there may be an expansion in some sectors in all member countries. This may occur in part because domestic prices fall due to increased trade within the FTA, encouraging an expansion of consumer demand, but also because the FTA discriminates against imports from non-member countries. A further stimulus to expansion in some sectors may be the reduction in the cost of imported intermediate inputs which reduces the prices of exports to non-member countries.

Formation of a Free Trade Area may also, of course, lead to a contraction of some sectors in some or all member countries. One obvious reason for this is that resources are reallocated from these sectors to those that have expanded, and/or that consumers have switched expenditure to products that are now lower-priced. The sectors which experience such contractions are wood and paper under all the bilateral agreements, and natural intensive products under the regional agreement. An alternative explanation, offered by Inkyo Cheong (2003) is that one of the member countries may act as an importer for the whole FTA region and then re-export these products to other members.

3. Preferred strategy

This section assumes that the governments of FTA member countries would make a decision on which trade agreement they wish to pursue based solely on two economic indicators – real GDP (measured as the percentage change from the benchmark) and welfare (measured as a percentage of benchmark GDP). The levels of these indicators under each policy are taken from **tables 6.3 and 6.4** and presented in **figure 6.1.**

The combinations of these 2 indicators allow us construct four diagrams that provide useful information on the likely gains for each member country under the four possible FTAs. There are two general patterns may be observed:

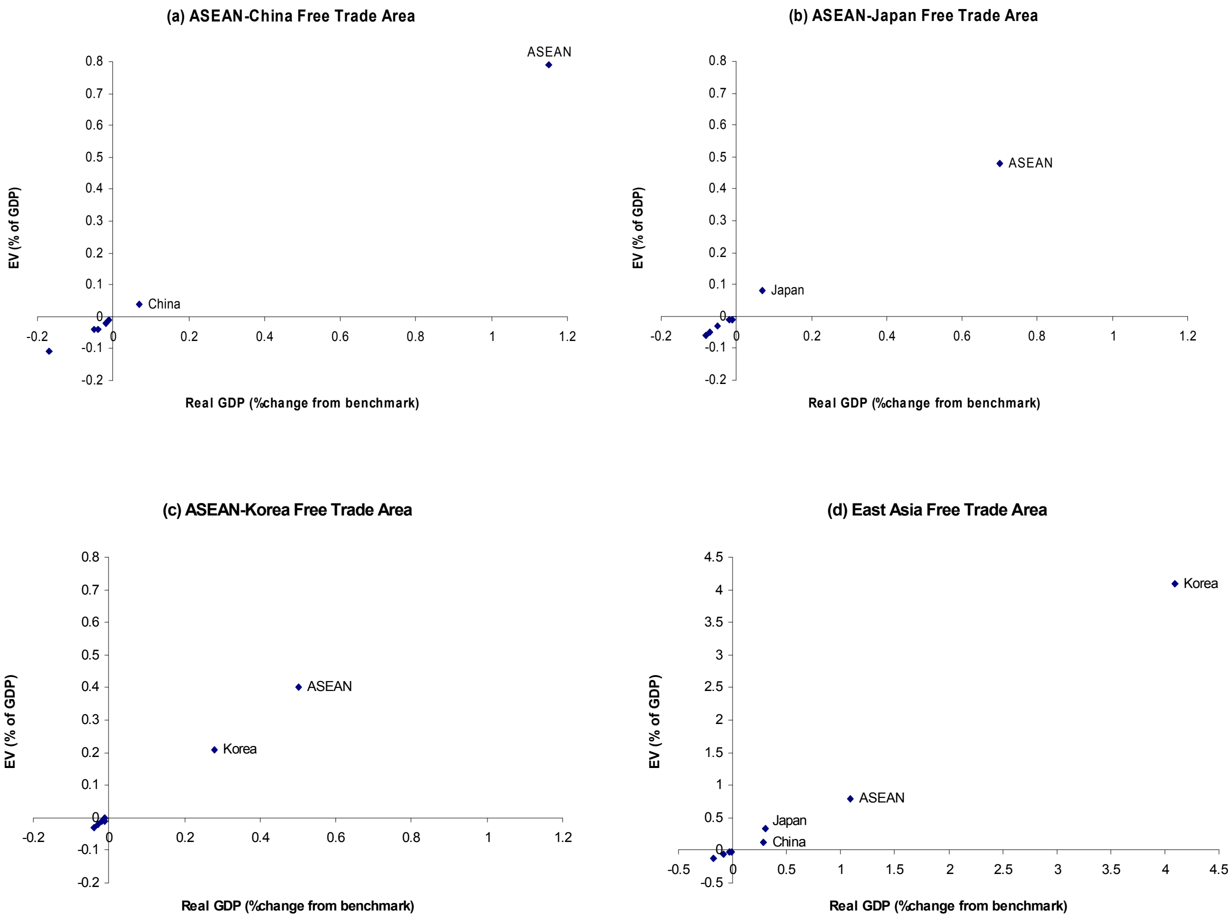
(1) Possible FTA members prefer FTAs of which they are a member, and are averse to FTAs from which they are excluded;

(2) Non-member countries always lose due to a reduction in real GDP and welfare. The outcomes for non-member countries are shown in the negative area of the figure, but individual countries/regions are not identified individually, as the extent of the real GDP and welfare losses in non-member countries are relatively very small. Full details of these non-member regions can also be found in tables 6.3 and 6.4.

From panels (a) (b) and (c) in figure 6.1, it is clear that, under bilateral agreements, ASEAN is better off in terms of the proportionate changes in real GDP and welfare to GDP. In contrast, the gains in GDP and welfare of the large trading partner in each case, e.g. China, Japan and Korea, tend to be relatively smaller.

The gap in the differences in the economic indicators between ASEAN and China is very large under the ASEAN-China FTA (figure 6.1(a)). The gap between ASEAN and Japan is smaller under ASEAN-Japan FTA (figure 6.1(b)), largely due to the reduced gains in ASEAN. The gap between ASEAN and Korea is smallest under ASEAN-Korea FTA (figure 6.1(c)) because Korea would benefit from its own Free Trade with ASEAN a lot more than would China and Japan. At the same time, ASEAN would benefit the least under a bilateral agreement with Korea. The reason for this is that the trade flows between ASEAN and Korea is relatively smaller than those with China or Japan.

Figure 6.1: Preferred strategy of FTA member countries



Under the regional agreement, shown in figure 6.1(d), the major winner is Korea; followed by ASEAN, Japan and China, respectively. All the large countries, e.g. China, Japan, and Korea, are better off in the East Asia FTA than under their individual bilateral agreements with ASEAN. Therefore, these large trading partners would have a common preference for the EAFTA option. However, the ASEAN members do not quite conform to this pattern as the ranking of the EAFTA option is marginally above that of the ASEAN-China FTA.

This in turn gives us some insight into possible ‘coalitions’ between those East Asian regions that would enjoy mutual benefits under particular FTAs. For example, Figures (a) and (d) show that either an ASEAN-China FTA or an East Asian FTA would benefit both ASEAN and China, so that either policy option could be supported by both parties, with some preference for ASEAN-China FTA by the ASEAN members and for the EAFTA by China. Japan and Korea would favour their own bilateral agreement with ASEAN and make even larger gains from an EAFTA. In other words countries prefer FTAs of which they are a member over those from which they are excluded.

However, it is arguable that the EAFTA is the best overall option for the East Asian economies, yielding substantial gains for all in terms of change in real GDP and proportion of welfare to GDP. It is clearly the best option for China, Japan and Korea, while the loss for the ASEAN countries compared to its best option (ASEAN-China) is relatively small, raising the possibility that the other East Asian countries could compensate ASEAN for agreeing to the East Asian FTA while still enjoying substantial gains compared to their other options.

The possibility of compensation is also investigated in this study under the assumptions that China, Japan and Korea would pay compensation to ASEAN to be more willing to join the East Asia FTA, and that exogenous compensation payment is transferred among government agent in member regions. The compensation proposal would be deemed as economically feasible if the new levels of real GDP also lead to higher levels of welfare in all member countries. Unfortunately we cannot find a clear result for ASEAN to be better off, in terms of both real GDP and national welfare, without making the other East Asian nations worse off.

4. Sensitivity analysis

One of the major criticisms of CGE modelling is the uncertainty about the reliability of a model's parameters. Since some of the parameters, e.g. elasticities, used in a CGE model cannot be calibrated directly from the benchmark data, these parameters have to be taken from outside sources. A sensitivity analysis is therefore conducted to assess the robustness of the results of policy simulations with respect to the choice of elasticity values. In this study, we test the sensitivity of the results to trade (Armington) elasticities and the elasticity of pay parameter in the wage curve.

Table 6.14 reports the effects on welfare, measured by the equivalent variation, of changing the trade elasticities. As would be expected, the higher (lower) the values of the elasticities the higher (lower) is the welfare gain. The sensitivity analysis on welfare, measured by the equivalent variation, of changing the elasticity of pay, reported in **Table 6.15**, also shows a consistent pattern. As trade liberalisation reduces unemployment, a higher elasticity of pay will lead to a higher wage rate, and so, ceteris paribus, a lower demand for labour. However in both cases the sensitivity analysis results suggest that the simulation outcomes are robust to different elasticities.

5. Conclusion

This paper reports on the analysis of the economic effects of various FTA options for the East Asian countries. The economic welfare, under the framework of CGE model, is usually calculated from the Equivalent Variation (EV) from the household consumption. It measures the cost to the household of the same bundle of goods, before and after pursuing an FTA. The intuition behind changes in welfare can also be explained by traditional Customs Unions theory in which welfare is determined by trade creation, trade diversion and terms of trade effects.

The combined results suggest that trade volume effects and terms of trade effects are more pronounced under the regional agreement than in any other bilateral agreements. Under the EAFTA, Korea would enjoy the highest level of welfare due to the improvement in its terms of trade and its relatively small trade diversion. China's welfare level is quite low because of its terms of trade deterioration. Japan and ASEAN, even with enhancing terms of trade, show evidence of large increase in trade diversion, which make their welfare gain to be less than in Korea.

The model used includes unemployment as a means of capturing the changes in real wage and unemployment in each region due to trade liberalisation. As trade is liberalised, the problem of real wage inequality is alleviated in countries abundant in unskilled labour, i.e. China and ASEAN. In contrast, real wage inequality worsens in Japan and Korea, where skilled labour is relatively abundant. The unemployment feature incorporated in the model gives both quantitative predictions of lower unemployment and higher real wages.

As fixed unemployment benefit per capita is assumed, government of FTA member regions can make substantial savings on government transfers, which were previously all spent on unemployment benefit payments. As a result, part of government transfer is left over and eventually transferred back to the household. Even though income tax rates tend to increase, reflecting the assumed government neutral revenue closure, the extra benefit that households receive from the government transfer residual can be viewed as an income tax subsidy.

The results from the model simulations have shown that the regional agreement (the East Asian FTA) would yield higher economic welfare gains and a greater economic impact, to East Asian Economies as a whole, than any of the bilateral agreements – ASEAN-China, ASEAN-Japan or ASEAN-Korea. Based on economic grounds, the inclusion of more member countries would definitely lead to a more desirable outcome.

The ideal regional economic integration, however, might be deterred due to many obstacles. First, Japan and Korea highly protect their agriculture sectors, while ASEAN and China wish to pursue the existing ASEAN-China Free Trade agreement, in which agriculture sectors are included, on member enlargement. Second, Japan's FTA strategy lately is more likely to initiate bilateral agreements on interested product coverage rather then comprehensive product coverage. Finally, the uneasy relationships between Japan and the other East Asian nations, especially China, during the WWII period might make it difficult to gain mutual trust in negotiations for complete regional integration.

Table 6.1: Economic impacts on world trade flow adjustments resulting from different East Asia FTAs

(US$ billion)

	Exports			Imports		
	Total	**To FTA members**	**To non-members**	**Total**	**from FTA members**	**from non-members**
ASEAN-China Free Trade Area						
ASEAN	22.53	43.61	-21.09	24.61	28.25	-3.65
China	16.10	13.48	2.62	14.68	28.84	-14.16
Total (members)	**38.63**	**57.09**	**-18.47**	**39.29**	**57.09**	**-17.81**
Japan	-1.94	-4.74	2.80	-2.71	-3.91	1.20
Korea	-0.72	-2.44	1.73	-1.01	-1.21	0.19
NAFTA	-1.91	-3.58	1.67	-2.01	-4.05	2.04
EU	-2.52	-3.09	0.57	-2.38	-4.40	2.02
CER	-0.23	-0.68	0.45	-0.29	-0.58	0.29
ROW	-2.09	-3.27	1.18	-1.66	-4.31	2.64
Total (non-members)	**-9.41**	**-17.80**	**8.40**	**-10.06**	**-18.46**	**8.38**
World	**29.22**	**39.29**	**-10.07**	**29.23**	**38.63**	**-9.43**
ASEAN-Japan Free Trade Area						
ASEAN	17.79	23.95	-6.16	17.76	31.43	-13.66
Japan	8.19	16.76	-8.57	9.17	9.29	-0.12
Total (members)	**25.98**	**40.71**	**-14.73**	**26.93**	**40.72**	**-13.78**
China	-0.72	-2.11	1.40	-0.99	-1.55	0.55
Korea	-0.46	-1.24	0.79	-0.56	-1.07	0.51
NAFTA	-1.55	-4.41	2.86	-2.34	-4.54	2.21
EU	-1.74	-3.18	1.44	-1.53	-3.49	1.95
CER	-0.25	-0.76	0.51	-0.37	-0.46	0.09
ROW	-1.40	-2.08	0.68	-1.26	-3.62	2.36
Total (non-members)	**-6.12**	**-13.78**	**7.68**	**-7.05**	**-14.73**	**7.67**
World	**32.10**	**54.49**	**-22.41**	**33.98**	**55.45**	**-21.45**
ASEAN-Korea Free Trade Area						
ASEAN	14.52	20.90	-6.38	14.60	24.72	-10.11
Korea	3.19	7.88	-4.69	3.72	4.07	-0.35
Total (members)	**17.71**	**28.78**	**-11.07**	**18.32**	**28.79**	**-10.46**
China	-0.52	-1.32	0.81	-0.70	-1.25	0.55
Japan	-0.93	-2.49	1.56	-1.18	-1.99	0.80
NAFTA	-0.80	-1.87	1.06	-1.16	-2.45	1.29
EU	-1.22	-1.69	0.48	-1.04	-2.32	1.28
CER	-0.16	-0.67	0.51	-0.24	-0.31	0.07
ROW	-1.07	-2.02	0.95	-0.98	-2.47	1.76
Total (non-members)	**-4.70**	**-10.06**	**5.37**	**-5.30**	**-10.79**	**5.75**
World	**13.01**	**18.72**	**-5.70**	**13.02**	**18.00**	**-4.71**
East Asia Free Trade Area						
ASEAN	28.20	39.50	-11.30	28.58	38.34	-9.75
China	55.15	50.09	5.06	51.34	79.92	-28.58
Japan	27.02	54.17	-27.15	32.88	37.11	-4.23
Korea	30.38	34.72	-4.33	27.21	31.57	-4.36
Total (members)	**140.75**	**178.48**	**-37.72**	**140.01**	**178.48**	**-38.46**
NAFTA	-6.17	-13.06	6.89	-6.39	-14.28	7.89
EU	-6.37	-12.39	6.02	-5.02	-10.97	5.96
CER	-0.54	-1.45	0.91	-0.86	-1.23	0.38
ROW	-6.31	-11.39	5.09	-6.38	-11.23	4.84
Total (non-members)	**-19.39**	**-38.29**	**18.91**	**-18.65**	**-37.71**	**19.07**
World	**121.36**	**140.19**	**-18.81**	**121.36**	**140.77**	**-19.39**

Source: Author calculation

Table 6.2: Economic impacts on terms of trade under different East Asia FTAs

(% Change from benchmark)

	ASEAN-China	ASEAN-Japan	ASEAN-Korea	EAFTA
ASEAN	0.80	0.25	0.24	0.40
Indonesia	0.91	0.33	0.46	0.49
Malaysia	0.45	-0.43	-0.15	-0.20
Philippines	0.44	0.06	0.25	-0.03
Singapore	1.40	0.74	0.81	1.10
Thailand	1.43	1.28	0.22	1.63
Vietnam	-0.46	-0.95	-1.42	-1.13
Other ASEAN	-0.85	-1.11	-1.00	-0.92
China	-0.11	-0.14	-0.09	-0.43
Japan	-0.27	0.29	-0.11	1.32
Korea	-0.27	-0.15	0.42	0.28
NAFTA	-0.05	-0.06	-0.03	-0.17
EU	-0.03	-0.02	-0.01	-0.07
CER	-0.10	-0.17	-0.11	-0.48
ROW	-0.01	-0.02	-0.02	-0.16

Source: Author calculation

Table 6.3: Economic impacts on real GDP and real absorption under different East Asia FTAs

(% change from benchmark)

	ASEAN-China		ASEAN-Japan		ASEAN-Korea		EAFTA	
	Real GDP	Real absorption	Real GDP	Real absorption	Real GDP	Real absorption	Real GDP	Real absorption
ASEAN	1.15	1.31	0.70	0.79	0.50	0.57	1.09	1.24
Indonesia	0.83	0.99	0.42	0.51	0.44	0.53	0.61	0.73
Malaysia	2.53	6.08	1.23	2.96	1.20	2.90	1.95	4.68
Philippines	0.94	0.88	0.51	0.47	0.63	0.59	0.67	0.63
Singapore	2.35	2.16	1.25	1.15	1.35	1.24	1.91	1.76
Thailand	1.43	1.69	2.00	2.36	0.34	0.40	2.46	2.90
Vietnam	1.65	1.28	0.92	0.71	0.80	0.62	2.79	2.17
Other ASEAN	0.04	0.04	0.00	-0.01	-0.01	-0.01	0.07	0.08
China	0.07	0.08	-0.05	-0.06	-0.03	-0.04	0.29	0.33
Japan	-0.04	-0.04	0.07	0.07	-0.02	-0.02	0.30	0.30
Korea	-0.17	-0.18	-0.08	-0.09	0.28	0.30	4.09	4.39
NAFTA	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
EU	-0.02	-0.02	-0.01	-0.01	-0.01	-0.01	-0.03	-0.03
CER	-0.05	-0.05	-0.07	-0.07	-0.04	-0.04	-0.18	-0.18
ROW	-0.02	-0.02	-0.02	-0.02	-0.01	-0.01	-0.08	-0.09

Source: Author calculation

Note: Real GDP is calculated from C+I+G+EX-IM, while real absorption is calculated from C+I+G.

Table 6.4: Economic impacts on economic welfare under different East Asia FTAs

	ASEAN-China		ASEAN-Japan		ASEAN-Korea		EAFTA	
	US$ billion	% of GDP	US$ billion	% of GDP	US$ billion	% of GDP	US$ billion	% of GDP
ASEAN	4.94	0.79	3.00	0.48	2.50	0.40	4.90	0.79
Indonesia	0.71	0.48	0.37	0.25	0.40	0.28	0.60	0.41
Malaysia	1.00	1.11	0.86	0.97	0.74	0.83	1.14	1.27
Philippines	0.73	1.01	0.35	0.49	0.50	0.69	0.48	0.67
Singapore	1.61	1.86	0.86	1.00	0.94	1.09	1.31	1.52
Thailand	1.05	0.90	1.44	1.23	0.32	0.28	1.87	1.59
Vietnam	0.61	1.85	0.39	1.18	0.32	0.96	0.95	2.83
Other ASEAN	0.11	0.14	0.07	0.09	0.08	0.10	0.14	0.18
China	0.52	0.04	-0.32	-0.03	-0.22	-0.02	1.43	0.12
Japan	-1.50	-0.04	3.47	0.08	-0.58	-0.01	13.91	0.33
Korea	-0.48	-0.11	-0.25	-0.06	0.90	0.21	18.21	4.09
NAFTA	-1.16	-0.01	-0.88	-0.01	-0.45	0.00	-1.72	-0.02
EU	-1.22	-0.02	-0.63	-0.01	-0.39	0.00	-1.53	-0.02
CER	-0.16	-0.04	-0.22	-0.05	-0.14	-0.03	-0.53	-0.13
ROW	-1.00	-0.02	-0.74	-0.01	-0.59	-0.01	-3.24	-0.06

Source: Author calculation

Note: Welfare is calculated in terms of Equivalent Variation (EV).

Table 6.5: Total regional welfare and welfare decomposition under different East Asia FTAs

(US$ billion)

	ASEAN-China			ASEAN-Japan			ASEAN-Korea			EAFTA		
	Total	**Allocative efficiency**	**Terms of trade**	**Total**	**Allocative efficiency**	**Terms of trade**	**Total**	**Allocative efficiency**	**Terms of trade**	**Total**	**Allocative efficiency**	**Terms of trade**
ASEAN	**4.94**	4.35	0.59	**3.00**	2.82	0.18	**2.50**	2.33	0.17	**4.90**	4.61	0.29
China	**0.52**	0.63	-0.12	**-0.32**	-0.17	-0.15	**-0.22**	-0.12	-0.10	**1.43**	1.90	-0.47
Japan	**-1.49**	-1.34	-0.16	**3.47**	3.30	0.17	**-0.58**	-0.52	-0.07	**13.92**	13.15	0.77
Korea	**-0.48**	-0.42	-0.06	**-0.25**	-0.22	-0.03	**0.90**	0.81	0.09	**18.21**	18.15	0.06
NAFTA	**-1.16**	-1.31	0.15	**-0.88**	-1.06	0.18	**-0.45**	-0.54	0.09	**-1.72**	-2.27	0.55
EU	**-1.22**	-1.22	-0.01	**-0.63**	-0.63	0.00	**-0.39**	-0.39	0.00	**-1.53**	-1.51	-0.01
CER	**-0.16**	-0.15	-0.01	**-0.22**	-0.21	-0.01	**-0.14**	-0.13	-0.01	**-0.52**	-0.50	-0.03
ROW	**-1.00**	-0.99	0.00	**-0.74**	-0.73	-0.01	**-0.59**	-0.58	-0.01	**-3.24**	-3.19	-0.05

Source: Author calculation

Table 6.6: Economic impacts on real wages under different East Asia FTAs

(% change from benchmark)

	ASEAN-China	ASEAN-Japan	ASEAN-Korea	EAFTA
		Unskilled labour		
ASEAN	1.64	1.49	1.09	2.10
Indonesia	0.90	0.68	0.54	0.92
Malaysia	4.90	5.08	3.90	6.44
Philippines	1.15	1.08	1.01	1.34
Singapore	1.95	1.01	1.15	1.54
Thailand	3.35	4.87	2.49	5.81
Vietnam	6.80	5.85	5.99	9.40
Other ASEAN	0.56	0.48	0.40	0.65
China	0.45	-0.04	-0.03	1.86
Japan	-0.03	0.12	-0.01	0.41
Korea	-0.10	-0.06	0.45	6.08
NAFTA	-0.01	-0.01	0.00	-0.01
EU	-0.01	-0.01	-0.01	-0.03
CER	-0.06	-0.07	-0.05	-0.18
ROW	-0.02	-0.02	-0.01	-0.06
		Skilled labour		
ASEAN	1.55	1.12	0.93	1.83
Indonesia	0.68	0.40	0.36	0.73
Malaysia	5.48	5.82	4.48	7.23
Philippines	0.52	0.43	0.44	0.57
Singapore	1.58	0.76	0.89	1.23
Thailand	2.47	2.61	1.40	3.75
Vietnam	6.33	5.11	5.39	8.30
Other ASEAN	0.37	0.24	0.27	0.35
China	0.42	-0.03	-0.02	0.87
Japan	-0.04	0.14	-0.01	0.48
Korea	-0.13	-0.06	0.43	7.52
NAFTA	-0.01	0.00	0.00	0.00
EU	-0.02	-0.01	0.00	-0.02
CER	-0.05	-0.06	-0.04	-0.12
ROW	-0.02	-0.01	-0.01	-0.03

Source: Author simulation

Table 6.7: Economic impacts on unemployment under different East Asia FTAs

(% change from benchmark)

	ASEAN-China	ASEAN-Japan	ASEAN-Korea	EAFTA
		Unskilled labour		
ASEAN	-16.37	-14.95	-10.89	-20.97
Indonesia	-8.96	-6.82	-5.40	-9.23
Malaysia	-48.98	-50.80	-39.04	-64.44
Philippines	-11.54	-10.77	-10.10	-13.42
Singapore	-19.53	-10.10	-11.49	-15.43
Thailand	-33.52	-48.69	-24.89	-58.11
Vietnam	-67.98	-58.50	-59.85	-94.04
Other ASEAN	-5.60	-4.81	-3.96	-6.51
China	-4.47	0.41	0.27	-18.56
Japan	0.30	-1.22	0.12	-4.08
Korea	1.02	0.61	-4.47	-60.76
NAFTA	0.08	0.07	0.04	0.14
EU	0.15	0.08	0.06	0.26
CER	0.60	0.69	0.46	1.79
ROW	0.20	0.16	0.12	0.65
		Skilled labour		
ASEAN	-15.46	-11.21	-9.34	-18.34
Indonesia	-6.82	-3.97	-3.56	-7.29
Malaysia	-54.80	-58.18	-44.83	-72.33
Philippines	-5.25	-4.28	-4.37	-5.74
Singapore	-15.79	-7.56	-8.92	-12.28
Thailand	-24.68	-26.05	-13.95	-37.53
Vietnam	-63.26	-51.06	-53.94	-83.00
Other ASEAN	-3.70	-2.41	-2.73	-3.48
China	-4.20	0.30	0.21	-8.73
Japan	0.36	-1.45	0.14	-4.79
Korea	1.30	0.58	-4.31	-75.24
NAFTA	0.09	0.04	0.03	0.02
EU	0.18	0.06	0.04	0.16
CER	0.49	0.61	0.36	1.23
ROW	0.17	0.10	0.07	0.33

Source: Author simulation

Table 6.8: Economic impacts on government transfer residual under different East Asia FTAs

(US$ billion)

	ASEAN-China	ASEAN-Japan	ASEAN-Korea	EAFTA
ASEAN	7.12	6.16	4.62	8.95
Indonesia	0.76	0.55	0.45	0.79
Malaysia	3.17	3.30	2.54	4.17
Philippines	0.61	0.55	0.53	0.70
Singapore	-0.27	-0.14	-0.16	-0.21
Thailand	3.41	4.66	2.40	5.74
Vietnam	2.84	2.41	2.49	3.88
Other ASEAN	0.41	0.32	0.30	0.45
China	2.60	-0.23	-0.15	9.55
Japan	-1.90	7.70	-0.78	25.70
Korea	-0.39	-0.21	1.56	22.81
NAFTA	-0.94	-0.55	-0.32	-0.71
EU	-2.08	-1.04	-0.74	-3.06
CER	-0.26	-0.31	-0.20	-0.76
ROW	-0.83	-0.61	-0.45	-2.42

Source: Author simulation

Table 6.9: Economic impacts on real investment under different East Asia FTAs

(% change from benchmark)

	ASEAN-China	ASEAN-Japan	ASEAN-Korea	EAFTA
ASEAN	1.79	0.92	0.77	1.41
Indonesia	2.14	0.94	1.14	1.19
Malaysia	13.66	5.72	6.15	9.32
Philippines	-0.18	-0.06	-0.08	0.04
Singapore	0.86	0.47	0.51	0.78
Thailand	2.81	3.17	0.61	3.91
Vietnam	1.51	1.59	1.88	1.59
Other ASEAN	0.07	-0.03	-0.02	0.06
China	0.10	-0.06	-0.04	0.28
Japan	-0.04	0.09	-0.01	0.34
Korea	-0.23	-0.09	0.42	4.89
NAFTA	0.01	-0.01	-0.01	-0.05
EU	-0.01	0.00	0.00	-0.02
CER	-0.04	-0.05	-0.03	-0.15
ROW	-0.02	-0.01	-0.01	-0.07

Source: Author simulation

Table 6.10: Economic impacts on exports under different East Asia FTAs

(Upper: US$ Billion, Lower: % change from benchmark)

	ASEAN-China	ASEAN-Japan	ASEAN-Korea	EAFTA
		Agriculture		
ASEAN	39.02	46.42	39.79	45.01
	15.04	36.87	17.32	32.72
China	16.72	15.28	15.61	37.82
	5.75	-3.37	-1.30	139.25
Japan	3.48	3.75	3.47	4.03
	-1.68	5.99	-2.06	13.81
Korea	2.56	2.43	2.72	10.69
	-0.29	-5.33	6.19	316.41
NAFTA	86.41	85.37	86.21	81.52
	-0.33	-1.52	-0.55	-5.96
EU	177.06	176.42	176.79	174.95
	-0.08	-0.44	-0.23	-1.27
CER	24.43	24.30	24.49	23.21
	-2.04	-2.53	-1.79	-6.90
ROW	125.89	125.38	125.89	123.42
	-0.49	-0.90	-0.50	-2.45
		Manufacture		
ASEAN	370.46	356.53	359.71	369.56
	6.03	2.04	2.95	5.77
China	356.53	340.91	340.82	374.88
	4.49	-0.09	-0.11	9.87
Japan	407.42	418.15	408.66	438.23
	-0.55	2.07	-0.25	6.97
Korea	155.64	156.16	160.06	180.01
	-0.61	-0.27	2.22	14.96
NAFTA	966.38	968.03	968.15	965.59
	-0.28	-0.11	-0.10	-0.36
EU	1,822.64	1,824.61	1,824.99	1,818.40
	-0.22	-0.11	-0.09	-0.45
CER	48.70	48.76	48.69	49.35
	0.44	0.56	0.41	1.79
ROW	1,075.34	1,076.72	1,076.58	1,071.12
	-0.20	-0.07	-0.08	-0.59
		Services		
ASEAN	59.72	61.51	61.70	60.30
	-5.74	-2.91	-2.61	-4.83
China	22.31	22.57	22.53	21.88
	-0.67	0.49	0.32	-2.56
Japan	40.18	39.31	39.96	37.79
	0.97	-1.21	0.43	-5.04
Korea	18.00	17.87	17.33	16.61
	1.34	0.60	-2.46	-6.50
NAFTA	266.96	266.71	266.49	268.38
	0.42	0.32	0.24	0.95
EU	512.34	511.79	511.56	514.84
	0.32	0.21	0.17	0.81
CER	17.61	17.66	17.63	17.87
	0.36	0.63	0.46	1.81
ROW	311.05	310.88	310.83	313.52
	0.22	0.16	0.15	1.01

Source: Author simulation

Table 6.11: Economic impacts on imports under different East Asia FTAs

(Upper: US$ Billion, Lower: % change from benchmark)

	ASEAN-China	ASEAN-Japan	ASEAN-Korea	EAFTA
		Agriculture		
ASEAN	31.45	31.31	30.50	32.51
	19.39	18.85	15.77	23.40
China	20.77	19.33	19.37	22.46
	6.87	-0.54	-0.32	15.57
Japan	55.97	61.35	56.22	68.06
	-0.66	8.89	-0.21	20.80
Korea	17.98	18.05	18.95	55.75
	-0.78	-0.41	4.54	207.57
NAFTA	81.18	81.25	81.33	81.29
	-0.29	-0.21	-0.11	-0.15
EU	203.08	203.13	203.20	203.01
	-0.10	-0.08	-0.04	-0.14
CER	4.37	4.36	4.38	4.36
	-0.78	-0.84	-0.55	-0.88
ROW	177.25	177.50	177.61	177.33
	-0.36	-0.22	-0.16	-0.32
		Manufacture		
ASEAN	333.43	327.54	324.56	337.98
	6.33	4.45	3.50	7.78
China	269.40	254.04	254.31	309.88
	5.64	-0.38	-0.28	21.51
Japan	286.65	293.02	287.89	309.98
	-0.78	1.43	-0.35	7.30
Korea	130.12	130.47	133.75	146.67
	-0.64	-0.37	2.14	12.00
NAFTA	1,488.67	1,488.24	1,489.40	1,483.92
	-0.11	-0.14	-0.06	-0.43
EU	1,860.49	1,861.08	1,861.52	1,858.36
	-0.09	-0.06	-0.03	-0.20
CER	71.25	71.19	71.30	70.71
	-0.35	-0.44	-0.28	-1.10
ROW	1,142.69	1,142.99	1,143.13	1,138.30
	-0.10	-0.07	-0.06	-0.48
		Services		
ASEAN	63.66	62.49	62.35	63.38
	3.69	1.78	1.56	3.22
China	39.44	39.22	39.25	39.73
	0.35	-0.23	-0.15	1.07
Japan	84.50	85.45	84.72	87.31
	-0.46	0.66	-0.20	2.85
Korea	27.12	27.22	27.63	29.11
	-0.64	-0.27	1.24	6.66
NAFTA	208.83	208.95	209.03	208.41
	-0.22	-0.16	-0.12	-0.42
EU	526.05	526.38	526.46	525.40
	-0.15	-0.09	-0.08	-0.28
CER	16.20	16.18	16.19	16.09
	-0.22	-0.34	-0.25	-0.87
ROW	266.83	266.87	266.89	266.00
	-0.09	-0.08	-0.07	-0.40

Source: Author simulation

Table 6.12: Economic impacts on intra-regional trade under different East Asia FTAs

(Upper: US$ billion, Lower: % change from benchmark)

	ASEAN-China			**ASEAN-Japan**			**ASEAN-Korea**		
Exporter Importer	**China ASEAN**	**ASEAN China**	**ASEAN ASEAN**	**Japan ASEAN**	**ASEAN Japan**	**ASEAN ASEAN**	**Korea ASEAN**	**ASEAN Korea**	**ASEAN ASEAN**
LINT	1.22	1.72	2.75	0.05	1.32	2.93	0.04	0.81	2.85
	28.99	84.40	94.04	43.98	18.65	107.00	29.93	155.58	100.88
FOOD	1.35	2.34	7.92	0.60	11.91	8.26	0.31	1.34	8.19
	143.07	81.24	80.49	62.82	183.06	88.27	152.08	131.02	86.80
NRTS	0.46	1.11	2.93	0.06	6.70	3.08	0.02	2.92	3.18
	52.33	-15.68	-5.95	37.12	-11.88	-1.18	8.26	21.65	1.83
TEXT	4.04	2.67	3.08	2.40	3.106	3.22	3.65	0.83	3.10
	85.01	228.19	30.23	154.06	62.19	36.28	127.90	93.23	31.01
SHOE	0.56	0.15	0.40	0.06	0.92	0.45	0.45	0.12	0.43
	52.14	90.87	23.66	82.67	108.25	41.33	64.53	114.39	32.74
WOPA	0.36	3.16	2.75	0.78	4.34	2.74	0.35	1.18	2.79
	44.90	44.47	20.47	48.92	9.03	20.12	44.92	26.01	22.29
PECO	4.70	2.88	8.82	10.24	2.96	8.47	2.87	1.13	9.07
	45.93	59.29	15.71	44.67	0.51	11.16	41.26	33.63	19.04
PLAS	2.62	12.76	10.49	7.09	3.19	9.94	2.99	1.50	10.31
	41.14	241.70	28.87	35.59	2.30	22.10	33.62	37.93	26.70
MOTR	5.21	0.46	3.19	12.26	0.78	2.74	3.30	0.16	3.50
	385.91	204.76	77.31	124.27	8.75	51.98	224.96	23.84	94.56
ELEC	8.55	21.91	36.95	19.00	18.16	37.60	7.19	6.37	37.62
	27.44	74.33	3.08	-0.20	0.06	4.91	5.88	5.21	4.97
MACH	4.95	6.92	13.34	18.81	5.41	13.03	2.90	1.26	13.56
	42.17	175.39	25.18	15.95	2.82	22.21	44.25	62.79	27.23
OMCH	0.82	0.34	1.10	0.95	0.94	1.11	0.46	0.18	1.14
	61.81	262.45	19.48	65.94	5.10	20.60	71.76	78.84	23.82
TRAN	0.18	0.25	0.41	0.51	1.07	0.42	0.22	0.35	0.42
	1.81	-3.74	-1.57	-0.22	-0.37	0.08	-1.08	-0.90	-0.57
SVCS	0.96	1.29	2.46	1.83	3.25	2.49	0.68	1.09	2.49
	3.29	-5.93	-2.56	0.73	-2.94	-1.64	-0.94	-1.53	-1.30

Source: Author simulation

Note: land-intensive sector (LINT), processed food (FOOD), natural resource intensive sector (NRTS), textile and apparel (TEXT), leather and shoes (SHOE), wood and paper (WOPA), petroleum coal and metals (PECO), rubber and plastic (PLAS), motor and equipment (MOTR), Electronic equipment (ELEC), machinery (MACH), other manufactures (OMCH), transports (TRAN), other services(SVCS)

Table 6.12: Economic impacts on intra-regional trade under different East Asia FTAs (cont.)

	EAFTA												
Exporter	**ASEAN**				**China**			**Japan**			**Korea**		
Importer	**China**	**Japan**	**Korea**	**ASEAN**	**Japan**	**Korea**	**ASEAN**	**China**	**Korea**	**ASEAN**	**China**	**Japan**	**ASEAN**
LINT	1.79	1.23	0.02	2.82	2.23	16.42	1.19	0.11	0.00	0.05	0.10	0.52	0.05
	91.41	10.10	-93.29	99.05	65.88	2,297.33	25.40	44.53	-96.73	36.97	145.83	49.46	73.44
FOOD	2.20	10.28	0.68	7.70	7.89	1.39	1.25	0.57	0.32	0.55	1.06	5.08	1.04
	70.52	144.25	16.61	75.67	124.52	81.87	125.66	139.20	50.55	50.19	689.11	438.97	751.54
NRTS	1.12	6.19	2.61	2.87	1.56	1.55	0.41	0.08	0.39	0.06	0.02	0.16	0.02
	-15.49	-18.61	9.04	-7.81	-1.18	28.74	35.27	32.58	393.77	24.61	88.10	47.18	-6.30
TEXT	1.65	2.29	0.68	2.57	23.79	4.86	3.33	12.92	0.75	1.84	10.60	1.58	3.46
	101.91	20.16	58.90	8.80	44.41	86.99	52.52	133.87	49.83	94.29	146.26	54.85	115.99
SHOE	0.10	0.62	0.11	0.35	4.10	0.63	0.47	0.11	0.04	0.04	2.40	0.60	0.64
	29.08	40.01	91.12	8.33	52.07	71.59	55.15	43.08	44.67	39.22	159.42	159.08	132.18
WOPA	2.93	4.33	1.22	2.69	2.42	0.38	0.34	0.94	0.26	0.74	1.39	0.25	0.33
	34.17	8.82	29.49	17.72	4.54	40.90	37.40	77.07	23.99	41.58	92.09	-1.93	35.69
PECO	2.62	2.96	1.08	8.16	3.63	2.47	4.18	8.15	6.03	9.58	6.26	3.80	2.55
	44.55	0.31	27.75	7.10	1.49	33.02	29.82	37.37	36.79	35.31	46.28	11.65	25.65
PLAS	11.21	3.20	1.41	9.90	2.83	1.50	2.40	8.95	6.02	6.76	9.42	1.68	2.90
	200.09	2.81	29.94	21.60	6.37	53.26	29.19	43.25	42.44	29.30	46.76	17.17	29.54
MOTR	0.29	0.80	0.16	2.36	1.04	0.68	3.72	8.54	1.34	9.91	1.82	0.24	2.01
	96.44	12.16	25.74	31.29	9.80	57.40	247.20	332.62	1.93	81.18	513.75	-2.36	98.04
ELEC	17.57	18.29	6.20	37.17	10.76	3.76	9.16	18.54	6.52	17.64	9.70	4.83	6.92
	39.82	0.76	2.38	3.71	20.31	42.01	36.67	45.00	35.08	-7.38	58.39	-4.14	1.91
MACH	5.69	5.53	1.15	12.93	8.36	2.32	4.61	24.64	11.15	17.62	6.27	1.88	2.57
	126.40	5.13	48.16	21.29	5.08	50.44	32.38	81.99	35.78	8.60	79.54	-4.73	27.83
OMCH	0.27	0.94	0.16	1.05	3.69	0.61	0.75	1.06	0.41	0.86	0.93	0.41	0.42
	180.81	5.52	56.54	13.87	6.11	53.81	47.08	182.37	1.10	49.20	167.32	14.21	55.47
TRAN	0.26	1.08	0.36	0.42	0.35	0.09	0.18	0.06	0.60	0.50	0.06	0.40	0.21
	-1.50	0.17	4.05	-0.19	-0.67	3.18	-1.02	-4.30	1.10	-3.02	-6.33	-4.74	-5.08
SVCS	1.30	3.24	1.11	2.46	1.44	0.23	0.94	1.09	0.47	1.78	0.21	0.71	0.66
	-5.10	-3.35	0.32	-2.59	0.03	3.83	0.81	-4.36	1.10	-1.84	-5.54	-3.79	-3.04

Source: Author simulation

Table 6.13: Economic impacts on domestic production under different East Asia FTAs

(% change from benchmark)

	ASEAN-China	ASEAN-Japan	ASEAN-Korea	EAFTA	ASEAN-China	ASEAN-Japan	ASEAN-Korea	EAFTA	ASEAN-China	ASEAN-Japan	ASEAN-Korea	EAFTA
	LINT				**FOOD**				**NRTS**			
ASEAN	2.13	5.05	2.28	4.53	1.44	9.65	2.28	7.30	-8.01	-5.67	-2.84	-7.45
China	-0.13	-0.13	-0.07	7.42	0.02	-0.37	-0.10	3.46	0.01	0.22	0.13	-1.63
Japan	0.16	-1.06	0.04	-3.16	0.03	-1.42	-0.01	-2.90	1.38	-0.22	0.58	-1.98
Korea	0.25	-0.17	-1.31	-59.04	-0.01	-0.37	-0.51	32.26	2.26	0.91	-3.19	-4.15
NAFTA	-0.02	-0.11	-0.08	-1.14	-0.01	-0.16	-0.04	-0.47	0.24	0.16	0.10	0.23
EU	0.05	-0.05	-0.03	-0.24	-0.02	-0.12	-0.06	-0.35	0.24	0.08	0.06	0.00
CER	-0.80	-0.67	-0.67	-3.15	-1.01	-1.58	-0.93	-3.27	1.59	1.61	1.00	3.70
ROW	-0.06	-0.08	-0.06	-0.33	-0.08	-0.18	-0.09	-0.49	0.60	0.35	0.23	1.03
	TEXT				**SHOE**				**WOPA**			
ASEAN	0.75	1.81	0.38	-1.85	-4.72	2.82	-0.48	-3.18	-0.15	-0.26	-0.25	1.70
China	0.33	-0.22	-0.19	-0.23	0.46	0.00	0.12	1.13	-0.64	0.14	0.10	-2.31
Japan	-0.18	0.88	-0.15	2.90	0.41	-1.88	0.06	-13.24	0.13	-0.13	0.04	-0.17
Korea	-0.35	-0.53	6.06	37.62	0.12	-0.38	3.46	83.30	0.14	0.11	-0.66	6.59
NAFTA	0.13	0.00	-0.03	-0.62	0.40	0.02	-0.02	-0.65	0.04	0.01	0.01	0.07
EU	0.06	-0.12	-0.15	-1.61	0.52	-0.19	-0.06	-2.15	0.06	0.00	0.00	0.01
CER	-0.06	-0.02	-0.15	-1.20	0.26	0.33	0.07	-2.47	0.02	0.02	0.03	0.25
ROW	-0.24	-0.24	-0.29	-2.40	0.14	-0.11	-0.14	-1.43	-0.04	-0.03	-0.01	0.01
	PECO				**PLAS**				**MOTR**			
ASEAN	0.40	-2.09	0.54	-1.71	16.54	0.83	2.67	13.40	-0.04	-4.64	2.37	-8.12
China	0.43	0.01	0.02	-1.77	-2.05	0.04	0.02	-4.59	6.47	-0.53	-0.20	-1.64
Japan	0.04	0.81	-0.03	1.40	-0.28	0.44	-0.07	1.22	-0.20	2.27	-0.21	2.12
Korea	0.07	-0.13	0.63	3.93	-1.72	-0.22	0.48	8.16	0.17	-0.59	3.69	2.18
NAFTA	0.00	0.00	0.00	0.12	-0.10	-0.01	-0.03	-0.11	-0.21	-0.21	-0.10	-0.08
EU	-0.03	-0.04	-0.02	0.00	-0.15	-0.08	-0.08	-0.20	-0.20	-0.14	-0.07	-0.04
CER	-0.12	-0.16	0.03	0.15	-0.36	-0.18	-0.13	-0.26	-0.46	-0.36	-0.09	0.25
ROW	-0.12	-0.10	-0.04	0.01	-0.54	-0.16	-0.12	-0.73	-0.23	-0.16	-0.06	-0.15

Source: Author simulation

Table 6.13: Economic impacts on domestic production under different East Asia FTAs (Cont.)

(% change from benchmark)

	ASEAN-China	ASEAN-Japan	ASEAN-Korea	EAFTA	ASEAN-China	ASEAN-Japan	ASEAN-Korea	EAFTA	ASEAN-China	ASEAN-Japan	ASEAN-Korea	EAFTA
	ELEC				**MACH**				**OMCH**			
ASEAN	2.61	0.39	0.53	1.95	11.25	4.70	6.02	10.82	-1.43	-0.76	-0.13	-1.13
China	3.88	0.40	0.09	7.84	0.16	0.07	0.00	-3.27	-0.11	0.26	0.12	-1.88
Japan	-0.28	-0.74	0.12	-1.20	0.09	-0.16	-0.09	2.44	0.21	0.14	0.03	0.14
Korea	-0.24	0.52	-1.86	0.70	0.29	0.16	-0.79	-0.64	0.67	0.01	1.48	10.85
NAFTA	-0.29	0.27	0.08	0.01	-0.05	0.01	-0.03	0.26	0.26	0.06	0.02	0.57
EU	-0.47	0.16	0.05	-0.38	-0.22	-0.10	-0.10	-0.18	0.10	-0.01	-0.02	0.19
CER	-0.15	0.45	0.28	0.86	-0.15	-0.01	0.05	0.73	0.08	0.13	0.09	0.59
ROW	-0.78	0.09	-0.04	-0.54	-0.35	-0.17	-0.12	-0.15	0.03	-0.08	-0.06	0.34
	TRAN				**SVCS**							
ASEAN	-0.54	0.22	-0.16	0.54	0.01	-0.18	-0.11	-0.14				
China	0.01	0.07	0.05	-0.68	0.01	-0.01	-0.01	-0.37				
Japan	0.10	0.00	0.05	0.00	-0.02	0.03	-0.01	0.13				
Korea	0.61	0.37	-0.49	0.71	-0.06	-0.02	0.06	3.03				
NAFTA	0.05	0.03	0.03	0.16	0.00	0.00	0.00	0.01				
EU	0.15	0.10	0.08	0.56	0.01	0.01	0.01	0.03				
CER	0.01	0.02	0.04	0.22	-0.03	-0.03	-0.02	-0.07				
ROW	0.07	0.06	0.05	0.37	-0.01	0.00	0.00	0.01				

Source: Author simulation

Note: land-intensive sector (LINT), processed food (FOOD), natural resource intensive sector (NRTS), textile and apparel (TEXT), leather and shoes (SHOE), wood and paper (WOPA), petroleum coal and metals (PECO), rubber and plastic (PLAS), motor and equipment (MOTR), Electronic equipment (ELEC), machinery (MACH), other manufactures (OMCH), transports (TRAN), other services (SVCS).

Table 6.14: Sensitivity test of trade elasticities on EV under different FTAs

(US$ Billion)

	Low elasticity	Medium elasticity	High elasticity
ASEAN-China			
China	0.37	0.49	0.68
ASEAN	3.97	4.94	7.66
ASEAN-Japan			
Japan	3.45	3.47	3.78
ASEAN	2.17	3.00	5.07
ASEAN-Korea			
Korea	0.83	0.90	1.08
ASEAN	2.09	2.50	3.43
EAFTA			
China	0.74	1.37	3.90
Japan	12.74	13.91	22.69
Korea	7.73	18.21	41.51
ASEAN	3.55	4.90	8.73

Source: Author simulation

Note: Low elasticities are scaled by 0.5, while high elasticities are scaled by 2.0

Table 6.15: Sensitivity test of elasticity of pay on EV under different FTAs

(US$ Billion)

	Low elasticity	Medium elasticity	High elasticity
ASEAN-China			
China	0.92	0.49	0.23
ASEAN	5.90	4.94	4.26
ASEAN-Japan			
Japan	4.53	3.47	2.82
ASEAN	3.82	3.00	2.41
ASEAN-Korea			
Korea	1.09	0.90	0.78
ASEAN	3.12	2.50	2.06
EAFTA			
China	3.03	1.37	0.36
Japan	17.52	13.91	11.74
Korea	21.13	18.21	16.42
ASEAN	6.13	4.90	4.03

Source: Author simulation

Note: Low elasticities are scaled by 0.5, while high elasticities are scaled by 2.0

Chapter 7

Poverty and Income Inequality in Thailand[1]

1. Introduction

The issues of the distribution of income, and in particular of poverty, have been of economic interest for decades. However, there have been few studies that have used CGE models to investigate the effects of changes in economic policy on poverty and on the distribution of income. The main reason is that CGE modellers commonly assume that there is a single representative household in each economy. This representative household can be viewed as a collective of all households in the economy. Welfare analysis that is based on one representative household therefore indicates whether households, as a whole, will be better off or worse off after the introduction of a policy change. Nevertheless, in reality, each individual household may be very different in terms of factor endowments, incomes and expenditure patterns, etc., so that it is usually misleading to assume that every household will be affected in the same way, or to the same extent, by a specific government policy change.

Trade liberalisation will have an impact on poverty and the income distribution through two main transmission channels. First, through the income channel where resource reallocation would change the factor intensities and factor prices. As a result, household incomes at the individual level would change. Second, through the

[1] Model specifications and the results in this chapter was presented at the RES third PhD presentation meeting (job market event), UCL, London in January 19-20, 2008.

expenditure (consumption) channel where a reduction in import tariffs will change domestic relative prices, and so alter the consumption pattern of individual households. Trade liberalisation will therefore result in some households gaining and the others losing due to their heterogeneity.

While CGE modelling, which is based on national account data, can yield a satisfactory estimate of economy-wide effects, the poverty and income distribution effects are generally analysed by the use of comprehensive household survey data, but usually without the sectoral detail that is the prime feature of CGE models. There have however recently been a number of attempts to incorporate household data into a CGE model in order to capture the poverty and income distribution effects in more detail. This approach allows the modeller to predict the quantitative economic impacts on households at the macro level while maintaining the micro level analysis.

2. Review of the literature on the incorporation of the microsimulation approach within a CGE model

As explained earlier, the microsimulation approach requires household-level data. There have been three main models incorporating household data in a CGE model. *First,* the amended representative household model, introduced by Adelman and Robinson (1978). This model is based on a conventional representative model in which there are several aggregate household groups, each group focusing on a particular socio-economic characteristic of the population, for example, urban and rural, rich and poor, etc. The economic impacts on the income of each group of representative household are estimated assuming that the distribution of income is modelled as either the lognormal (e.g. Adelman and Robinson, 1978) or the beta distribution (e.g. Decaluwé et al., 1999). These models assume that the mean of the income distribution is endogenously determined while its variance is specified exogenously.[2] This approach derives the income distribution using disaggregated household survey data. However, the distribution functions pose a problem because any change in factor returns would affect each intra-group household in the same proportion. This would result in the income inequality within the same group being relatively unchanged. The major drawback of this type of model is therefore the lack of income distribution information provided within each group. Even though households are typically grouped by location, occupation or income, there is still considerable variation in the source of income for each household. It is usually argued that income inequality within a group can be even more important than income inequality across groups.[3]

Second, a micro-macro model, as presented by Robilliard et al. (2001), and Bourguignon et al. (2003). This approach combines a microsimulation model with a standard CGE model. The two models are treated separately in that the microsimulation model is based on household survey data, while the CGE model is based on a Social Accounting Matrix. The CGE model provides the values for macro variables such as total employment, commodity prices, wages, etc. On the other hand, the behaviour of labour markets and household income and consumption

[2] The main difference between the lognormal and beta distributions is that the lognormal distribution is symmetric, while beta distribution allows greater flexibility in the shape of the income distribution, in that it can be skewed left or right. Therefore, this better represent the income distribution within the household group of different categories.

[3] Davies (2004) argues that " . .changes in income inequality can occur due to redistribution *between* groups. On the other hand, changes in poverty can occur from purely *within-group* changes. For example, if all incomes fall equiproportionally, relative inequality of the society is unaffected but absolute poverty will increase. And the extent of the increase within each household group will depend on the relative density of population in the neighbourhood of the poverty line, which will generally differ between groups"

patterns are modelled using the household survey data. The parameters used in the microsimulation model are econometrically estimated. The model is then linked to the CGE model through wage levels, value-added prices, total employment, and consumer prices. The model is solved subject to the constraint that the aggregate changes in microsimulation model are consistent with the results from the CGE model.

Robilliard et al. (2001) and Bourguignon et al. (2003) investigated the impact of the financial crisis on poverty and inequality in Indonesia. The CGE models, which both included 38 sectors and 15 factors, were designed to capture the macro effects on the economy. The microsimulation model, which employed sample survey data for 9,800 households, was designed to capture interactions in the labour market. In addition, the microsimulation model determined the choices of occupation, the household consumption price index, the profit functions for self-employed workers, and the real income mechanism, which takes skill, location and gender into account. The authors concluded that the models provided relatively unbiased results compared to the amended representative household model, which generally underestimates the impacts on poverty and inequality.

Even though the model allows a richer specification of household behaviour at the individual level, the main criticisms are that the model is very complex and difficult to implement and, more importantly, there is no guarantee that there will be micro and macro model coherence, so that a convergent solution cannot be always reached.

Third, an integrated model, as found in Cogneau and Robilliard (2000), Cockburn (2001), and Cororaton (2003, 2004). The authors incorporate 'all' household survey data into a CGE model. This is equivalent to having as many households in the CGE model as in the survey. As the income and expenditure of each individual household are known, the initial income distributions can be estimated. The incomes of individual households are adjusted, when implementing government policy simulations, through changes in commodity prices, factor prices, etc, generating a new income distribution for households. The mean income and its variance are endogenised under this approach; therefore, the integrated model can capture changes in the within-group income distribution. Incorporating household data directly has two main advantages: it avoids making the representative household assumption, while allowing the modeller to calculate poverty indices, i.e. Gini and Atkinson coefficients, FGT indices, etc., which are usually based on household level data, both before and after the policy change.

Cogneau and Robilliard (2000) constructed an integrated CGE model, built on household data, to study the impact of growth strategies on poverty and the income distribution in Madagascar. The authors incorporated 4,508 households, categorized into 14 household groups, into a SAM-based CGE model. However, the model contained only 3 sectors and 4 goods, providing very limited analysis on a sectoral basis. The mean income and the variance in each household group were endogenised. Their results showed that the assumptions of fixed intra-group income distribution and fixed prices can both bias the results. Even though they found that there is a significant change in relative mean income and prices, the impact of various growth shocks on both poverty and income inequality is quite small.

Cockburn (2001) studied the impacts of trade liberalisation in Nepal, based on a sample survey of 3,373 households. His model comprised 15 factors, 15 commodities, with 3 groups of households categorized by region. The model results showed that the microsimulation technique makes a substantial contribution to the distributive analysis. For example, the author found that poverty was greatest among the moderately poor rather than among the poorest in the rural areas. On the other hand, income inequality increased among the richest in the urban areas. He emphasized that this technique is straightforward and simple, and does not cause computational problems in performing simulations.

Following the same approach, Cororaton (2003, 2004) analysed the effects of trade reforms on poverty and income distribution in the Philippines. His analysis was based on a large survey data set of almost 25,000 households. He found that trade reforms would alleviate the poverty problem in both rural and urban regions, but that the income inequality problem would become worse in most regions, except for the capital region.

In summary, an integrated model and a micro-macro model are similar in terms of the information on individual households taken into account. That is, the heterogeneity among households is modelled formally. On the other hand, the key differences between an integrated model and a micro-macro model are the way in which individual households are incorporated into a CGE model and the economic mechanism of linking microsimulation to a CGE model. Under an integrated model, the representative household is disaggregated into individual households, and then incorporated explicitly into a CGE model, in order to capture the impacts on individual households. In contrast, with a micro-macro model, a separate model is developed to reflect the socio-economic and demographic features of households before linking with the CGE model through prices and wages.

Although Robilliard et al. (2001) and Bourguignon et al. (2003) sought to emphasize the superiority of micro-macro models over integrated models, a reasonable conclusion would be that micro-macro models are more suitable for certain purposes while integrated models are better fitted for others. In this study, we have chosen to use the integrated model approach as such models use all the available household data, so that there are fewer conceptual problems and more transparency. In contrast, micro-macro models require making sets of assumptions about the functional form of preferences and the constraints on households and individuals.

The household data are incorporated into the CGE model by replacing the single regional household with individual households (taken from the survey). In order to ensure consistency between the individual household data and the national data, we assume that the aggregate income of individual households equals the national income level. For example, the aggregate level of individual household income generated from a particular type of factor would be equal to the part of national income generated by that type of factor. Therefore we can calculate the share parameters of the factor endowment of an individual household at the national level from the benchmark data. The income of each individual household from the government transfer is calculated on the same principle, through share parameters. These share parameters are assumed to be fixed throughout the policy simulations, which implies that the level of income of each individual household is uniformly adjusted with a change in national factor endowments and government transfers. The unemployment level for the entire economy is also uniformly adjusted to reflect changes in real wages. Since individual household data are explicitly included in the CGE model in this manner, the specification of the intra-group income distribution is not needed. Instead, the intra-group income distribution can be directly calculated from the benchmark and counterfactuals. However it should be noted that, by applying this technique, poverty can apparently be affected due to the change in an individual household's income level under each policy simulation. However, the impact on income inequality can be relatively small because adjustments in individual households' income and consumption are smoothly allocated across households due to the fixed share parameters.[4]

3. Thailand household data and national data

The household data are taken from publications by the National Statistics Office (NSO) of Thailand which conducts the Thailand Socio Economic Survey (SES) every two years. The surveys usually have a sample size of approximately 25,000 households. The information gathered includes household income and household expenditure, household consumption patterns, changes in assets and liabilities, ownership of durable goods, and other housing characteristics. Due to data unavailability in 2001, therefore, the household data for 2000 are used on the assumption that household consumption and expenditure patterns in 2000 are not significantly different from those which would have held in 2001.

[4] The calculation of share parameters and model calibration is presented in section 5: Model calibration for an extension on integrating household data.

The surveys record household income and expenditure on consumption on a monthly basis in terms of the domestic currency (the Thai baht). The major components of household income are money income and income-in-kind, while household expenditure on consumption is allocated among food and beverages, tobacco products, and other goods and services. Direct income tax payments are recorded as "other household expenditure". Since there is no recording of household saving, the level for each household is calculated as the residual between its total income and its total expenditure.

The national data are taken from the Thailand Social Accounting Matrix (SAM), which is built from GTAP database version 6, which reflects the global economy in 2001. Unlike the household survey data, which represents households at the micro level, the data in the SAM are recorded for the representative household of the economy. Based on the structure of a SAM described in Chapter 5, this representative household receives its income from factor returns and government transfers, and allocates that income between the consumption of commodities, income tax payments, and saving.

In order to link the micro and macro level, the data from the two sources need to be reconciled. The most important reconciliation is between the income and expenditure items in the SES and the SAM. The compositions of income and expenditure on consumption are discussed in sections 3.1 and 3.2 respectively.

3.1 Income sources

According to the survey, the main sources of household income are money income and income-in-kind. Both types of income are broken down into ten sub-items. The income sources from the survey need to be aggregated to match with those in the SAM, as shown in **table 7.1**.

Table 7.1: Composition of income

Household data (SES)		National data (SAM)
Field	**Ref. Account**[5]	
Money income		
Wages and salaries	H301	Income from labour
Entrepreneur income	H311	Income from capital
Farm income	H312	
Land rent for farming	H321	
Land rent for non-farming	H322	
Interest and dividends	H323	
Royalties	H324	
Social pensions for elderly	H331	Government transfer
Pensions for disability	H332	
Work compensation	H333	
Income-in-kind		
Food as part of pay	H401	Income from labour
Rent received as pay	H402	
Other goods received as pay	H403	
Home produced food	H411	Income from capital
Owner occupied home	H412	
Other home produced goods	H413	
Crops received as rent	H421	
Food received free	H431	
Rent received free	H432	
Other good received free	H433	
Total income	**Summation**	

Source: Thailand National Statistics Office, and Thailand SAM

[5] Thailand Socio-Economic Survey, 2000.

3.2 Expenditure on consumption

The survey records household expenditure on food and beverages; tobacco products; and other goods and services. Expenditure on food and beverages breaks down into 14 sub-items, while that on other goods and services is broken down into 28 sub-items. The expenditures on consumption from the survey need to be aggregated to match those in the SAM. In **table 7.2**, consumption expenditure is aggregated into ten groups (sectors):[6] plants and products; animals and products; other agriculture; textile and apparel; leather and shoes; motor and equipment; energy; other manufacture; transport; and other services.

Table 7.2: Composition of expenditure on consumption

Household data (SES)		National data (SAM)
Field	**Ref. Account**[7]	
I. Agriculture		
Grains and cereal products	J010	Plants and products
Oils and fats	J014	
Fruits and nuts	J015	
Vegetables	J016	
Sugar and sweets	J017	
Spices, coffee, etc.	J018	
Meat and poultry	J011	Animals and products
Fish and seafood	J012	
Milk cheese and eggs	J013	
Prepared meals taken home	J019	Other Agriculture
Non-alcoholic beverages at home	J020	
Alcoholic beverages at home	J021	
Alcoholic beverages drunk away	J022	
Meals eaten away from home	J023	
Tobacco products	J101	
II. Manufacture		
Cloth and clothing	J111	Textile and apparel
Textile house furnishings	J123	
Footwear	J112	Leather and shoes
Vehicle operation	J153	Motor and equipment
Vehicle purchase	J154	
Fuel and light	J122	Energy

[6] Ideally, we would aggregate the expenditure on consumption into 14 sectors to match the number of sectors in previous chapters. However the Thai household data are not sufficiently detailed, especially in manufacturing sectors. Therefore we have to reduce the number of sectors from fourteen to ten.

[7] Thailand Socio-Economic Survey, 2000

Table 7.2: Composition of expenditure on consumption (cont.)

Household data (SES)		National data
Field	**Ref. Account**	
Shelter	J121	Other manufactures
Minor equipment	J124	
Major equipment	J125	
Cleaning supplies	J126	
Medical supplies	J131	
Personal supplies	J141	
Communication equipment	J156	
Recreation and spot equipment	J162	
Musical equipment	J163	
Reading materials	J164	
III. Transport		Transports
Local transportation	J151	
Travel out of area	J152	
IV. Other services		Other services
Domestic servants	J127	
Medical services (outpatient)	J132	
Medical services (inpatient)	J133	
Personal services	J142	
Communication services	J155	
Admissions	J161	
Religious activities	J165	
Education	J171	
Ceremonies	J181	
Miscellaneous services	J182	
Total expenditure	**summation**	

Source: Thailand National Statistics Office, and Thailand SAM

3.3 Comparison of household data and national data

Ideally the values of total income and expenditure from the household survey, taking into account sample weights and adjusting to the same currency, should be equal or at least close to those from the SAM table. Moreover the composition of each element should be the same in both data sets. However, in reality, it is very unlikely that there will be full consistency between the two sources of data.

The aggregated data from the SES and the SAM provided in **table 7.3** are unlikely to be exactly comparable due to the different base years. However, they should represent approximately the composition of the aggregates. As expected, none of the values from both data sets are equal. In addition, the compositions of each element of household income and expenditure from different data source also vary substantially.

Table 7.3: Income and expenditure comparison

	Household data (SES)[8]		National data (SAM)[9]	
	value	% of total	value	% of total
Total income (US$ billion)	**41.04**	**100.00**	**93.47**	**100.00**
Income from skilled labour	17.62[10]	42.93	21.76	23.28
Income from unskilled labour			8.27	8.85
Income from capital[11]	19.96	48.64	52.53	56.20
Government transfer	3.46	8.43	10.91	11.67
Total expenditure (US$ billion)	**41.04**	**100.00**	**93.47**	**100.00**
Plants and products	4.00	9.75	3.85	4.12
Animal and products	2.88	7.02	2.27	2.43
Other agriculture	5.07	12.34	4.78	5.12
Textile and apparel	1.12	2.72	5.19	5.55
Leather and shoes	0.26	0.62	1.42	6.89
Motor equipment	3.31	8.05	3.96	4.24
Energy	1.47	3.58	0.00	0.00
Other manufacture	7.08	17.26	9.97	10.67
Transport	0.95	2.32	4.76	5.10
Other services	3.17	7.72	26.37	28.21
Income tax	0.23	0.55	5.68	6.07
Saving[12]	11.52	28.06	25.23	26.99
Total population (millions)	**58.20**		**62.80**	
Per capita income (US$)	**705.15**		**1,488.38**	
Income tax rate (%)	**0.61**		**6.41**	
Saving rate (%)	**28.23**		**28.74**	

Source: Author calculation

The values of total income and total expenditure calculated from the SES data account for approximately forty-four percent of those given in the SAM. Despite the fact that the total incomes recorded in the two data sets are markedly different, the components of income are still placed in the same order. The majority of household income is from capital, followed by income from labour and government transfers respectively.

[8] Household data based from Thailand Socio-Economic Survey (SES) of 24,747 households in 2000.
[9] National data are based on the GTAP database version 6 in 2001.
[10] The Thai SES does not differentiate wages of unskilled and skilled labour in the source of income account.
[11] Income from capital is calculated after deducted by capital depreciation.
[12] As there is no information of saving in Thai household SES data, it is therefore calculated as a residual from other available information.

However, this may not be the case for the expenditure side as the compositions of consumption are completely inconsistent, especially the consumption of other services and income taxes. In the SAM data, household expenditure on consumption of other services is greatest among other goods, but it does not seem to be a very significant item when calculated from SES data. The income tax revenue calculated from the SES data is much lower than that recorded in the SAM.

The discrepancies may be expected due to three key reasons. First, the household survey and GTAP database are based on different years, different currencies, different time period, etc. For example, the data from the Thai household survey are monthly data compiled in 2000 and valued in Thai baht, while the GTAP database reports annual data collected in 2001 and valued in US dollars. Second, data recorded in the household survey are, by their nature, very different from those in the GTAP database.[13] Incomes recorded in the household survey are, usually, markedly understated. This problem occurs because of sample bias, in which samples may not well-represent the population,[14] but also because households do not provide accurate estimates of their income. On the other hand, the expenditure on non-necessity goods or luxury goods recorded in the household survey is likely to be under-reported as well. Third, there are errors from mapping and/or the calculation of residuals because the classifications of the household survey are not the same as those of the GTAP database.

[13] Ivanic M. (2004) explains how household survey data are aggregated by a 'bottom-up' technique. In contrast, the GTAP database is taken from national data which are disaggregated by a 'top-down' technique. Therefore, these data sets tend not to be mutually consistent.

[14] As discussed with NSO staff, the high-income households are quite reluctant to answer the survey questions. This may lead to inaccurate household sample weights and incorrect aggregation values as a consequence.

4. Reconciling the household survey and national account data

As explained earlier, the information in the Thailand SAM does not necessarily match with the information provided by the Thailand SES. The procedure used in reconciling the two sets of data can be summarized as follows:

1. Income sources in the SAM and the SES are aggregated into four categories: income from skilled-labour, income from unskilled-labour,[15] income from capital, and government transfers.

2. The sectors in the SAM and SES are aggregated into 10 sectors: plants and products, animals and products, other agriculture, textile and apparel, leather and shoes, motor equipment, energy, other manufactures, transport and other services.

3. By following an integrated model approach, the representative household in SAM is replaced by **all** 24,747 households from SES 2000 data. Therefore, we have to create links between the income and expenditure accounts in the SAM and the income and expenditure recorded in the household survey. To transform the household level data to national level data, the data values were multiplied by the sample weights provided in the survey.

4. The household income and expenditure have to be adjusted by the Consumer Price Index (CPI) and the exchange rate to ensure that both data sets may be compared; i.e. they have the same base year and the same currency.[16]

5. At this stage, we find that the discrepancies between aggregate data computed by household survey and SAM are still substantial, as the household survey understates income and expenditure. Therefore, we need to find a sensible way to reconcile the data. So far, there is no standard reconciliation procedure. The typical

[15] The SES data report income from labour under a single account. We use the share parameter calculated from GTAP database to calibrate the incomes of skilled and unskilled-labour.

[16] The reported CPI in 2000 is 100, while in 2001 it is 101.64. The exchange rate is 56.37 Thai baht for 1 dollar in 2000. (The International Financial Statistics Yearbook, IMF).

techniques used to adjust data include inflating household income and expenditure to match the national data, regrouping some income sources, re-calculating the income of self-employed households, discarding 'bad' samples, e.g. households reporting no income or expenditure, etc.[17]

There are two common approaches to reconciling such data. The first is to adjust the aggregated household survey data to fit with the macro SAM. The second, the other way round, is to adjust the macro SAM to fit the aggregated household survey data. The former approach is implemented under the assumption that the data in the macro SAM are more reliable. This keeps the economy's structure intact in terms of its size and composition; however; the household income and expenditure patterns will be affected. In contrast, the latter approach is based on the assumption that the data in the household survey are more reliable. This implies that the patterns of household income and expenditure composition are preserved; however, the structure of the economy is inevitably altered.[18]

In this study, the former approach is chosen as more desirable on the grounds of technical commonsense. The reason is simply that we need to preserve other parts of the model as far as possible. While the analysis in Chapter 6 focused on the economic impacts at regional/national level following the trade liberalisation options in East Asia, the analysis in Chapter 7 focuses on the income distribution and poverty

[17] See Robilliard and Robinson (2001), Cockburn (2001), Cororaton (2003), Ivanic (2004), Yusuf (2006) for examples.

[18] Ivanic (2004) has drawn the advantages from both approaches for income reconciliation by setting two main assumptions: (a) GTAP database reflects better than the household survey data for the total values of value added in main sectors of the economy, (b) The household data reflects better than GTAP database for the composition of returns to factors. By doing so, the pattern of household income and expenditure remains unchanged and their total values are equal with those in the macro SAM.

impacts in Thailand of different trade liberalisation options. In order to create links between these two chapters using the same basic CGE model, we need to specify that Thailand's economic and household structures are unchanged. We can then assume that the summation of individual households is equal to the aggregated household without generating contradictions between the economic compositions used in the two chapters.

In practice we need to calculate scale parameters for each component, except for saving, calculated by dividing the macro SAM total by the total in the aggregated household survey. Then each component is re-scaled by its own scale parameter value. One of the CGE modelling requirements is to maintain the equality between household income and expenditure. It is crucial to make sure that the equality is valid at both the aggregated and the individual household levels. As the saving of each household is determined from the residuals between its income and expenditure, the equality will then be achieved.[19]

6. The final step is to replace adjusted household income and expenditure compositions in the SAM table, shown as the shaded area in **table 7.4**. The value in the new SAM will be very close to the old SAM but it may not be exactly balanced. Therefore we need to balance the new SAM to make sure that each economic constraint used in the model still meets the general equilibrium requirement.

[19] At the individual household level we can observe that households may experience dissaving (negative saving). It causes no problem as long as total income and total expenditure of a particular household are equal. As we believe in the accuracy of the macro SAM data, in the first approach, the total income and total expenditure of aggregated household are automatically equal as well.

Two popular techniques may be used to rebalance the matrix, the RAS method[20] and the cross-entropy method.[21] The latter is generally accepted to be superior, as the RAS method may generate severe distortions, while the cross-entropy method re-estimates new weights in such a way that they are close to the prior and satisfy constraints in which the survey results are consistent with the national data. Accordingly the cross entropy method is chosen to rebalance the new SAM table in this study.[22]

Table 7.4 shows the replaced Thai household data (in the shaded area) of the household account in SAM of Thailand; other parts remain unchanged.

5. Model calibration for an extension on integrating household data

Parameters read from Thai household survey data[23]

$C0\_THA_{h,i,tha}$	Initial consumption of commodity i of household h
$YTAX0\_THA_{h,tha}$	Initial income tax of household h
$SH0\_THA_{h,tha}$	Initial saving of household h
$FS0\_THA_{h,f,tha}$	Initial factor supply of factor f of household h
$GTR0\_THA_{h,tha}$	Initial government transfer received by household h
$DEP0\_THA_{h,tha}$	Initial capital depreciation of household h

[20] See Bacharach (1970).
[21] See Robilliard and Robinson (2001).
[22] The GAMs code used to rebalance the new SAM is adjusted from code provided in Robinson, et al. (1998).
[23] All of these parameters are reconciled with the macro data in the SAM. The technique of adjustment is that elaborated in section 4: Reconciling household surveys and national accounts data.

Table 7.4: Aggregate Social Accounting Matrix (SAM) for Thailand

	Activities	**Commodities**	**Factors**	**Household**	**Government**	**Investment**	**International transport**	**Rest of the world**	**Total**
Activities		Domestic supply					Exports of transport services	Exports of commodities	**Total income of domestic output**
Commodities	Intermediate use			Household consumption	Government consumption	Investment consumption			**Total income of composite commodities**
Factors	Primary input use								**Total factor income**
Household			Factor incomes		Government transfer				**Total household income**
Government	Taxes on production	Taxes on commodities	Taxes on factors	Income taxes					**Total government income**
Investment				Saving Capital depreciation			Trade balance of transport services	Trade balance	**Total saving**
International transport		Transport margins on imports							**Total income from inter transport**
Rest of the world		Imports of commodities							**Total income from imports**
Total	**Total expenditure on domestic output**	**Total expenditure on composite commodities**	**Total factor expenditure**	**Total household expenditure**	**Total government expenditure**	**Total investment**	**Total expenditure on inter transport**	**Total expenditure on exports**	

Share parameters

$$SHFS_{h,f,tha} = \frac{FS0\_THA_{h,f,tha}}{FS0_{f,tha}} \quad \text{where } \sum_{h} FS0\_THA_{h,f,tha} = FS0_{f,tha}$$

$$SHDEP_{h,tha} = \frac{DEP0\_THA_{h,tha}}{DEP0_{tha}} \quad \text{where } \sum_{h} DEP0\_THA_{h,tha} = DEP0_{tha}$$

$$SHGTR_{h,tha} = \frac{GTR0\_THA_{h,tha}}{GTR0_{tha}} \quad \text{where } \sum_{h} GTR0\_THA_{h,tha} = GTR0_{tha}$$

where:

$SHFS_{h,f,tha}$	Share parameter of factor supply f of household h
$SHDEP_{h,tha}$	Share parameter of capital depreciation of household h
$SHGTR_{h,tha}$	Share parameter of government transfer received by household h

Other parameters

$$\tau y\_THA_{h,tha} = \frac{YTAX0\_THA_{h,tha}}{YH0\_THA_{h,tha}}$$

$$MPS\_THA_{h,tha} = \frac{SH0\_THA_{h,tha}}{YH0\_THA_{h,tha} - YTAX0\_THA_{h,tha}}$$

$$\alpha C\_THA_{h,i,tha} = \frac{\varepsilon_{i,tha} \cdot PC0_{i,tha} \cdot C0\_THA_{h,i,tha}}{MH0\_THA_{h,tha}}$$

$$MINC\_THA_{h,i,tha} = C0\_THA_{h,i,tha} + \frac{\alpha C\_THA_{h,i,tha}}{PC0_{i,tha}} \cdot \left(\frac{MH0\_THA_{h,tha}}{Frisch_{tha}} \right)$$

where:

$\tau y\_THA_{h,tha}$	Income tax rate of household h
$MPS\_THA_{h,tha}$	Marginal propensity to save of household h
$\alpha C\_THA_{h,i,tha}$	Share parameter of consumption demand function of

household h

$MINC\_THA_{h,i,tha}$	Subsistence level of consumption commodity i of household h

Household income and expenditure

$$\begin{aligned} YH0\_THA_{h,tha} = {} & PF0_{capital,tha} \cdot SHFS_{h,capital,tha} \cdot FS0_{capital,tha} + \\ & PF0_{uklab,tha} \cdot SHFS_{h,uklab,tha} \cdot (FS0_{uklab,tha} - UNEMP0_{uklab,tha}) + \\ & PF0_{sklab,tha} \cdot SHFS_{h,sklab,tha} \cdot (FS0_{sklab,tha} - UNEMP0_{sklab,tha}) + \\ & CPI0_{tha} \cdot SHGTR_{h,tha} \cdot GTR0_{tha} - SHDEP_{h,tha} \cdot DEP0_{tha} \end{aligned}$$

$$MH0\_THA_{h,tha} = \sum_{i} PC0_{i,tha} \cdot C0\_THA_{h,i,tha}$$

$$SN0\_THA_{h,tha} = MH0\_THA_{h,tha} - \sum_{ii} PC0_{ii,tha} \cdot MINC\_THA_{h,ii,tha}$$

where:

$YH0\_THA_{h,tha}$	Initial income of household h
$MH0\_THA_{h,tha}$	Initial income dedicated for consumption of household h
$SN0\_THA_{h,tha}$	Initial supernumerary income of household h

Additional Equations

$$\begin{aligned} YH\_THA_{h,tha} = {} & PF_{capital,tha} \cdot SHFS_{h,capital,tha} \cdot FS_{capital,tha} + \\ & PF_{uklab,tha} \cdot SHFS_{h,uklab,tha} \cdot (FS_{uklab,tha} - UNEMP_{uklab,tha}) + \\ & PF_{sklab,tha} \cdot SHFS_{h,sklab,tha} \cdot (FS_{sklab,tha} - UNEMP_{sklab,tha}) + \\ & CPI_{tha} \cdot SHGTR_{h,tha} \cdot GTR_{tha} - SHDEP_{h,tha} \cdot DEP_{tha} \end{aligned}$$

$$SH\_THA_{h,tha} = MPS\_THA_{h,tha} \cdot (YH\_THA_{h,tha} - YTAX\_THA_{h,tha})$$

$$YTAX\_THA_{h,tha} = \tau y\_THA_{h,tha} \cdot YH\_THA_{h,tha}$$

$$MH\_THA_{h,tha} = YH\_THA_{h,tha} - YTAX\_THA_{h,tha} - SH_{h,tha}$$

$$C\_THA_{h,i,tha} = MINC\_THA_{h,i,tha} + \frac{\alpha C\_THA_{h,i,tha}}{PC_{i,tha}} \cdot (MH\_THA_{h,tha} - \sum_{ii} PC_{ii,tha} \cdot MINC\_THA_{h,ii,tha})$$

where:

$YH\_THA_{h,tha}$	Income of household h
$SH\_THA_{h,tha}$	Saving of household h
$YTAX\_THA_{h,tha}$	Income tax of household h
$MH\_THA_{h,tha}$	Income dedicated on consumption of household h
$C\_THA_{h,i,tha}$	Consumption of commodity i of household h

6. Consistency checks

At national level: Total household income = total household expenditure

$$\sum_f PF_{fr} \cdot (FS_{fr} - UNEMP_{fr}) + GTR_r - DEP_r = \sum_i PC_{ir} \cdot C_{ir} + YTAX_r + SH_r$$

The household receives its income from factor income (inclusive of capital depreciation) and government transfers, while the household expenditure is allocated among household consumption, income tax payments, and saving.

At individual household level: The 1st household income-expenditure balance is:

$$\sum_f PF_{fr} \cdot SHFS_{1,fr}(FS_{fr} - UNEMP_{fr}) + CPI_r \cdot SHGTR_{1,r} \cdot GTR_r - SHDEP_{1,r} \cdot DEP_r$$
$$= \sum_i PC_{ir} \cdot C\_THA_{1,ir} + YTAX\_THA_{1,r} + SH\_THA_{1,r}$$

Similarly, the 24,747th household income-expenditure balance is:

$$\sum_f PF_{fr} \cdot SHFS_{24747,fr}(FS_{fr} - UNEMP_{fr}) + CPI_r \cdot SHGTR_{24747,r} \cdot GTR_r - SHDEP_{24747,r} \cdot DEP_r$$
$$= \sum_i PC_{ir} \cdot C\_THA_{24747,ir} + YTAX\_THA_{24747,r} + SH\_THA_{24747,r}$$

where r = Thailand (THA)

Specifying the model calibration and equations in this manner will ensure that the household integration at the micro level will not alter the rest of the model specification. Specifically, the equality of household income and expenditure at the national level is not affected. In addition the general equilibrium of individual household income and expenditure is still attained.

7. Poverty and inequality measurement

7.1 Poverty index

The three poverty indices,[24] the so-called FGT index (Foster, Greer and Thorbecke, 1984), are the headcount, the poverty gap, and the squared poverty gap. The general formula is:

$$P\alpha = \frac{1}{n}\sum_{i=1}^{j}\left[\frac{z-y_i}{z}\right]^{\alpha}$$

where $P\alpha$ is the poverty measure, j is a sub-group of individuals with income below the poverty line, n is the number of individuals in the sample, z is the poverty line, y_i is the welfare indicator, usually income or expenditure, of the i^{th} individual. The parameter α can take three possible values:

- ***The headcount index or incidence of poverty*** $(\alpha = 0)$ is the proportion of the population whose income or consumption is below the poverty line.[25] In other words, it is the share of population that cannot afford to buy basic goods.

- ***The poverty gap or depth of poverty*** $(\alpha = 1)$ measures how far households are above the poverty line. It is the mean distance separating the population from the

[24] See Ravallion (1992) for further discussion of these measures.

[25] The World Bank defines poverty lines as cut-off points separating the poor from the non-poor. Poverty lines can also be monetary or non-monetary. By definition, the poverty line is the level of income that allows one to enjoy a minimum standard of living. Therefore, people whose incomes are below poverty line are classified as poor.

poverty line, with the non-poor group given a distance of zero.

- ***The squared poverty gap or poverty severity*** $(\alpha = 2)$ provides information not only on how far households are from poverty line, but also on how large is the inequality among the poor.

According to the general formula of the poverty index, the value of this index is crucially reliant on the poverty line, so that the choice of poverty line is critical to the poverty analysis. In 2004, The National Economic and Social Development Board (NESDB) of Thailand and the United Nation Development Programme (UNDP) jointly initiated a revision of the poverty line.[26]

The calculation of the new poverty line for Thailand uses the new base year, updated for consumption patterns, the regional cost of living, and nutritional requirements. The new method of calculating food poverty line is based on consumer theory, in contrast to the conventional method, where a fixed consumption pattern is assumed. Households with consumption equal to the poverty line, under the new method, have the same level of utility no matter where they live. The non-food poverty line is also based on consumer theory. In addition economies of scale resulting from household size are also taken into the consideration in the calculation of the non-food poverty line since some consumption goods may be shared among household members.[27]

The office of the National Economic and Social Development Board (NESDB) Thailand reported the poverty line of Thailand in 2000 as 1,135 baht per person per month. Based on 2001, this is equivalent to 245.58 US dollar per person per

[26] Jitsuchon et al. (2004)
[27] Office of the National Economic and Social Development Board (NESDB), Thailand.

annum.[28] We then use this poverty line for the calculation of poverty indices in Thailand under different policy simulations.[29] In addition, in order to calculate the poverty index, we again use the consumption approach, i.e. real expenditure on consumption, rather than the traditional income approach. The main reasons are that this approach is more internationally accepted and that household consumption tends to be stable over time, so that it better reflects household welfare. In contrast, household income can vary greatly over time and can be easily misreported.

7.2 Income distribution index

- ***The Gini coefficient*** is the most commonly used measure of inequality. It is a summary statistic derived from the Lorenz curve.[30] The Gini coefficient, which can be calculated from unordered data, is the mean of the difference between every possible pair of individuals, divided by the mean size $\overline{y}$. The Gini value lies between 0 and 1. The closer is the coefficient value to 0, the more equality these is in the economy; conversely, the closer is the coefficient value to 1, the more inequality in the economy.

The formula for the Gini coefficient is:

$$\text{Gini} = \frac{1}{2n^2\overline{y}} \sum_{i=1}^{n} \sum_{j=1}^{n} \left| y_i - y_j \right|$$

[28] The value of poverty line has to be adjusted for annual basis, inflated by CPI, and then converted by exchange rate.

[29] In case that poverty line is not known, the choice of poverty line is somehow arbitrary. For example, Cockburn (2001) calculate poverty line based on the sample mean. He defines a poverty line of Nepal as one-half of median income. Sahn and Stifel (2003) derive poverty line by calculating for asset index which corresponds to the World Bank estimation of money-metric poverty at one US dollar per person per day. However, until these days, the choice of poverty line can still be highly debatable.

[30] The Lorenz curve is used in economics and ecology to describe inequality in wealth or size. The Lorenz curve is a function of the cumulative proportion of ordered individuals mapped onto the corresponding cumulative proportion of their size. If all individuals are the same size, the Lorenz curve is a straight diagonal line, called the line of equality. If there is any inequality in size, then the Lorenz curve falls below the line of equality. (http://mathworld.wolfram.com)

where n is the size of the population, y the income of individual i, and $\bar{y}$ the arithmetic mean income.

To apply the Gini formula, all income data need to be converted into individual rather than in household terms. In doing so, the income level in the benchmark and under policy simulations are then divided by household size and deflated by the Consumer Price Index (CPI) to obtain real income per capita. This procedure ensures that the poverty and inequality indices from benchmark and counterfactual scenarios are comparable

- ***The Atkinson index*** is one of the few inequality measures that is explicitly based on a social welfare function (Atkinson, 1970). The formula of the Atkinson index is:

$$\text{Atkinson} = \begin{cases} 1-\left[\dfrac{1}{n}\sum_i\left(\dfrac{y_i}{\bar{y}}\right)^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}} & \text{if } \varepsilon \neq 1 \\ 1-\prod_i\left(\dfrac{y_i}{\bar{y}}\right)^{\frac{1}{n}} & \text{if } \varepsilon = 1 \end{cases}$$

where n is the population size, y the income of individual i, $\bar{y}$ the arithmetic mean income, ε the inequality aversion parameter. The inequality aversion parameter reflects the strength of society's preference for equality.

The Atkinson index is sensitive to changes at the extremes. In other words, it is more strongly correlated with the extent of poverty. In contrast, the Gini coefficient is less sensitive to changes at the extremes, i.e. it is much less sensitive to income transfers between households if they lie around the middle of income distribution. (Francois and Rojas-Romagosa, 2005).

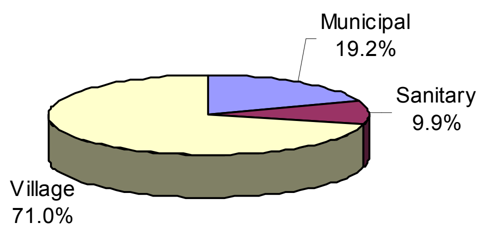
The value of inequality aversion typically lies between 0 and 2. However the most commonly used values of ε lie between 0 and 1 because it tends to give rankings similar to those derived from the Gini coefficient (Atkinson, 1970; Atkinson, et al., 1995). We thus use three different values of inequality aversion (0.5, 0.75, and 1) to estimate the trend of inequality in Thailand.

8. A profile of poverty and inequality in Thailand

8.1 The share of population by community and region

Communities in Thailand, based on the household survey, are classified into three main types – municipal area, sanitary district, and village. These communities are classified by the administration according to their degree of urbanization. Roughly speaking, the 'municipal area' is urban, while the other two are rural.

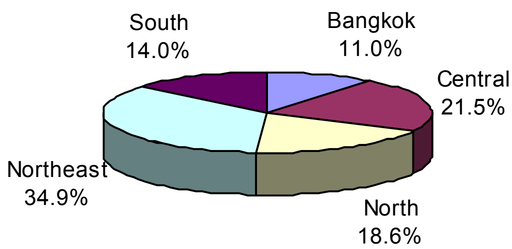
Figure 7.1: Thailand population share by community



Source: Author calculation from Thai household survey (2000).

From figure 7.1, which is based on the Thai household survey in 2000, around eighty percent of the Thai population still lives in rural areas – seventy one percent live in villages, and ten percent live in sanitary districts. The rest of population, approximately nineteen percent, lives in the urban, or municipal, area. Regions in Thailand are classified into 5 sub-regions, based on their geographical location, – Bangkok (capital city), Central, North, Northeast, and South.

Figure 7.2: Thailand population share by region



Source: Author calculation from Thai household survey (2000)

From figure 7.2, based on the household survey in 2000, the vast majority of the Thai population lives in the Northeast region, which accounts for thirty-five percent of the population. There are approximately twenty-two percent living in the Central region, nineteen percent in the North, fourteen percent in the South, and eleven percent the in Bangkok.

8.2 Source of household income

Tables 7.5 and 7.6 present the sources of household income, based on the adjusted household survey in 2000, by community and region respectively. The value of household income for the village category is the greatest (US$ 55.48 billion); however more than 11 percent of total income is from government transfers. The value of household income in the municipal category is US$ 41.80 billion, with almost 40 percent of total income from municipal area being wage income for both skilled and unskilled labour. Income from the sanitary districts is relatively quite low, around US$ 11.49 billion.

Even though the population is less than in any other region, it earns the second-highest income at approximately US$ 27.23 billion. The Central region has the highest income at US$ 27.45 billion. The third-highest income is from the Northeast at US$ 24.51 billion. The bottom two regions are the North, US$ 16.14 billion, and the South, US$ 13.44 billion respectively.

The two regions that receive high government transfers relative to total income, implying poverty problems in those areas, are the North (12.30 percent) and the Northeast (15.55 percent). Bangkok has the highest wage income from skilled labour in terms of its proportion of total income, 10.58 percent, in terms of value, US$ 2.88 billion.

Table 7.5: Sources of household income by community

(US$ billion)

	Municipal area		**Sanitary district**		**Village**	
	Value	**%**	**Value**	**%**	**Value**	**%**
Capital	22.84	54.64	7.07	61.56	37.91	68.34
Unskilled	11.09	26.53	2.42	21.09	8.25	14.86
Skilled	4.21	10.08	0.92	8.01	3.13	5.65
Gov Transfer	3.66	8.75	1.07	9.34	6.18	11.15
Total	**41.80**	**100.00**	**11.49**	**100.00**	**55.48**	**100.00**

Source: Thai household survey, Author calculation

Table 7.6: Sources of household income by region

(US$ billion)

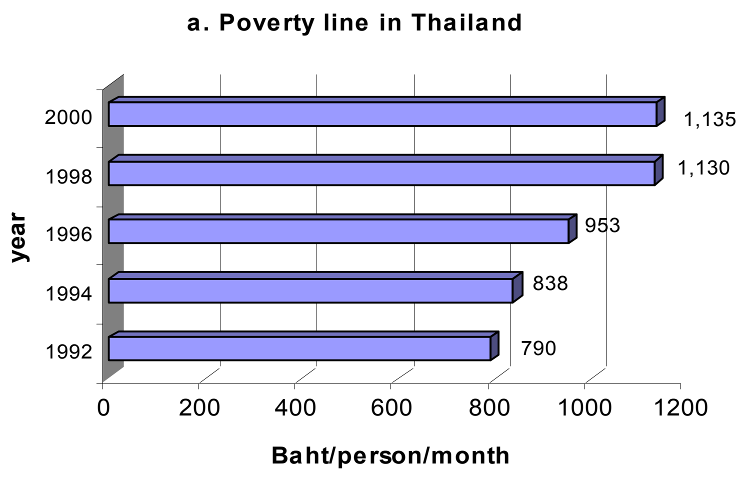
	Bangkok		Central		North		Northeast		South	
	Value	**%**	**Value**	**%**	**Value**	**%**	**Value**	**%**	**Value**	**%**
Capital	14.65	53.8	16.91	61.6	10.60	65.7	16.30	66.5	9.36	69.6
Unskilled	7.58	27.8	6.16	22.4	2.57	15.9	3.19	13.0	2.25	16.8
Skilled	2.88	10.6	2.34	8.5	0.98	6.1	1.21	4.94	0.86	6.4
Gov Transfer	2.12	7.8	2.03	7.4	1.98	12.3	3.81	15.5	0.97	7.2
Total	**27.23**	**100.0**	**27.45**	**100.0**	**16.14**	**100.0**	**24.51**	**100.0**	**13.44**	**100.0**

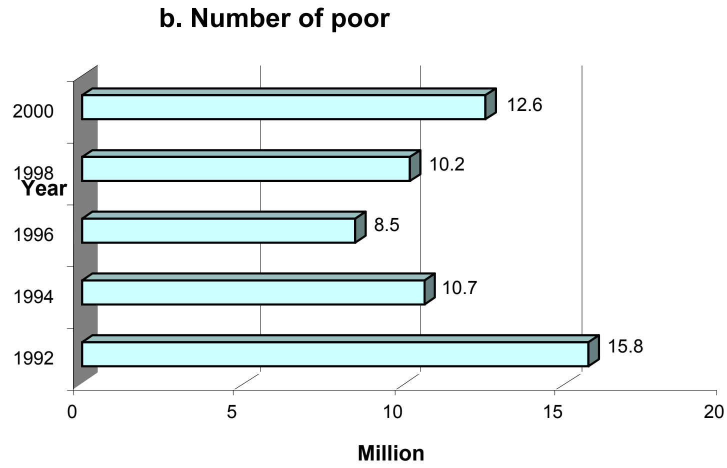
Source: Thai household survey, Author calculation

8.3 Poverty in Thailand

Thailand's official poverty line is based on the cost of basic goods, covering both food and non-food consumption. Figure 7.3 shows the poverty line and the number of poor in Thailand from 1992 to 2000. The poverty line in Thailand continuously increases due to the rising cost of living (from 790 baht per person per month in 1992 to 1,135 baht per person per month in 2000).

Figure 7.3: Poverty line and number of poor in Thailand





Source: National Economic and Social Development Board (NESDB) of Thailand

The number of poor people in Thailand has gradually reduced, from 15.8 million people in 1992 to 8.5 million people in 1996. However, the number of poor started to increase again during and after the Asian financial crisis, rising from 10.2 million in 1998 to 12.6 million in 2000.

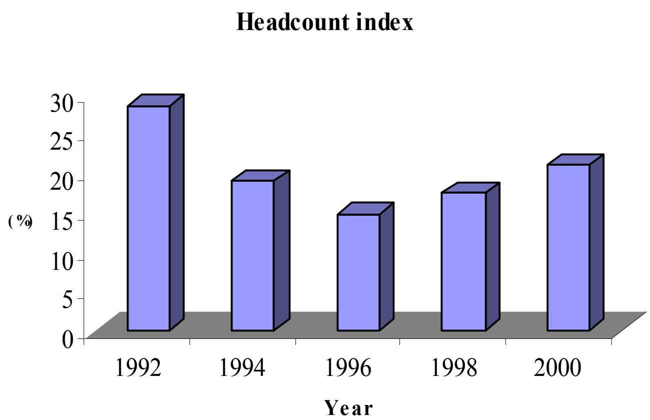
8.4 Poverty and inequality indices for Thailand

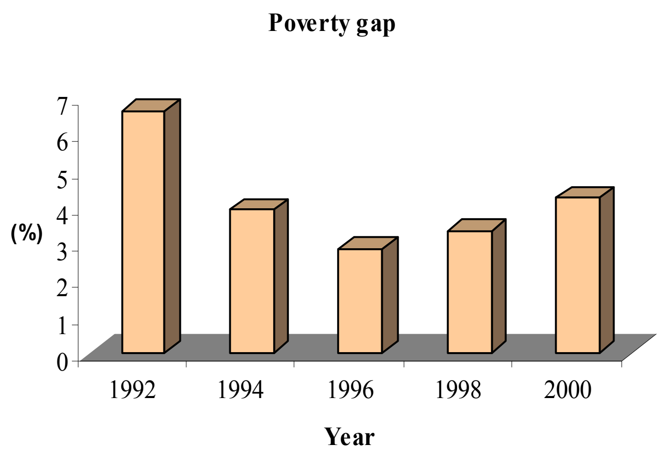
8.4.1 Poverty indices for Thailand

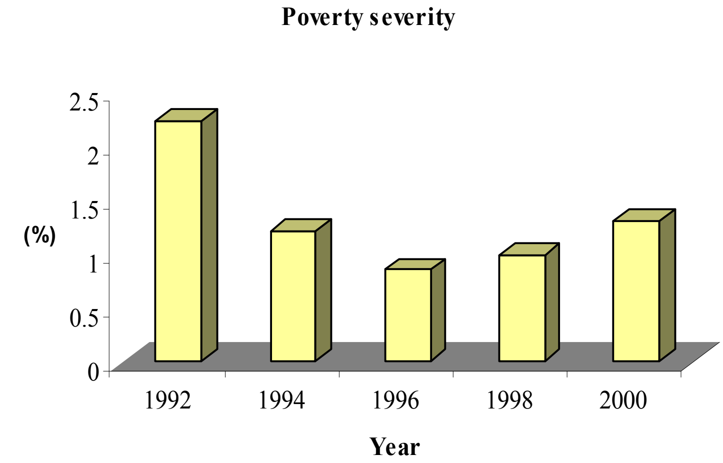
As Thailand has recently revised its official poverty line, the headcount index at the household level is measured by comparing per capita household expenditure on consumption against the poverty line. Typically, if an individual has an income below the poverty line, he or she is classified as poor. Figure 7.4 shows that the poverty incidence or headcount index was 28.43 percent in 1992, but that it decreased considerably, to 14.75 percent, in 1996. However, owing to the Asian Financial crisis, the headcount index increased slightly to 17.46 and 20.98 percent in 1998 and 2000.

The problem of using the poverty incidence measure is that it does not reflect the depth and severity of poverty. The poverty gap ratio, which measures the depth of poverty, decreased significantly from 6.62 percent in 1992 to 2.85 percent in 1996. It subsequently increased to 4.24 percent in 2000. On the other hand, the poverty severity index, which measures inequality among the poor, dropped to 0.85 percent in 1996. Nonetheless, the financial crisis worsened the poverty situation and brought the poverty severity index up to 1.3 percent in 2000. Summarising, both the poverty gap and the poverty severity in Thailand from 1992 to 2000 show the same trend as the headcount index.

Figure 7.4: Headcount index, poverty gap and poverty severity in Thailand





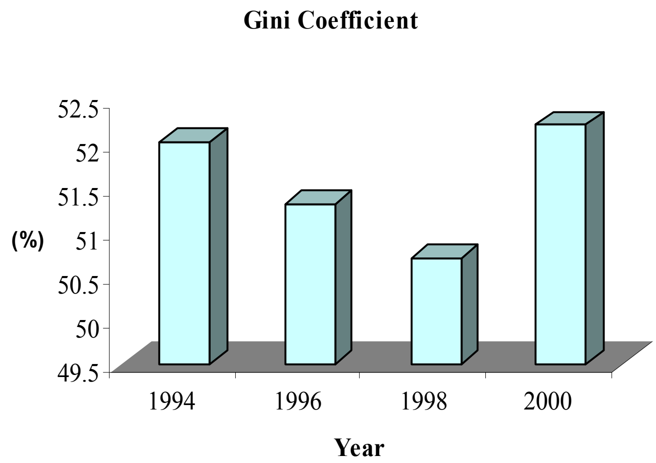


Source: National Economic and Social Development Board (NESDB) of Thailand

8.4.2 Inequality indices for Thailand

Gini coefficients are widely used to measure the extent to which the distribution of income among individuals or households within a country deviates from a perfectly equal income distribution. Figure 7.5 shows that the Gini coefficient was 52 percent in 1994, indicating a moderate income disparity. The coefficient gradually fell to 51.30 percent and then to 50.70 percent in 1996 and 1998 respectively. However, income inequality worsened in 2000, when the Gini coefficient was 52.20 percent.

Figure 7.5: Gini coefficient in Thailand



Source: National Economic and Social Development Board (NESDB) of Thailand

9. Simulation results

This study reports on four different policy simulations – (1) ASEAN-China Free Trade Area, (2) ASEAN-Japan Free Trade Area, (3) ASEAN-Korea Free Trade Area, and (4) East Asian Free Trade Area.[31] As explained in section 2, the simulation results from an integrated model allow the modeller to calculate various poverty and inequality indices. As income and expenditure of all households are explicitly incorporated in the model, the simulation results therefore display the new levels of income and expenditure of all households following policy shocks. We can then compute these indices for Thailand and make comparisons between the various before- and after- trade liberalisation options. The DAD Software is used to facilitate the calculation of the poverty and inequality indices reported here.[32]

The poverty or FGT indices are calculated using real expenditure on consumption per capita, as the information on the expenditure side is deemed to be more reliable than that on the income side. The measures used are the headcount index, the poverty gap, and the poverty severity. To measure inequality, we use real income per capita to compute two indices – the Gini coefficient and the Atkinson index. The reason for calculating two different indices is that there is no consensus as to which index is the better measure of inequality. Thus, we compare the inequality information that they provide, in particular using the of Atkinson index to test the robustness of the traditional Gini coefficient.

[31] East Asian Free Trade Area (EAFTA) refers to ASEAN, China, Japan, and Korea. In some papers, it is called as ASEAN+3.

[32] DAD, developed by Duclos J. Y., Araar A. and Fortin C. (2001), is a software package used for Distributive Analysis/Analyze Distributive. The program is freely distributed and is available at www.mimap.ecn.ulaval.ca

9.1 Benchmark scenario

After the data of household survey have been reconciled and readjusted for the base year 2001, poverty and inequality indices are calculated from these benchmark data. **Table 7.7** presents the headcount index, the poverty gap, poverty severity, the Gini coefficient, and the Atkinson index with three different inequality aversion values.

Table 7.7: FGT, Gini, and Atkinson indices by region and by community at benchmark

	FGT index			Inequality index			
	Headcount index	Poverty gap	Poverty severity	Gini Coeff.	Atkinson Index $\varepsilon = 0.5$	$\varepsilon = 0.75$	$\varepsilon = 1.0$
Whole Kingdom	**12.95**	**3.17**	**1.15**	**51.24**	**21.52**	**29.63**	**36.46**
Region							
Bangkok	0.08	0.01	0.00	42.71	15.23	21.25	26.52
Central	3.74	0.78	0.24	45.06	16.79	23.34	29.01
North	14.29	3.44	1.24	46.50	17.66	24.49	30.31
Northeast	22.90	5.72	2.11	46.62	18.37	25.01	30.55
South	10.62	2.57	0.95	47.38	18.45	25.79	32.20
Community							
Municipal	0.82	0.14	0.04	44.08	16.14	22.63	28.36
Sanitary	7.38	1.55	0.49	46.31	17.72	24.69	30.77
Village	17.00	4.21	1.55	45.93	17.55	24.22	29.93

Source: Author simulation

9.1.1 Poverty indices at benchmark

The headcount index for the whole kingdom is 12.95 percent. If decomposed by region, Northeast is the region with the highest proportion of the poor at 22.90 percent, followed by North, South, Central and Bangkok at 14.29, 10.62, 3.74, and

0.08 percent respectively. On the other hand, if decomposed by community type, ‘village’ is the community with the highest proportion of the poor, at 17 percent, followed by ‘sanitary’ and ‘municipal’ at 7.38 and 0.82 percent respectively.

The poverty gap and poverty severity measures for the whole kingdom are 3.17 and 1.15 percent. When decomposed by region and community, as with the headcount index, the poverty gap and poverty severity indices display the same regional trends, with the Northeast region having the highest poverty gap (5.72 percent) and poverty severity (2.11 percent). The highest poverty gap (4.21 percent) and poverty severity (1.55 percent) indices are again in the ‘village’ areas. These results indicate that poverty in Thailand varies substantially across regions and communities, and that the poverty problem is at its worst in the Northeast and North regions, and in the ‘village’ area.

9.1.2 Inequality indices at benchmark

The Gini coefficient of Thailand for the whole kingdom is 51.24 percent (**table 7.7**). Decomposing the inequality effects by region shows that, with the exception of Bangkok, the Gini coefficients do not vary markedly across regions. The highest income inequality is in the South region, with a Gini coefficient of 47.38 percent, with the other regions having Gini coefficients between 45 and 47 percent.

The exception, Bangkok, has a Gini coefficient of 42.71 percent. The Gini coefficients in different communities are also broadly similar. The ‘sanitary’ districts have the highest inequality (46.31 percent), followed by the ‘village’ (45.93 percent) and ‘municipal’ areas (44.08 percent).

Setting the inequality aversion parameter values at $\varepsilon = 0.5$, $\varepsilon = 0.75$, and $\varepsilon = 1.0$ gives Atkinson indices for Thailand at 21.52, 29.63, and 36.46 respectively. As expected, the higher is ε, the higher is the Atkinson index. This is because increasing inequality aversion increases the sensitivity of the Atkinson index to low incomes. The Atkinson income inequality indices yield the same rankings as those derived from the Gini coefficients when decomposed by region and community. The income disparity in the South region is the highest, followed by Northeast, North, Central, and Bangkok. Similarly, the Atkinson indices also give the same ranking for the 'sanitary' districts, 'villages' and 'municipal areas'.

9.2 Policy simulation scenarios

9.2.1 Overview of results

Trade liberalisation can affect an individual household through the channels of changes in factor and output prices. Households would be better off if their disposable income levels increase after the policy is implemented. These disposable incomes are usually spent on consumption of commodities. Therefore, as a preliminary indicator of households' well-being, real expenditure on consumption per capita under different East Asia FTAs is given in **table 7.8**.

Table 7.8: Real expenditure on consumption per capita under different East Asia FTAs

	ASEAN-China		ASEAN-Japan		ASEAN-Korea		EAFTA	
	US$	% change	US$	% change	US$	% change	US$	% change
Consumption per capita	1,486.91	2.20	1,526.04	4.89	1,471.89	1.17	1,538.06	5.72

Source: Author simulation

The integrated model approach provides the simulation results at the level of expenditure on consumption for each individual household. With the information of household size and its sample weight taken into account, real expenditure on consumption per capita under each FTA can be calculated from these post-simulation results. Real expenditure on consumption per capita under the EAFTA is the highest among other alternative trade agreements, since the households would spend US$ 1,538.06 on consumption per head, an increase of 5.72 percent from the benchmark level. This is followed by ASEAN-Japan FTA (US$ 1,526.04 per capita, an increase of 4.89 percent from the benchmark), ASEAN-China FTA (US$ 1,486.91 per capita, an increase of 2.20 percent from the benchmark) and ASEAN-Korea FTA (US$ 1,471.89 per capita, an increase of 1.17 percent from the benchmark), respectively.

The results on expenditure on consumption per capita indicate that trade liberalisation would lead households to spend more on consumption than their benchmark level, which suggests that households in general should be better off. However, the results at the individual household level show that some households' expenditure on consumption per capita is actually reduced. This implies that not every household can achieve higher welfare after trade is liberalised. **Table 7.9** presents the number of household with decreasing real expenditure on consumption per capita. To enrich the analysis, these results are also decomposed by community and by region to allow the identification of which areas would be most affected.

Table 7.9: Number of households with decreasing real expenditure on consumption per capita decomposed by community and by region

Community and region	Number of total household	ASEAN-China		ASEAN-Japan		ASEAN-Korea		EAFTA	
		No.	% of total	No.	% of total	No.	% of total	No.	% of total
Whole kingdom	**24,747**	**3,050**	**12.32**	**426**	**1.72**	**4,975**	**20.10**	**373**	**1.51**
Municipal area	9,217	1580	17.14	257	2.79	2458	26.67	233	2.53
Sanitary district	6,061	713	11.76	80	1.32	1156	19.07	68	1.12
Village	9,469	757	7.99	88	0.93	1361	14.37	72	0.76
Whole kingdom	**24,747**	**3,050**	**12.32**	**426**	**1.72**	**4,975**	**20.10**	**373**	**1.51**
Bangkok	1,649	328	19.89	42	2.55	516	31.29	42	2.55
Central	6,609	934	14.13	109	1.65	1545	23.38	94	1.42
North	5,566	597	10.73	72	1.29	981	17.62	63	1.13
Northeast	6,726	749	11.14	140	2.08	1169	17.38	116	1.72
South	4,197	442	10.53	63	1.50	764	18.20	58	1.38

Source: Author simulation

Based on the survey data, there are 24,747 households in total used in the counterfactuals. Around 20 percent of Thai households, or approximately 4,975 households, would be worse off due to a decrease in their consumption under the ASEAN-Korea FTA. Under the ASEAN-China FTA, at least 12 percent of households would be worse off, compared to 1.72 percent under ASEAN-Japan and only 1.51 percent under the EAFTA. Focusing on which area/region would be most affected in terms of the number of households, the results show a similar pattern, in that the households in municipal area, especially in the capital, Bangkok, would be most susceptible to a decrease in their consumption per capita. For example, approximately 27 percent (and 31 percent) of households in the municipal area (and in Bangkok) would spend less income on consumption under the ASEAN-Korea option. The in-depth analysis of trade liberalisation effects is investigated using the poverty and income inequality indices, and these are presented in the next section.

9.2.2 Poverty indices at policy scenarios

The values of the poverty indices, decomposed by community and region, under the benchmark and the four policy simulations are shown in **tables 7.10 and 7.11**, respectively. Overall the simulation results indicate that no matter which Free Trade Area Thailand chooses to pursue, the poverty problem would be reduced. However, the degree of poverty reduction varies according to the implemented policy.

At first glance, we observe that all the overall FGT indices do not seem to imply a substantial reduction in poverty in Thailand. For example, the headcount index decreases slightly from 12.95 percent in the benchmark to 12.50 percent under ASEAN-Korea FTA. (and to 12.10 percent under ASEAN-China FTA, 11.56 percent under ASEAN-Japan FTA, and 11.20 percent under EAFTA). In addition, the poverty gap and poverty severity for the whole kingdom also do not indicate a major effect on poverty reduction.

However, the effects of poverty alleviation are more noticeable once we decompose them by community and region. When decomposed by community, the headcount index, poverty gap, and poverty severity under different policy simulations still provide the same patterns as in the benchmark, with people who live in the ‘villages’ tending to suffer more from poverty than those who live in the sanitary districts and municipal areas.

Surprisingly, although flagged as the poorest area, the FGT indices for the villages decrease more than in the other communities, as shown in **table 7.10**. For example, under the EAFTA option, the headcount index for the village area falls from 17 to

14.21 percent, its poverty gap from 4.21 to 3.55 percent, and its poverty severity from 1.54 to 1.28 percent.

Table 7.10: Thailand FGT poverty indices decomposed by community

Community	ASEAN-China		ASEAN-Japan		ASEAN-Korea		EAFTA	
	%	Change in % points	%	Change in % points	%	Change in % points	%	Change in % points
Headcount index								
Whole kingdom	**12.10**	**-0.85**	**11.56**	**-1.39**	**12.50**	**-0.45**	**11.20**	**-1.75**
Municipal area	0.76	-0.06	0.72	-0.10	0.82	0.00	0.68	-0.14
Sanitary district	6.23	-1.15	6.44	-0.94	7.22	-0.16	6.24	-1.14
Village	15.88	-1.12	15.20	-1.80	16.38	-0.62	14.21	-2.79
Poverty gap								
Whole kingdom	**2.95**	**-0.22**	**2.75**	**-0.42**	**3.05**	**-0.12**	**2.67**	**-0.50**
Municipal area	0.13	-0.01	0.11	-0.03	0.14	0.00	0.11	-0.03
Sanitary district	1.45	-0.10	1.32	-0.23	1.51	-0.04	1.28	-0.27
Village	3.91	-0.30	3.66	-0.55	4.05	-0.16	3.55	-0.66
Poverty severity								
Whole kingdom	**1.06**	**-0.09**	**0.99**	**-0.16**	**1.11**	**-0.04**	**0.95**	**-0.20**
Municipal area	0.03	-0.01	0.03	-0.01	0.03	-0.01	0.03	-0.01
Sanitary district	0.46	-0.03	0.41	-0.08	0.48	-0.01	0.39	-0.10
Village	1.43	-0.11	1.32	-0.22	1.48	-0.06	1.28	-0.26

Source: Author simulation

When decomposed by region the FGT indices under the different FTA options also give the same rankings as in the benchmark. People who live in the Northeast region still suffer the most from poverty. They are followed by those who live in North, South, Central and Bangkok, consecutively.

Again, flagged as the two poorest regions, the FGT indices in the Northeast and North fall more than in any other regions (**table 7.11**). For example, under the EAFTA option, the headcount index for the Northeast drops almost 3 percentage points, from 22.90 to 19.98 percent, while that of the North decreases by more than 2 percentage points, from 14.07 to 12.18 percent. The poverty gap in the Northeast and North under EAFTA, is much smaller, falling from 5.72 to 4.85 percent and from 3.44 to 2.87 percent respectively. Poverty severities in these two regions are also improved by 0.36 percent in the Northeast and by 0.22 percent in the North.

Table 7.11: Thailand FGT poverty indices decomposed by region

Region	ASEAN-China		ASEAN-Japan		ASEAN-Korea		EAFTA	
	%	Change in % points	%	Change in % points	%	Change in % points	%	Change in % points
Headcount index								
Whole kingdom	**12.10**	**-0.85**	**11.56**	**-1.39**	**12.50**	**-0.45**	**11.20**	**-1.75**
Bangkok	0.08	0.00	0.08	0.00	0.08	0.00	0.08	0.00
Central	3.62	-0.12	3.37	-0.37	3.74	0.00	3.23	-0.51
North	13.77	-0.52	13.01	-1.28	14.07	-0.22	12.18	-2.11
Northeast	21.21	-1.69	20.40	-2.50	21.92	-0.98	19.98	-2.92
South	9.64	-0.98	9.18	-1.44	10.09	-0.53	8.96	-1.66

Table 7.11: Thailand FGT poverty indices decomposed by region (cont.)

Region	ASEAN-China		ASEAN-Japan		ASEAN-Korea		EAFTA	
	%	Change in % points	%	Change in % points	%	Change in % points	%	Change in % points
Poverty gap								
Whole kingdom	**2.95**	**-0.22**	**2.75**	**-0.42**	**3.05**	**-0.12**	**2.67**	**-0.50**
Bangkok	0.00	-0.01	0.00	-0.01	0.01	0.00	0.00	-0.01
Central	0.76	-0.02	0.68	-0.10	0.78	0.00	0.66	-0.12
North	3.20	-0.24	2.97	-0.47	3.32	-0.12	2.87	-0.57
Northeast	5.31	-0.41	5.00	-0.72	5.48	-0.24	4.85	-0.87
South	2.40	-0.17	2.21	-0.36	2.48	-0.09	2.14	-0.43
Poverty severity								
Whole kingdom	**1.06**	**-0.09**	**0.99**	**-0.16**	**1.11**	**-0.04**	**0.95**	**-0.20**
Bangkok	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Central	0.23	-0.01	0.21	-0.03	0.24	0.00	0.20	-0.04
North	1.15	-0.09	1.06	-0.18	1.20	-0.04	1.02	-0.22
Northeast	1.94	-0.17	1.81	-0.30	2.01	-0.10	1.75	-0.36
South	0.88	-0.07	0.80	-0.15	0.91	-0.04	0.77	-0.18

Source: Author simulation

9.2.3 Inequality indices at policy scenarios

- **Gini coefficients**

Table 7.12 reports the Gini coefficients by community and by region under the benchmark and four different policy simulations. Overall no matter which FTA option that Thailand pursues, there is little effect on income inequality. The Gini coefficients for each community and/or each region are little changed, indicating that trade liberalisation does not worsen the inequality situation in Thailand.

Table 7.12: Thailand Gini coefficients decomposed by community and by region

Community and region	ASEAN-China		ASEAN-Japan		ASEAN-Korea		EAFTA	
	%	Change in % points	%	Change in % points	%	Change in % points	%	Change in % points
Community								
Whole kingdom	**51.20**	**-0.04**	**51.24**	**0.00**	**51.22**	**-0.02**	**51.22**	**-0.02**
Municipal area	44.05	-0.03	43.95	-0.13	44.05	-0.03	43.96	-0.12
Sanitary district	46.29	-0.02	46.28	-0.03	46.30	-0.01	46.28	-0.03
Village	45.88	-0.05	45.86	-0.07	45.89	-0.04	45.84	-0.09
Region								
Whole kingdom	**51.20**	**-0.04**	**51.24**	**0.00**	**51.22**	**-0.02**	**51.22**	**-0.02**
Bangkok	42.68	-0.03	42.55	-0.16	42.68	-0.03	42.57	-0.14
Central	45.05	-0.01	44.99	-0.07	45.05	-0.01	45.00	-0.06
North	46.42	-0.08	46.39	-0.11	46.45	-0.05	46.37	-0.13
Northeast	46.49	-0.13	46.50	-0.12	46.54	-0.08	46.45	-0.17
South	47.35	-0.03	47.30	-0.08	47.35	-0.03	47.31	-0.07

Source: Author simulation

Gini coefficients decomposed by community under four different FTAs show the same pattern as in the benchmark. For example, under ASEAN-China FTA, sanitary area suffers the most from income disparity (approximately 46.29 percent), followed by villages (approximately 45.88 percent) and municipal areas (approximately 44.05 percent).

Gini coefficients decomposed by region under the four different FTAs also show the same pattern as in the benchmark. For example, under ASEAN-China FTA, people who live in the South region suffer the most from income inequality (47.35 percent). This is followed by the Northeast (46.49 percent), North (46.42 percent), Central (45.05 percent) and Bangkok (42.68 percent) consecutively. This implies that inequality across regions is slightly greater than inequality across communities.

- **Atkinson index**

In this study we use the Atkinson index as a check on the robustness of the Gini coefficient. As the value of inequality aversion parameters can be varied, we choose three different values ($\varepsilon = 0.5, 0.75, 1.0$) for estimating the trend of inequality in Thailand. The Atkinson indices, decomposed by community and by region under the benchmark and the four different policies, are reported in **tables 7.13 and 7.14** respectively.

Table 7.13: Thailand Atkinson indices decomposed by community

Community	ASEAN-China		ASEAN-Japan		ASEAN-Korea		EAFTA	
	%	Change in % points	%	Change in % points	%	Change in % points	%	Change in % points
$\varepsilon = 0.5$								
Whole kingdom	**21.50**	**-0.02**	**21.52**	**0.00**	**21.51**	**-0.01**	**21.50**	**-0.02**
Municipal area	16.13	-0.01	16.04	-0.10	16.12	-0.02	16.06	-0.08
Sanitary district	17.71	-0.01	17.69	-0.03	17.71	-0.01	17.69	-0.03
Village	17.51	-0.04	17.49	-0.06	17.52	-0.03	17.49	-0.06
$\varepsilon = 0.75$								
Whole kingdom	**29.60**	**-0.03**	**29.63**	**0.00**	**29.61**	**-0.02**	**29.61**	**-0.02**
Municipal area	22.61	-0.02	22.50	-0.13	22.60	-0.03	22.52	-0.11
Sanitary district	24.67	-0.02	24.65	-0.04	24.67	-0.02	24.65	-0.04
Village	24.17	-0.05	24.15	-0.07	24.19	-0.03	24.14	-0.08
$\varepsilon = 1.0$								
Whole kingdom	**36.41**	**-0.05**	**36.46**	**0.00**	**36.43**	**-0.03**	**36.43**	**-0.03**
Municipal area	28.33	-0.03	28.22	-0.14	28.33	-0.03	28.24	-0.12
Sanitary district	30.75	-0.02	30.74	-0.03	30.76	-0.01	30.73	-0.04
Village	29.86	-0.07	29.85	-0.08	29.88	-0.05	29.83	-0.10

Source: Author simulation

Table 7.14: Thailand Atkinson indices decomposed by region

Region	ASEAN-China		ASEAN-Japan		ASEAN-Korea		EAFTA	
	%	Change in % points	%	Change in % points	%	Change in % points	%	Change in % points
ε = 0.5								
Whole kingdom	**21.50**	**-0.02**	**21.52**	**0.00**	**21.51**	**-0.01**	**21.50**	-0.02
Bangkok	15.22	-0.01	15.12	-0.11	15.22	-0.01	15.14	-0.09
Central	16.78	-0.01	16.73	-0.06	16.78	-0.01	16.74	-0.05
North	17.60	-0.06	17.56	-0.10	17.61	-0.05	17.55	-0.11
Northeast	18.29	-0.08	18.29	-0.08	18.32	-0.05	18.26	-0.11
South	18.44	-0.01	18.39	-0.06	18.44	-0.01	18.40	-0.05
ε = 0.75								
Whole kingdom	**29.60**	**-0.03**	**29.63**	**0.00**	**29.61**	**-0.02**	**29.61**	-0.02
Bangkok	21.23	-0.02	21.09	-0.16	21.22	-0.03	21.12	-0.13
Central	23.33	-0.01	23.27	-0.07	23.33	-0.01	23.28	-0.06
North	24.41	-0.08	24.37	-0.12	24.43	-0.06	24.35	-0.14
Northeast	24.89	-0.12	24.90	-0.11	24.93	-0.08	24.85	-0.16
South	25.77	-0.02	25.71	-0.08	25.77	-0.02	25.71	-0.08
ε = 1.0								
Whole kingdom	**36.41**	**-0.05**	**36.46**	**0.00**	**36.43**	**-0.03**	**36.43**	-0.03
Bangkok	26.49	-0.03	26.33	-0.19	26.48	-0.04	26.36	-0.16
Central	29.00	-0.01	28.94	-0.07	29.00	-0.01	28.95	-0.06
North	30.21	-0.10	30.17	-0.14	30.24	-0.07	30.14	-0.17
Northeast	30.40	-0.15	30.42	-0.13	30.46	-0.09	30.36	-0.19
South	32.17	-0.03	32.09	-0.11	32.17	-0.03	32.10	-0.10

Source: Author simulation

As indicated by the Gini coefficients, trade liberalisation rarely generates any substantial impact on inequality. The Atkinson indices under the different values of the inequality aversion parameter show a uniform trend even though the actual values differ due to the different sensitivity to low incomes. Note that the Atkinson index for each community and/or each region is almost unchanged. The results are consistent with those from the Gini coefficients, confirming that trade liberalisation does little to worsen the inequality situation in Thailand.

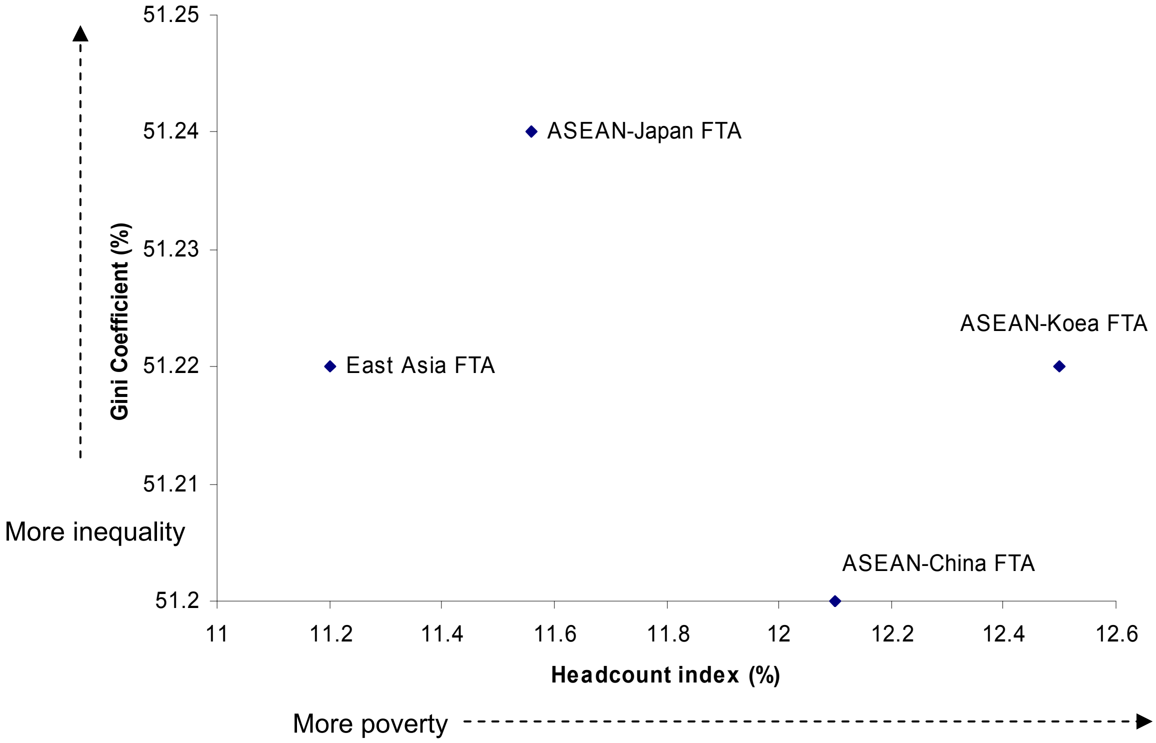
Paralleling the Gini coefficient results, the Atkinson index decomposed by community under four different FTAs shows that the sanitary area suffers the most from income inequality, followed by the village and municipal areas respectively. When decomposed by region the Atkinson index under four different FTAS indicates that people who live in the South region suffer the most from income disparity, followed by the Northeast, North, Central and Bangkok consecutively.

9.3 Preferred strategy

In order to determine which FTA option would most alleviate the poverty and income inequality problem in Thailand, we assume that the Thai government bases its judgement on the simulation results of headcount index and Gini coefficient of the whole kingdom. The combination of these two indices in the figure below indicates whether or not that policy yields a satisfactory economic outcome. *The lower and the closer the position is to the origin, the more favourable the outcome*. Figure 7.6 below represents the position of Thai economy under different FTA choices.

From figure 7.6 it is clear that ASEAN-China dominates ASEAN-Korea, and that EAFTA dominates ASEAN-Japan. Therefore the next step is to compare between ASEAN-China and EAFTA. The choice between these two policies depends on the weights that government would put on the Gini coefficient and the headcount index.

Figure 7.6: Preferred strategy of Thai government



We assume that both policy choices – ASEAN-China and EAFTA – lie on the same indifference curve, and that the government has a Cobb Douglas Utility function:

$$U_g = G^{\alpha} \cdot H^{1-\alpha}$$

where U_g is government utility, G is the Gini coefficient, H is the headcount index, α is the weight on Gini coefficient.

$$\ln U_g = \alpha \cdot \ln G + (1-\alpha) \cdot \ln H = \alpha \cdot (\ln G - \ln H) + \ln H$$

Suppose the two points are (G_1, H_1) and (G_2, H_2) Then for the two points to lie on the same indifference curve we must have a value of α that satisfies:

$$\alpha \cdot (\ln G_1 - \ln H_1) + \ln H_1 = \alpha \cdot (\ln G_2 - \ln H_2) + \ln H_2$$

or $$\alpha \cdot (\ln G_1 - \ln G_2) + \alpha \cdot (\ln H2 - \ln H_1) = \ln H_2 - \ln H_1$$

so that $$\alpha = \frac{\ln(H_2 / H_1)}{\ln(G_1 / G_2) + \ln(H_2 / H_1)}$$

According to the model results, under ASEAN-China FTA, the coordination values of the Gini and Headcount indices are 12.10 and 51.20, respectively. The coordination values of Gini and Headcount indices, under EAFTA, are 11.20 and 51.22.

Therefore $$\alpha = \frac{\ln(51.22/51.20)}{\ln(11.20/12.10) + \ln(51.22/51.20)}$$

$$\alpha = 0.005$$

This calculation yields the crucial value of α. If $\alpha = 0.005$ then the Thai government is indifferent between the two options. If the 'actual' value of α is greater than 0.005, the government will prefer the FTA option that gives the higher Gini coefficient. In contrast, if the government's actual alpha is lower than 0.005, it will prefer the FTA option that gives the lower Gini coefficient. Since the government actual value of α is not known, we cannot identify which is the best policy on the basis of alpha values. However, the simulation results considered in section 9.2.2, 'Inequality indices and policy scenarios', imply that FTAs have a noticeably small effect on income distribution in Thailand. The government may put more weight on the poverty issue, implying that the policy which most reduces poverty – EAFTA – is more economically desirable.

10. Conclusion

This study shows that government policies on implementing trade liberalisation with different trading partners may have different economic impacts on poverty and the distribution of income for the Thai people. As each household owns different amounts and different types of factor supply, the changes in factor prices due to trade liberalisation will inevitably affect the household income and expenditure patterns at the individual level.

We have used an integrated model incorporating all household data to analyse the poverty and inequality effects within a CGE framework. It is apparent that trade liberalisation would lead to higher consumption per capita for the aggregate Thai household. However, this does not guarantee that every household would be better off, because some households' consumption per capita are reduced from the benchmark level.

The model results on household income and expenditure also allow us to calculate poverty (FGT) and inequality indices (Gini coefficient and Atkinson index) for the benchmark and the four different policies. The model results at the national level suggest that all trade liberalisation options will alleviate the poverty problem in Thailand, but that the degree of poverty reduction will vary depending upon the implemented policy. The poverty in the poorest community, 'villages', and in the poorest region, the Northeast, improves the most under all the Free Trade Area options.

The results from the Gini coefficient and the Atkinson indices are used to assess the effects on income inequality. Both suggest the same conclusion: regional trade liberalisation, no matter which option, does not have a major impact on income disparity in Thailand. In other words, implementing the Free Trade Area with East Asian trading partner/s will not harm income inequality in Thailand. However, it should be kept in mind that the relatively small effect on income distribution would in part be due to the model specification in which the overall impact would be smoothly allocated across households.

When combined the outcomes on both poverty and income distribution issues, the results indicate that EAFTA may be the best policy option for Thai government to pursue. This policy choice, made from a broad economic point of view, is the best for both a reduction of poverty and income inequality for the increase in real GDP and welfare[33] for Thailand.

[33] As stated in the policy simulations in Chapter 6: Policy Simulations.

Chapter 8

Conclusions

1. Conclusions from the study

It is evident that interest in regionalism in East Asia, and particularly bilateral and regional trade liberalisation – between ASEAN, China, Japan and Korea – has increased over the last five years. A major goal for all countries in the region is to deepen the economic integration and cooperation among the East Asian nations. Even though such initiatives can be focused on several channels, e.g. trade and investment facilitation, one of the practical ways to realise such integration would be to set up the East Asia Free Trade Area (EAFTA) to eliminate tariff (and other) barriers to intra-regional trade.

Due to the differences in the level of development and economic structure of the East Asian economies, the process of negotiating the establishment of EAFTA will be time-consuming. Moving towards bilateral agreements among the member regions, and then extending them to other members seems to be a reasonable and practical approach. Framework agreements on bilateral tariff elimination between ASEAN nations and other large East Asia countries or groups (i.e. ASEAN-China, ASEAN-Japan and ASEAN-Korea) have been signed and their implementation is under way.[1] In this respect, it is very interesting to assess what the economic effects of these bilateral agreements would be, particularly in comparison to those of the ultimate regional goal – the East Asia Free Trade Area.

[1] Details are given in Chapter 2: Regionalism in East Asia.

The general equilibrium model developed in this thesis is an appropriate and useful tool that can provide some comprehensive insights. In order to enhance and broaden the analysis, the CGE model used here has two distinct extensions or 'deviations' from a 'standard' CGE model. First, the labour markets are modelled as imperfect.[2] Second, for one of the East Asian countries, Thailand, the standard 'representative household' has been replaced by a set of highly disaggregated households in order to provide a deeper insight into some of the consequences of regional integration.[3] These additional features enrich the analysis of the economic impacts of trade liberalisation on the markets for skilled and unskilled labour and on poverty and the distribution of income.

1.1 General conclusions

FTA member countries tend to trade more with other members in order to enjoy the FTA tariff preferences, and this will inevitably reduce the volume of trade with non-member countries. As a result, both trade creation and trade diversion effects are generated. Trade creation, in which domestic production shifts to more efficient sources within the FTA, leads to an increase in welfare. In contrast trade diversion, in which imports shift to less efficient FTA sources, may lead to a decrease in welfare. An FTA would be viewed as preferable to the status quo if, in aggregate, the gains from trade creation exceed the losses from trade diversion. All FTA options in East Asia – ASEAN-China FTA, ASEAN-Japan FTA, ASEAN-Korea FTA, and EAFTA – would be net trade-creating to the member countries and be net trade-diverting to the non-member countries. This implies that FTA member countries would enjoy

[2] The incorporation of unemployment is explained in details in Chapter 4: A CGE model for East Asia.

[3] The model with the disaggregated household is described in Chapter 7: Poverty and income inequality in Thailand.

welfare gains while non-members would suffer from welfare losses. However, at the global level, all four of the alternative FTAs in East Asia would eventually bring welfare gains to the world. The extent of global welfare gains would be the greatest under the EAFTA.

Changes in the terms of trade also affect the welfare level of an economy. A country's terms of trade improve when its export prices rise relative to its import prices, which yields a welfare gain, and vice-versa. FTA member countries generally enjoy an improvement in their terms of trade, while non-member countries' terms of trade typically deteriorate. However, exceptions appear for China (an FTA member with a adverse change in its terms of trade) and the NAFTA (a non-member with an improvement in its terms of trade). This is because China and the NAFTA would be a major importer and a major exporter, respectively, in the global trade system once trade is liberalised in East Asia.

The economic gains of the EAFTA members through the increases in real GDP and in economic welfare are estimated to be greater than under any of the bilateral agreements considered. Member regions will enjoy economic gains from joining the East Asia Free Trade Area, while regions that stay outside EAFTA will tend to suffer negative impacts. Changes in real absorption – the sum of household consumption, government consumption and investment –show a similar pattern to the changes in real GDP. The total welfare change can be decomposed into allocative efficiency and terms of trade effects. The total welfare and terms of trade effects can be directly calculated from the model results on the changes in the EV and in trade volumes and prices. In general, a country's welfare gain or loss is reinforced by both allocative efficiency and terms of trade effects, in which FTA member countries tend to have either positive effects from both sources; or vice-versa. Even though these are not the outcomes for China and the NAFTA, in that their terms of trade effects are in the opposite direction to the allocative efficiency effects, their total levels of welfare still follow the pattern of net welfare increases for FTA member countries and net welfare decreases for non-member countries.

Trade liberalisation substantially reduces the level of unemployment in the member regions. Under the assumption of fixed unemployment benefit per capita, governments can make considerable savings on government transfers, which are assumed to be spent on unemployment benefits, and can transfer the surplus back to the households. Even though income tax rates tend to increase, reflecting the government neutral revenue closure assumption, the extra benefit that households receive can be viewed as an income tax subsidy. The formation of an FTA leads to real wage convergence in ASEAN and China, where unskilled labour is relatively abundant. In contrast, real wage inequality deteriorates in Japan and Korea, where skilled labour is relatively abundant.

The sectoral impacts on intra-regional trade are complex under the East Asia FTA, as they are determined by trade structures and the levels of initial trade barriers. In general, the magnitudes of the changes in domestic production and intra-regional trade under the regional agreement – the East Asia FTA – are greater than under any of the bilateral agreements. ASEAN's trade with China would increase significantly, while China would considerably expand its exports to the previously more protectionist Japan and Korea. Japan and Korea would slightly reduce trade with one another but would find China's and ASEAN's markets more favourable for their exports.

Changes in domestic production in each member region would depend on many factors. Some sectors would contract in some or all member regions as a consequence of resource reallocation. Some sectors would expand in all member regions as the FTA creates discrimination against imports from non-member regions, resulting in falling prices of intermediate inputs and final products within the FTA. All of the results in this study have been tested for robustness using sensitivity tests.

The government in each region is assumed to make a decision on which trade agreement it wishes to pursue, based on changes in real GDP (measured as a percentage change from the benchmark) and in welfare (measured as a percentage of GDP) under each option. The East Asia FTA appears to be the most economically desirable for the East Asian economies as a whole. Even though ASEAN would have a preference for the ASEAN-China FTA, the large East Asia nations – China, Japan and Korea – would all prefer the East Asia FTA, which raises the possibility that ASEAN could be compensated for agreeing to join the East Asia FTA. The possibility of compensation is also investigated in this study; unfortunately we cannot identify any scenario where ASEAN is better off, in terms of both real GDP and national welfare, without the other East Asian nations being worse off.

1.2 Conclusions on poverty and income inequality in Thailand

The assumption of one representative household makes it impossible to analyse the poverty and income distribution issues, since all households in the economy are aggregated into one. Instead of having only one representative household in each region, in Chapter 7 we have modelled the Thai household as highly disaggregated in order to allow the calculation of the poverty and income distribution indices under the benchmark and the four different trade agreements. Additional data on household income and expenditure in Thailand were obtained from the Thai National Statistic Office. It should be noted that the assumption of one representative household in all other regions remains unchanged.

The model results show that Free Trade Areas with different trading partners generate different magnitudes of changes in poverty and income inequality in Thailand. As trade is liberalised, each sector is affected differently. Some sectors expand, while others contract, resulting in changes in factor demands and factor prices, and eventually in commodity prices. Each individual household is therefore inevitably affected because of changes in household income and expenditure patterns.

Participating in any of the East Asia FTAs would increase Thai households' real expenditure on consumption per capita, implying that Thai households are better off from trade liberalisation. Real expenditure per capita is the highest under the EAFTA, followed in sequence by the ASEAN-Japan FTA, the ASEAN-China FTA and the ASEAN-Korea FTA. However there is no guarantee that every individual household would be better off as the results also show that, in terms of numbers of households, some households' consumption per capita is indeed decreased. People who live in the municipal area, especially in the capital Bangkok, are the most vulnerable to a reduction in their consumption per capita.

For a deeper analysis, the headcount, poverty gap and poverty severity indices are used to evaluate the poverty effects in Thailand. At the national level, all trade agreements will reduce poverty in Thailand, especially in the poorest community, 'villages', and in the poorest region, the Northeast. The results also show that the East Asia FTA would yield a greater reduction in poverty than any other FTA option. Intuitively, since the East Asia FTA will yield the highest real wage rates (for both skilled and unskilled labour) and the lowest unemployment rates of all the bilateral trade agreements, households earn more income and spend more on consumption. This will make households in general better off and will move the poorest away from the poverty line. The income inequality effects under different trade agreements, measured by the Gini coefficient and the Atkinson indices, appear to be very small. These results imply that income disparity in Thailand will not be worsened by trade liberalisation.

When the outcomes for both poverty and the income distribution are combined, they indicate that EAFTA may be the best policy option for the Thai government to pursue. This policy choice, made from a broad economic point of view, is the best for reducing both poverty and income inequality.

Even though the economic results indicate that the East Asia Free Trade area would be the most favourable policy for member regions, establishing that Free Trade Area for the whole region may not be an easy task, there being four main obstacles. *First*, ASEAN and China wish to cooperate on member enlargement under the existing ASEAN-China FTA. However, to include Japan and Korea within the same umbrella of trade agreement may prove to be difficult as both regions show different interests in product coverage.

Second, Japan and Korea are notorious for being highly protective of their agriculture sectors. This issue has been a feature of their domestic policies for a long time, and they may be unlikely to accept a dramatic change in the near future.

Third, Japan currently uses a different approach to making regional trade arrangements, preferring bilateral negotiations with individual ASEAN nations. This raises the concern that there may be a 'spaghetti bowl'[4] problem.

Fourth, there is still an unsettled issue, the uneasy relationships between Japan and other East Asian nations, especially China, stemming from World War II.

1.3 Model results of trade liberalisation in East Asia compared with other previous studies

There are numerous empirical studies that have used CGE models for analysing regional integration in North America and Europe. Studies of regionalism in Asia, especially East Asia, are relatively less common. In particular, there are a limited number of studies that make a comprehensive comparison between existing and implemented bilateral trade agreements – ASEAN-China FTA, ASEAN-Japan FTA and ASEAN-Korea – and the ultimate regional trade agreement – the East Asia FTA. Nevertheless, the general consensus in the model results from this literature survey and the thesis are:

[4] Various trade agreements tend to have different tariff schedules, different implementation periods, different rules of origin, etc., which leads to higher cost of administration for member countries.

(1) The more countries/regions participate in a trade liberalisation agreement, the more sizable are the positive economic welfare gains for FTA-member countries/regions.

(2) Even though welfare improves in the FTA-member countries/regions, a bilateral or regional agreement generates a certain level of trade diversion, which can then be harmful to non-member countries/regions.

Under the EAFTA, the results in this thesis show that Japan's welfare gain is approximately 0.33 percent of its GDP which is almost the same as the results from a standard GTAP model (Scollay and Gilbert, 2001) where Japan's welfare gain is approximately 0.34 percent of its GDP. A model based on the New Trade theory, in Brown et al (2003), predicts that Japan's welfare gain would be higher at 2.62 percent of its GDP. In contrast Lee et al (2004) show that, with dynamic effects included, Japan's welfare gain is increased to US$ 66.30 billion, a substantial increase compared to the US$ 13.92 billion (without dynamic effects) derived from the results in this thesis.

The above comparisons imply that model specification plays an important role to the size of welfare gains and losses. As shown in Cheong (2003), incorporating dynamic effects substantially increases the levels of GDP and welfare in member countries/regions. The approaches to including dynamic impacts in CGE models vary across authors; for example, Cheong (2003) includes capital accumulation effects by allowing consumers to determine their savings based on the expected rate of return generated by the establishment of an FTA, while Kawasaki (2003) applies steady-state growth closure rules to link trade with consumption, production and investment.

On the other hand, the Brown et al (2003) Michigan model incorporates some aspects of the New Trade theory. The authors explain that markets still respond to trade liberalisation in similar way as under perfect competition; however the gains from trade are not limited to those from resource reallocation and changes in the terms of trade, since there are also gains from scales economies and increased product variety.

The pattern of the estimated impact on welfare in the ASEAN nations under different model specifications – this thesis,[5] the standard GTAP model,[6] the New Trade theory[7] model – is similar in that all indicate that the level of welfare gain as a percentage of GDP varies significantly across individual ASEAN countries, and in that all indicate that .Singapore tends to be the 'winner' with the highest percentage welfare gain, while welfare gains in Indonesia and Philippines are relatively much smaller.

The results from this thesis, as well as those from others, also suggest that small developing countries in ASEAN tend to gain more than the large countries – China, Japan and Korea. This can be explained by observing that the impacts of FTAs are generally derived from changes in prices and quantities of traded goods. Since a small economy usually has a small share in trade flows of large economies, its participation in an FTA would have no effect on prices. Therefore, the gains or losses in a large country are relative much smaller than in a small country.

[5] See Chapter 6: Policy simulations.
[6] See Scollay and Gilbert (2001).
[7] See Brown et al (2003).

1.4 Regionalism as an accelerator to multilateralism

Preferential Trade Agreements (PTAs) have become part of the modern trading system. Viewed as a second-best approach, they discriminate against non-member countries/regions. The results from the CGE model for East Asia used in this study clearly show that the gains for FTA-member countries are to some extent at the expense of non-member countries. Even though the debate about the pros and cons of establishing any form of PTA still remains inconclusive, it is undeniable that PTAs are now proliferating around the world. Therefore, what should be perceived as more important is how to enhance the benefits and to minimise the costs of existing and potential PTAs.

According to the model results, the regional trade agreement – the EAFTA – is more economically desirable than any of the bilateral agreements – ASEAN-China FTA, ASEAN-Japan FTA, and ASEAN-Korea FTA. The more member countries join in an FTA, the more benefits (welfare gains) there will be to the member countries. Even though this would imply higher costs (welfare losses) to non-member countries, the net gains at the global level from a regional trade agreement are considerably larger than those from bilateral agreements.

There follow some suggestions that would help to ensure that the EAFTA will be established with the lowest possible costs:

(1) All EAFTA member countries should apply low MFN tariffs to accompany the preferential tariffs offered to other members. This would help the local producers to have more access to low-priced input sources from outside the EAFTA, which

would lead to a reduction in trade diversion. Trade liberalisation can then become a powerful mechanism for increasing domestic competitiveness. Moreover, even though the EAFTA would generally cause both trade creation and trade diversion, it will bring welfare gains at the global level as long as it is a net trade creating agreement.

(2) The initial gaps between the levels of import tariffs among EAFTA members should not be wide enough to promote a terms of trade shock. A worsened terms of trade in the member countries with initial high import tariffs occurs because a decrease in domestic sales cannot be offset by an increase in their exports.

(3) The EAFTA member countries should adopt the same Rules of Origin (ROO)[8] to reduce the cost of administration. At the moment, those FTAs implemented in East Asia have adopted a combination of ROO, depending on the trading partners. For example, ASEAN-China FTA's ROO use a local (or regional) value content of 40 percent or a product specific rule; ASEAN-Korea's ROO use a local (or regional) value content of 40, 50, or 60 percent; ASEAN-Japan's ROO is even more complicated, with each individual ASEAN country having its own ROO with Japan. If member countries do not negotiate on the adoption of the same ROO, this will eventually result in severe spaghetti bowl effects.

[8] Rules of origin (ROO) are used to determine which goods are eligible for the preferential tariffs. Typically there are three types of rule: (a) a change in tariff classification rule defined at a detailed Harmonized System (HS) level; (b) a local (or regional) value content rule which a product must satisfy a minimum local (or regional) value in the country (or region) of an FTA; and (c) a specific process rule which requires a specific process for an item. (Kawai, M. and Wignaraja, G., 2008)

By consolidating multiple or overlapping bilateral FTAs into a regional FTA, and adopting consistent and complementary rules within the WTO, these do not only mitigate the harmful or negative impacts to the world but also make the regional FTA more 'friendly' to multilateralism.

2. Limitations and future research extensions

2.1 Model limitations

(1) At the time of writing this thesis, it is not known how an East Asia FTA could be formed. The negotiation of product coverage with some ASEAN nations is still not finalised under either the ASEAN-Japan FTA or the ASEAN-Korea FTA. We have assumed that all final negotiations will eventually comply with Article XXIV of the GATT, in which Free Trade Areas should cover 'substantially all' trade. The simulations are therefore based on the complete removal of bilateral import tariffs.[9]

The study does not include the possible economic effects from other forms of economic cooperation beyond trade issues, for example, intellectual property, investment facilitation, expert training, customs harmonization, etc. In addition, the study ignores the possibility of spaghetti bowl effects resulting from different Rules of Origin employed with different partners.

The CGE model for the East Asia analysis used in this study is static by nature. Therefore, it ignores the potential effects of economic growth and of technology

[9] According to an estimate by the ASEAN secretariat, 99% of import tariffs will be liberalised under the ASEAN-China FTA. Even though ASEAN and China do not have to conform with Article XXIV because both parties are categorised as developing countries, its product coverage is considered as 'substantially all' trade since all product exclusions account for less than 5% of the value of imports from other member regions (Lee C. J. et al, 2006).

transfers coming from trade liberalisation. Even though the dynamic effects are not included, the model results on the changes in the level of real investment implicitly suggest higher capital accumulation once trade is liberalised.

(2) In the context of the calculation of Thailand poverty and income distribution effects, the quality of the Thailand household data plays an important role. The data used in this thesis are relatively quite 'crude'; in that sectors could be grouped into only ten sets. Since 2005 the National Statistic Office in Thailand has improved the questionnaire used in the survey, and more recently collected data should have more detail and be of better quality. Thus it should be possible to have more household groups in future research.

The model specification used in this thesis implicitly assumes that the overall economic impacts on the level of unemployment and household income are allocated smoothly among households. Therefore the results on changes in unemployment levels for both skilled and unskilled labour in the Thai economy are presented as a whole. In other words, the model does not seek to investigate which unit of labour or household would be employed/unemployed after the policy simulations. In addition the economic impact of trade liberalisation on income distribution in Thailand may be underestimated since each individual household uniformly absorbs the total effects.

(3) As with most CGE studies, the values of elasticities have been taken from outside sources. Some values of elasticities in some sectors or in some sectors cannot be found in the literature, therefore they have to be set arbitrarily. The most commonly

criticised elasticities are trade elasticities used under the Armington assumption to allow two-way trade. These elasticities may lead to overstated welfare gains for FTA member countries and understated welfare losses for non-member countries.

2.2 Extensions for future research

(1) The CGE model used in this study is based on the conventional assumptions of constant returns to scale and perfect competition. However, in reality, there are some sectors that could be better modelled as imperfectly competitive. For example, energy sectors, airline industries, etc. Such adjustments could enhance the simulations.

(2) One of the crucial weaknesses of a static CGE model is its inability to assess the full effects of policy changes. A static CGE model of the type used in this study can capture the economic impact only at a single point of time and the gains are only from increased resource allocation efficiency. However, in reality, many policies could yield their outcomes in subsequent time periods. Therefore, it is worth considering the incorporation of dynamic impacts in any future study.

The possible extensions in (1) and (2) reflect the fact that trade liberalisation would open economies to more competition; induce higher productivity and economies of scales; and result in economic growth. In addition trends towards regionalism in East Asia these days are not only concerned with a ‘shallow’ integration through the reduction of import tariffs or border trade barriers, but also with a deeper integration through the cooperation of national and international institutions (Evans et al, 2006).

(3) As explained earlier, the model specification for the incorporation of individual households used in this thesis may lead to an underestimation of income distribution effects. Therefore, a new technique should be developed.

(4) For the developing regions, the role of central government is always significant. However, the specification of government in this study is simple, in that governments behave as a consumer in the economy. The role of governments could be more elaborately specified, for example, by introducing government-provided goods and services, or by improving the modelling of government transfers.

In summary, this thesis aims to make a comprehensive assessment and comparison of quantitative economic impacts of four alternative Free Trade Areas in East Asia – ASEAN-China, ASEAN-Japan, ASEAN-Korea and East Asia – by using a static multi-region, multi-sector CGE model as a tool. The introduction of unemployment and the incorporation of highly disaggregated household data (Thailand is a case study), which are two main extensions to the 'standard' CGE model, enhance the analysis of the labour markets and poverty and the income distribution. The simulation results show that, under the model assumptions and limitations, the regional agreement – **East Asia Free Trade Area** – is the most economically preferable option for member countries.

Appendix

2A Timeframe for tariff elimination under ASEAN-China Free Trade Area

Modality for Tariff Reduction and Elimination

for Tariff Lines Placed in the Normal Track

(i) ASEAN 6 and China

X = Applied MFN Tariff Rate	ACFTA Preferential Tariff Rate (Not later than 1 January)			
	2005*	**2007**	**2009**	**2010**
$X \geq 20\%$	20	12	5	0
$15\% \leq X < 20\%$	15	8	5	0
$10\% \leq X < 15\%$	10	8	5	0
$5\% < X < 10\%$	5	5	0	0
$X \leq 5\%$	Standstill		0	0

* The first date of implementation shall be 1 July 2005.

(ii) Vietnam

X = Applied MFN Tariff Rate	ACFTA Preferential Tariff Rate (Not later than 1 January)							
	2005*	**2006**	**2007**	**2008**	**2009**	**2011**	**2013**	**2015**
$X \geq 60\%$	60	50	40	30	25	15	10	0
$45\% \leq X < 60\%$	40	35	35	30	25	15	10	0
$35\% \leq X < 45\%$	35	30	30	25	20	15	5	0
$30\% \leq X < 35\%$	30	25	25	20	17	10	5	0
$25\% \leq X < 30\%$	25	20	20	15	15	10	5	0
$20\% \leq X < 25\%$	20	20	15	15	15	10	0-5	0
$15\% \leq X < 20\%$	15	15	10	10	10	5	0-5	0
$10\% \leq X < 15\%$	10	10	10	10	8	5	0-5	0
$7\% \leq X < 10\%$	7	7	7	7	5	5	0-5	0
$5\% \leq X < 7\%$	5	5	5	5	5	5	0-5	0
$X < 5\%$	Standstill							0

* The first date of implementation shall be 1 July 2005.

(iii) Cambodia, Lao PDR and Myanmar

X = Applied MFN Tariff Rate	ACFTA Preferential Tariff Rate (Not later than 1 January)							
	2005*	2006	2007	2008	2009	2011	2013	2015
$X \geq 60\%$	60	50	40	30	25	15	10	0
$45\% \leq X < 60\%$	40	35	35	30	25	15	10	0
$35\% \leq X < 45\%$	35	35	30	30	20	15	5	0
$30\% \leq X < 35\%$	30	25	25	20	20	10	5	0
$25\% \leq X < 30\%$	25	25	25	20	20	10	5	0
$20\% \leq X < 25\%$	20	20	15	15	15	10	0-5	0
$15\% \leq X < 20\%$	15	15	15	15	15	5	0-5	0
$10\% \leq X < 15\%$	10	10	10	10	8	5	0-5	0
$7\% \leq X < 10\%$	7**	7**	7**	7**	7**	5	0-5	0
$5\% \leq X < 7\%$	5	5	5	5	5	5	0-5	0
$X < 5\%$	Standstill							0

* The first date of implementation shall be 1 July 2005.

** Myanmar shall be allowed to maintain ACFTA Rates at no more than 7.5% until 2010.

Source: ASEAN Secretariat (2004)

4A: Data Aggregation of 14-region, 14-sector, and 3-factor

I. Region aggregation

Aggregated Regions			GTAP database
No.	Code	Description	Description and code[1]
1	IDN	Indonesia	Indonesia (IDN)
2	MYS	Malaysia	Malaysia (MYS)
3	PHL	Philippines	Philippines (PHL)
4	SGP	Singapore	Singapore (SGP)
5	THA	Thailand	Thailand (THA)
6	VNM	Vietnam	Vietnam (VNM)
7	XSE	Rest of Southeast Asia	Rest of Southeast Asia (XSE)
8	CHN	China	China (CHN)
9	KOR	Korea	Korea (KOR)
10	JPN	Japan	Japan (JPN)
11	CER	the Australia-New Zealand Closer Economic Relations	Australia (AUS), New Zealand (NZL)
12	NAFTA	North American Free Trade Area	Canada (CAN), United States (USA), Mexico (MEX)
13	EU	European Union	Austria (AUT), Belgium (BEL), Denmark (DNK), Finland (FIN), France (FRA), Germany (DEU), United Kingdom (GBR), Greece (GRC), Ireland (IRL) , Italy (ITA), Luxembourg (LUX), Netherlands (NLD), Portugal (PRT), Spain (ESP), Sweden (SWE)
14	ROW	Rest of the world	Rest of Oceania (XOC), Hong Kong (HKG), Taiwan (TWN), Rest of East Asia (XEA), Bangladesh (BGD), India (IND), Sri Lanka (LKA), Rest of South Asia (XSA), Rest of North America (XNA), Colombia (COL), Peru (PER), Venezuela (VEN), Rest of Andean Pact (XAP), Argentina (ARG), Brazil (BRA), Chile (CHL), Uruguay (URY), Rest of South America (XSM), Central America (XCA), Rest of FTAA (XFA), Rest of Caribbean (XCB), Switzerland (CHE), Rest of EFTA(XEF), Rest of Europe (XER), Albania (ALB), Bulgaria (BGR), Croatia (HRV), Cyprus (CYP), Czech Republic (CZE), Hungary (HUN), Malta (MLT), Poland (POL), Romania (ROM), Slovakia (SVK), Slovenia (SVN), Estonia (EST), Latvia (LVA), Lithuania (LTU), Russia Federation (RUS), Rest of Former Soviet Union (XSU), Turkey (TUR), Rest of Middle East (XME), Morocco (MAR), Tunisia (TUN), Rest of North Africa (XNF), Botswana (BWA), South Africa (ZAF), Rest of South African Customs Union (XSC), Malawi (MWI), Mozambique (MOZ), Tanzania (TZA), Zambia (ZMB), Zimbabwe (ZWE), Rest of SADC (XSD), Madagascar (MDG), Uganda (UGA), Rest of Sub-Saharan Africa (XSS)

[1] GTAP region codes are shown in brackets.

II. Sector aggregation

Aggregated Sectors			GTAP database
No.	**Code**	**Description**	**Description and code[2]**
1	LINT	Land-intensive sector	Paddy rice (PDR), Wheat (WHT), Cereal grains nec (GRO), Vegetables fruit nuts (V_F), Oil seeds (OSD), Sugar cane sugar beet (C_B), Plant-based fibers (PFB), Crops nec (OCR), Bovine cattle sheep goats horses (CTL), Animal products nec (OAP), Raw milk (RMK), Wool silk-worm cocoons (WOL)
2	FOOD	Processed food	Bovine meat products (CMT), Meat products nec (OMT), Vegetable oils and fats (VOL), Dairy products (MIL), Processed rice (PCR), Sugar (SGR), Food products nec (OFD), Beverages and tobacco products (B_T)
3	NRTS	Natural resource-intensive sector	Forestry (FRS), Fishing (FSH), Coal (COA), Oil (OIL), Gas (GAS), Minerals nec (OMN)
4	TEXT	Textile and apparel	Textiles (TEX), Wearing apparel (WAP)
5	SHOE	Leather and shoes	Leather products (LEA)
6	WOPA	Wood and paper	Wood products (LUM), Paper products publishing (PPP)
7	PECO	Petroleum, coal and metals	Petroleum coal products (P_C), Mineral products nec (NMM), Ferrous metals (I_S), Metals nec (NFM), Metal products (FMP)
8	PLAS	Rubber and plastic	Chemical rubber plastic products (CRP)
9	MOTR	Motor and equipment	Motor vehicles and parts (MVH), Transport equipment nec (OTN)
10	ELEC	Electronic equipment	Electronic equipment (ELE)
11	MACH	Machinery	Machinery and equipment nec (OME)
12	OMAN	Other manufactures	Manufactures nec (OMF)
13	TRAN	Transports	Transport nec (OTP), Water transport (WTP), Air transport (ATP)
14	SVCS	Other services	Electricity (ELY), Gas manufacture distribution (GDT), Water (WTR), Construction (CNS), Trade (TRD), Communication (CMN), Financial services nec (OFI), Insurance (ISR), Business services nec (OFI), Recreational and other services (ROS), Public administration defense education health (OSG), Dwellings (DWE)

III. Factor aggregation

Aggregated Factors			GTAP database
No.	**Code**	**Description**	**Description and code[3]**
1	UKLAB	Unskilled labour	Unskilled Labour (UnSklab)
2	SKLAB	Skilled labour	Skilled Labour (SkLab)
3	CAPITAL	Capital	Land (Land), Capital (Capital), Natural resource (NatlRes)

[2] GTAP sector codes are shown in brackets.
[3] GTAP factor codes are shown in brackets

4B: The Linear Expenditure System (LES)

The Stone-Geary Utility function and the associated Linear Expenditure System (LES) demand function do not yield a unit income elasticity (as do the CES family of functions).[4] The Cobb-Douglas utility function may be modified to yield the LES demand function by introducing a minimum (subsistence) consumption of each commodity i. The household is still assumed to make the optimal allocation between consumption of commodities by maximising this LES utility function:

$$\text{Max} \quad UC_r\,(C_{1r},\ldots,C_{ir}) = \prod_i (C_{ir} - MINC_{ir})^{\alpha C_{ir}}, \text{ where } \sum_i \alpha C_{ir} = 1$$

$$\text{subject to} \quad \sum_i PC_{ir} \cdot C_{ir} = MH_r$$

The demand for household consumption of commodity i in region r is:

$$C_{ir} = MINC_{ir} + \frac{\alpha C_{ir}}{PC_{ir}} \cdot (MH_r - \sum_i PC_{ir} \cdot MINC_{ir})$$

The term $MH_r - \sum_1 PC_{ir} \cdot MINC_{ir}$ is also known as the supernumerary or residual income of the household. This term represents the available or residual income after the household has satisfied its minimum consumption. There are two alternatives to calibrating parameters in the LES function:

(1) If the subsistence consumption level ($MINC_{ir}$) is known from the household consumption demand equation, we can derive the share parameters as

$$\alpha C_{ir} = \frac{PC_{ir} \cdot (C_{ir} - MINC_{ir})}{MH_r - \sum_i PC_{ir} \cdot MINC_{ir}}$$

[4] Engle's Law posits that as income rises so the proportion of income spent on 'necessities' will decline, which is inconsistent with a constant unit income elasticity. The Stone-Geary utility function does not lead to a constant unit income elasticity, but the income elasticities converge to unity as income rises, which is not consistent with Engle's Law. However, for small changes in income it is sufficiently consistent (in that the income elasticity for necessities remains below unity) for its use in CGE models to be justifiable.

(2) If the income elasticity of demand for commodity i (ε_{ir}) is known then, from the household demand equation, we can derive the share parameters as follows:

by the definition of income elasticity,

$$\varepsilon_{ir} = \frac{\partial C_{ir}}{\partial MH_r} \cdot \frac{MH_r}{C_{ir}} \quad \varepsilon_{ir} = \frac{\alpha C_{ir}}{PC_{ir}} \cdot \frac{MH_r}{C_{ir}}$$

so that

$$\alpha C_{ir} = \frac{\varepsilon_{ir} \cdot PC_{ir} \cdot C_{ir}}{MH_r}$$

Here we cannot use method (1) due to the lack of subsistence consumption data, while we can obtain estimates of income demand elasticities from the published literature.

The share coefficient has to be readjusted since, as the income elasticities are taken from an outside source, the sum of the shares may not be equal to one. The expenditure shares are scaled by:

$$\alpha C_{ir} = \frac{\alpha C_{ir}}{\sum_i \alpha C_{ir}}$$

To determine the level of subsistence consumption, information on the Frisch parameters is needed. The Frisch parameter is defined as the ratio of total consumption to discretionary consumption, i.e.

$$\text{Frisch}_r = -\frac{MH_r}{MH_r - \sum_i PC_{ir} \cdot MINC_{ir}}$$

By substituting the Frisch parameter into the consumption demand equation, the subsistence consumption can be calibrated as:

$$MINC_{ir} = C_{ir} + \frac{\alpha C_{ir}}{PC_{ir}} \cdot \left(\frac{MH_r}{\text{Frisch}_r} \right)$$

4C: Income elasticities of demand and Frisch parameters

Income elasticities of demand (ε_{ir})

	CHN	MYS	PHL	IDN	THA	SGP	VNM	XSE	JAP	KOR	NAFTA	EU	CER	ROW
LINT	0.82	0.79	0.84	0.84	0.79	0.38	0.83	0.81	0.36	0.51	0.47	0.41	0.45	0.76
FOOD	1.05	0.93	0.98	1.01	0.89	0.59	0.98	0.92	0.61	0.65	0.65	0.61	0.59	0.89
NRTS	1.29	1.1	1.16	1.21	1.08	1.05	1.24	1.09	1.05	1.05	1.06	1.07	1.03	1.18
TEXT	1.06	0.95	1.01	1.02	0.93	0.78	0.99	0.95	0.8	0.77	0.81	0.78	0.75	0.93
SHOE	1.06	0.95	1.01	1.02	0.93	0.78	0.99	0.95	0.8	0.77	0.81	0.78	0.75	0.93
WOPA	1.25	1.04	1.1	1.17	1.00	0.86	1.21	1.03	0.87	0.84	0.88	0.86	0.82	1.09
PECO	1.25	1.04	1.1	1.17	1.00	0.86	1.21	1.03	0.87	0.84	0.88	0.86	0.82	1.09
PLAS	1.25	1.04	1.1	1.17	1.00	0.86	1.21	1.03	0.87	0.84	0.88	0.86	0.82	1.09
MOTR	1.25	1.04	1.1	1.17	1.00	0.86	1.21	1.03	0.87	0.84	0.88	0.86	0.82	1.09
ELEC	1.25	1.04	1.1	1.17	1.00	0.86	1.21	1.03	0.87	0.84	0.88	0.86	0.82	1.09
MACH	1.25	1.04	1.1	1.17	1.00	0.86	1.21	1.03	0.87	0.84	0.88	0.86	0.82	1.09
OMCH	1.25	1.04	1.1	1.17	1.00	0.86	1.21	1.03	0.87	0.84	0.88	0.86	0.82	1.09
TRAN	1.27	1.06	1.12	1.18	1.03	0.95	1.22	1.05	0.96	0.93	0.96	0.9	0.91	1.12
SVCS	1.13	1.11	1.14	1.09	1.13	1.15	1.07	1.1	1.14	1.22	1.18	1.19	1.17	1.17

Source: Author calculation (adapted from income elasticities provided in GTAP database by Dimaranan B. V. et al, Ch. 20, 2006.)

Note: LINT is the land-intensive sector, Food is processed food, NRTS is natural resource intensive sector, TEXT is textile and apparel, SHOE is leather and shoes, WOPA is wood and paper, PECO is petroleum coal and metals, PLAS is rubber and plastic, MOTR is motor and equipment, ELEC is electronic, MACH is machinery, OMCH is other manufactures, TRAN is transports, and SVCS is other services.

Frisch parameters (Frisch_r)

	CHN	MYS	PHL	IDN	THA	SGP	VNM
Frisch	-5.0	-3.5	-5.1	-5.4	-3.5	-2.0	-6.0

	XSE	JAP	KOR	NAFTA	EU	CER	ROW
Frisch	-6.0	-2.0	-2.0	-2.0	-2.0	-2.0	-4.0

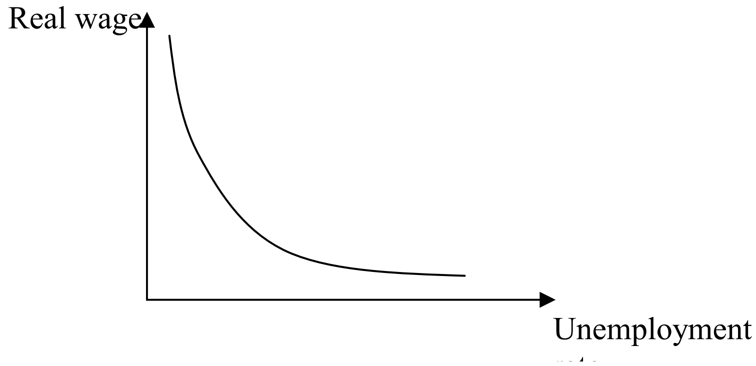
Sources: Taylor (1979), Hertel et al. (1997), Annabi et al. (2006)

Note CHN is China, MYS is Malaysia, PHL is Philippines, IDN is Indonesia, THA is Thailand, SGP is Singapore, VNM is Vietnam, XSE is other ASEAN, JAP is Japan, KOR is Korea, NAFTA is North America Free Trade Area, EU is European Union, CER is Australia-New Zealand Closer Economic Relations, and ROW is rest of the world.

4D Wage curve

Blanchflower B. G. and Oswald A. J. (1994) introduced the wage curve, which is surprisingly consistent with bargaining and efficiency models, in a simple formula to illustrate the negative relationship between real wage and unemployment rate;

$$\ln w \quad = \quad -0.1 \ln u$$



The wage curve is presented in logarithm form without error terms. If doubling the unemployment rate, the real wage rate will decrease approximately ten percent.

Taking logarithms, we then obtain:

$$\frac{\partial w}{w} \quad = \quad -0.1 \cdot \frac{\partial u}{u}$$

By the definition, the real wage is the nominal wage deflated by the consumer price index. The unemployment rate is the ratio of unemployment to the labour endowment.

$$w \quad = \quad \frac{PF}{CPI} \quad \text{and} \quad u \quad = \quad \frac{UNEMP}{FS}$$

Therefore, $$\frac{\frac{PF}{CPI} - \frac{PF0}{CPI0}}{\frac{PF0}{CPI0}} \quad = \quad -0.1 \cdot \left[\frac{\frac{UNEMP}{FS} - \frac{UNEMP0}{FS0}}{\frac{UNEMP0}{FS0}} \right]$$

$$\frac{PF/CPI}{PF0/CPI0} - 1 \quad = \quad -0.1 \cdot \left[\frac{UNEMP/FS}{UNEMP0/FS0} - 1 \right]$$

4E Equivalent Variation

As already explained previously, the consumption demand of the representative household is derived by maximising a LES utility function subject to his budget constraint – level of disposable income, MH_r.

Since the equivalent variation is based on money metric indirect utility function, the price index of disposable income can be obtained by minimising the level of household expenditure required after the satisfaction of the subsistence consumption requirements.

$$\text{Min} \quad \sum_i PC_{ir} \cdot C_{ir} \tag{1}$$

$$\text{subject to} \quad MH_r = \prod_i (C_{ir} - MINC_{ir})^{\alpha C_{ir}}, \text{ where } \sum_i \alpha C_{ir} = 1 \tag{2}$$

The Lagrangean function is

$$\Lambda = \sum_{i=1} PC_{ir}\, C_{ir} + \lambda\,(MH_r - \prod_i (C_{ir} - MINC_{ir})^{\alpha C_{ir}}) \tag{3}$$

F.O.C w.r.t. C_{ir}

$$PC_{ir} = \lambda \cdot \frac{\alpha C_{ir}}{(C_{ir} - MINC_{ir})} \cdot MH_r$$

$$(C_{ir} - MINC_{ir}) = \lambda \cdot \frac{\alpha C_{ir}}{PC_{ir}} \cdot MH_r \tag{4}$$

Raising (4) to the power of αC_{ir} , and take the product over i:

$$\prod_i (C_{ir} - MINC_{ir})^{\alpha C_{ir}} = \prod_i \left(\lambda \cdot \frac{\alpha C_{ir}}{PC_{ir}} \cdot MH_r\right)^{\alpha C_{ir}}$$

By making use of (2):

$$MH_r = \prod_i \left(\lambda \cdot \frac{\alpha C_{ir}}{PC_{ir}} \cdot MH_r \right)^{\alpha C_{ir}}$$

$$MH_r = \prod_i \left(\frac{\lambda^{\alpha C_{ir}} \cdot \alpha C_{ir}^{\alpha C_{ir}} \cdot MH_r^{\alpha C_{ir}}}{PC_{ir}^{\alpha C_{ir}}} \right)$$

$$MH_r = \lambda^{\sum \alpha C_{ir}} \cdot MH_r^{\sum \alpha C_{ir}} \cdot \prod_i \left(\frac{\alpha C_{ir}}{PC_{ir}} \right)^{\alpha C_{ir}}$$

As from equation (2), $\sum_i \alpha C_{ir} = 1$, thus:

$$MH_r = \lambda \cdot MH_r \cdot \prod_{i=1} \left(\frac{\alpha C_{ir}}{PC_{ir}} \right)^{\alpha C_{ir}}$$

Substituting the value of λ solved from (4):

$$MH_r = \frac{(C_{ir} - MINC_{ir}) \cdot PC_{ir}}{\alpha C_{ir} \cdot MH_r} \cdot MH_r \cdot \prod_i \left(\frac{\alpha C_{ir}}{PC_{ir}} \right)^{\alpha C_{ir}}$$

$$(C_{ir} - MINC_{ir}) = \frac{\alpha C_{ir} \cdot MH_r}{PC_{ir}} \cdot \prod_i \left(\frac{\alpha C_{ir}}{PC_{ir}} \right)^{-\alpha C_{ir}} \qquad (5)$$

By the definition of budget constraint, the value of household expenditure is equal to sum of the value of residual income of good i.

$$PMH_r \cdot MH_r = \sum_i PC_{ir} (C_{ir} - MINC_{ir}) \qquad (6)$$

By rearranging, we obtain the unit expenditure function:

$$PMH_r = \frac{\sum_i PC_{ir} (C_{ir} - MINC_{ir})}{MH_r} \qquad (7)$$

Substituting the value of $(C_{ir} - MINC_{ir})$ from (5) into (7):

$$PMH_r = \frac{\sum_i \left(PC_{ir} \cdot \frac{\alpha C_{ir} \cdot MH_r}{PC_{ir}} \cdot \prod_i \left(\frac{\alpha C_{ir}}{PC_{ir}} \right)^{-\alpha C_{ir}} \right)}{MH_r}$$

$$PMH_r = \frac{\sum_i \left(\alpha C_{ir} \cdot MH_r \cdot \prod_i \left(\frac{\alpha C_{ir}}{PC_{ir}} \right)^{-\alpha C_{ir}} \right)}{MH_r}$$

$$PMH_r = \frac{\sum \alpha C_{ir} \cdot MH_r \cdot \prod_i \left(\frac{\alpha C_{ir}}{PC_{ir}} \right)^{-\alpha C_{ir}}}{MH_r}$$

$$PMH_t = \prod_i \left(\frac{PC_{ir}}{\alpha C_{ir}} \right)^{\alpha C_{ir}} \qquad (8)$$

Equation (8) is therefore aggregated price of household expenditure. Then the economy price index is simply the ratio of new prices under policy scenarios to initial prices.

$$PINDEX_r = \frac{PMH_r}{PMH0_r} \text{ ,then}$$

$$PINDEX_r = \frac{\prod_i \left(\frac{PC_{ir}}{\alpha C_{ir}} \right)^{\alpha C_{ir}}}{\prod_i \left(\frac{PC0_{ir}}{\alpha C_{ir}} \right)^{\alpha C_{ir}}}$$

$$PINDEX_r = \frac{\prod_i PC_{ir}^{\alpha C_{ir}}}{\prod_i PC0_{ir}^{\alpha C_{ir}}}$$

Note "0" denotes the initial equilibrium

As the equivalent variation measures how much income is needed to make the household as well off as it is under the policy scenarios valued at the benchmark prices, then it is the difference of residual income measured at the new prices and residual income measured at initial prices.

$$EV_r = \frac{SN_r}{PINDEX_r} - SN0_r$$

where $SN_r = MH_r - \sum_i PC_{ir} \cdot MINC_{ir}$ and $SN0_r = MH0_r - \sum_i PC0_{ir} \cdot MINC_{ir}$

where EV_r is the equivalent variation., and SN_r is the supernumerary income.

5A Values of elasticities

sectors	σD_{ir}	σM_{ir}	σV_{ir}	σP_{ir}	σT_{ir}
LINT	2.5	5.0	0.2	0.12	-3.0
FOOD	2.5	5.0	1.1	0.12	-3.0
NRTS	4.9	13.0	0.2	0.12	-3.0
TEXT	3.8	7.5	1.3	0.12	-3.0
SHOE	4.1	8.1	1.3	0.12	-3.0
WOPA	3.1	6.3	1.3	0.12	-3.0
PECO	3.0	6.2	1.3	0.12	-3.0
PLAS	3.3	6.6	1.3	0.12	-3.0
MOTR	3.1	6.4	1.3	0.12	-3.0
ELEC	4.4	8.8	1.3	0.12	-3.0
MACH	4.1	8.1	1.3	0.12	-3.0
OMCH	3.8	7.5	1.3	0.12	-3.0
TRAN	1.9	3.8	1.7	0.12	-3.0
SVCS	1.9	3.9	1.4	0.12	-3.0

Source: Author calculation from GTAP database version 6

Note σD_{ir} are elasticities of substitution between domestic and imported goods.

σM_{ir} are elasticities of substitution among imported goods.

σV_{ir} are elasticities of substitution between primary factor inputs.

σP_{ir} are elasticities of substitution between value added and intermediate inputs.

σT_{ir} are elasticities of transformation between domestic sales and exports.

Note LINT is land intensive sector, FOOD is processed food, NRTS is natural resource intensive sector, TEXT is textile and apparel, SHOE is leather and shoes, WOPA is wood and paper, PECO is petroleum coal and metals, PLAS is rubber and plastic, MOTR is motor and equipment, ELEC is electronic, MACH is machinery, OMCH is other manufactures, TRAN is transports, and SVCS is other services.

5B Macro-SAM of 14 regions

(1) SAM of Indonesia

	ACT	COM	VA	HH	GOV	INV	TRN	ROW	TOT
ACT		221.04					0.58	68.55	290.16
COM	146.37			88.04	10.19	23.36			267.96
VA	136.62								136.62
HH			135.22		9.10				144.32
GOV	7.18	1.51	1.39	9.21					19.29
INV				47.07			1.31	-25.03	23.36
TRN		1.89							1.89
ROW		43.52							43.52
TOT	290.16	267.96	136.62	144.32	19.29	23.36	1.89	43.52	

Source: Author calculation from GTAP database version 6.

(2) SAM of Malaysia

	ACT	COM	VA	HH	GOV	INV	TRN	ROW	TOT
ACT		92.13					2.61	125.53	220.26
COM	135.77			18.18	5.47	12.94			172.36
VA	84.29								84.29
HH			83.60		6.37				89.97
GOV	0.20	3.55	0.69	7.39					11.84
INV				64.39			-0.02	-51.43	12.94
TRN		2.59							2.59
ROW		74.09							74.09
TOT	220.26	172.36	84.29	89.97	11.84	12.94	2.59	74.09	

Source: Author calculation from GTAP database version 6.

(3) SAM of Philippines

	ACT	COM	VA	HH	GOV	INV	TRN	ROW	TOT
ACT		113.41					0.59	38.25	152.25
COM	81.96			52.87	9.50	14.01			158.34
VA	60.05								60.05
HH			60.04		6.24				66.28
GOV	10.24	1.15	0.01	4.34					15.75
INV				9.07			0.97	3.97	14.01
TRN		1.56							1.56
ROW		42.22							42.22
TOT	152.25	158.34	60.05	66.28	15.75	14.01	1.56	42.22	

Source: Author calculation from GTAP database version 6.

Note All values are in billions of US dollar.
Note: ACT is activity account, COM is commodity account, VA is factor or value-added account, HH is household account, GOV is government account, INV is saving-investment account. TRN is international transport or trade margin account, ROW is rest of the world account, and TOT is total account.

(4) SAM of Singapore

	ACT	COM	VA	HH	GOV	INV	TRN	ROW	TOT
ACT		111.21					5.65	111.29	228.15
COM	150.41			50.17	12.25	29.97			242.80
VA	74.91								74.91
HH			74.06		-1.46				72.61
GOV	2.82	7.12	0.85	0.00					10.79
INV				22.44			-1.99	9.52	29.97
TRN		3.66							3.66
ROW		120.81							120.81
TOT	228.15	242.80	74.91	72.61	10.79	29.97	3.66	120.81	

Source: Author calculation from GTAP database version 6.

(5) SAM of Thailand

	ACT	COM	VA	HH	GOV	INV	TRN	ROW	TOT
ACT		173.80					0.98	80.27	255.05
COM	145.95			62.57	11.59	23.15			243.26
VA	98.74								98.74
HH			97.85		10.91				108.76
GOV	10.36	5.58	0.89	5.68					22.51
INV				40.52			1.32	-18.69	23.15
TRN		2.30							2.30
ROW		61.57							61.57
TOT	255.05	243.26	98.74	108.76	22.51	23.15	2.30	61.57	

Source: Author calculation from GTAP database version 6.

(6) SAM of Vietnam

	ACT	COM	VA	HH	GOV	INV	TRN	ROW	TOT
ACT		50.88					0.32	15.46	66.67
COM	36.53			26.77	2.57	12.73			78.60
VA	28.03								28.03
HH			27.74		4.21				31.95
GOV	2.11	2.58	0.29	1.80					6.78
INV				3.38			0.52	8.83	12.73
TRN		0.85							0.85
ROW		24.29							24.29
TOT	66.67	78.60	28.03	31.95	6.78	12.73	0.85	24.29	

Source: Author calculation from GTAP database version 6.

Note All values are in billions of US dollar.
Note: ACT is activity account, COM is commodity account, VA is factor or value-added account, HH is household account, GOV is government account, INV is saving-investment account. TRN is international transport or trade margin account, ROW is rest of the world account, and TOT is total account.

(7) SAM of Other ASEAN

	ACT	COM	VA	HH	GOV	INV	TRN	ROW	TOT
ACT		129.68					0.10	8.60	138.38
COM	60.50			49.53	8.45	19.09			137.56
VA	72.55								72.55
HH			70.70		8.72				79.42
GOV	5.33	1.17	1.86	8.81					17.17
INV				21.08			0.25	-2.24	19.09
TRN		0.35							0.35
ROW		6.36							6.36
TOT	138.38	137.56	72.55	79.42	17.17	19.09	0.35	6.36	

Source: Author calculation from GTAP database version 6.

(8) SAM of China

	ACT	COM	VA	HH	GOV	INV	TRN	ROW	TOT
ACT		2,752.48					3.90	384.48	3,140.86
COM	2,014.36			495.48	147.63	408.78			3,066.24
VA	963.40								963.40
HH			963.40		59.05				1,022.46
GOV	163.11	32.53		11.05					206.68
INV				515.93			5.65	- 112.80	408.78
TRN		9.55							9.55
ROW		271.68							271.68
TOT	3,140.86	3,066.24	963.40	1,022.46	206.68	408.78	9.55	271.68	

Source: Author calculation from GTAP database version 6.

(9) SAM of Japan

	ACT	COM	VA	HH	GOV	INV	TRN	ROW	TOT
ACT		6,853.26					25.40	453.02	7,331.68
COM	3,299.31			2,334.19	718.34	1,059.68			7,411.52
VA	3,619.27								3,619.27
HH			3,224.55		598.14				3,822.68
GOV	413.10	145.20	394.72	363.45					1,316.48
INV				1,125.04			-7.26	-58.09	1,059.68
TRN		18.13							18.13
ROW		394.93							394.93
TOT	7,331.68	7,411.52	3,619.27	3,822.68	1,316.48	1,059.68	18.13	394.93	

Source: Author calculation from GTAP database version 6.

Note All values are in billions of US dollar.
Note: ACT is activity account, COM is commodity account, VA is factor or value-added account, HH is household account, GOV is government account, INV is saving-investment account. TRN is international transport or trade margin account, ROW is rest of the world account, and TOT is total account.

(10) SAM of Korea

	ACT	COM	VA	HH	GOV	INV	TRN	ROW	TOT
ACT		777.95					14.62	177.18	969.75
COM	561.10			246.23	42.27	109.93			959.53
VA	381.75								381.75
HH			373.05		35.25				408.30
GOV	26.90	18.99	8.71	22.92					77.52
INV				139.15			-7.78	-21.44	109.93
TRN		6.84							6.84
ROW		155.74							155.74
TOT	969.75	959.53	381.75	408.30	77.52	109.93	6.84	155.74	

Source: Author calculation from GTAP database version 6.

(11) SAM of NAFTA

	ACT	COM	VA	HH	GOV	INV	TRN	ROW	TOT
ACT		18,900.20					23.40	1,321.65	20,245.25
COM	8,933.23			7,773.74	1,733.04	2,256.99			20,697.00
VA	11,223.22								11,223.22
HH			10,199.78		1,085.21				11,284.99
GOV	88.80	102.98	1,023.44	1,603.03					2,818.24
INV				1,908.21			26.47	322.31	2,256.99
TRN		49.87							49.87
ROW		1,643.96							1,643.96
TOT	20,245.25	20,697.00	11,223.22	11,284.99	2,818.24	2,256.99	49.87	1,643.96	

Source: Author calculation from GTAP database version 6.

(12) SAM of EU

	ACT	COM	VA	HH	GOV	INV	TRN	ROW	TOT
ACT		11,995.24					93.33	2,510.60	14,599.17
COM	7,169.00			4,657.06	1,625.45	1,614.49			15,066.00
VA	7,055.38								7,055.38
HH			5,938.85		1,331.34				7,270.19
GOV	374.79	499.35	1,116.53	966.12					2,956.79
INV				1,647.01			-25.62	-6.90	1,614.49
TRN		67.71							67.71
ROW		2,503.70							2,503.70
TOT	14,599.17	15,066.00	7,055.38	7,270.19	2,956.79	1,614.49	67.71	2,503.70	

Source: Author calculation from GTAP database version 6.

Note All values are in billions of US dollar.
Note: ACT is activity account, COM is commodity account, VA is factor or value-added account, HH is household account, GOV is government account, INV is saving-investment account. TRN is international transport or trade margin account, ROW is rest of the world account, and TOT is total account.

(13) SAM of CER

	ACT	COM	VA	HH	GOV	INV	TRN	ROW	TOT
ACT		667.24					1.61	91.35	760.20
COM	374.56			243.47	72.81	87.40			778.25
VA	370.08								370.08
HH			358.64		45.12				403.77
GOV	15.55	22.30	11.44	68.65					117.93
INV				91.65			1.53	-5.78	87.40
TRN		3.14							3.14
ROW		85.57							85.57
TOT	760.20	778.25	370.08	403.77	117.93	87.40	3.14	85.57	

Source: Author calculation from GTAP database version 6.

(14) SAM of ROW

	ACT	COM	VA	HH	GOV	INV	TRN	ROW	TOT
ACT		8,603.23					61.34	1,524.02	10,188.59
COM	5,350.22			3,232.60	806.00	1,069.63			10,458.44
VA	4,564.66								4,564.66
HH			4,311.87		442.32				4,754.19
GOV	273.71	307.44	252.79	414.38					1,248.32
INV				1,107.21			4.66	-42.24	1,069.63
TRN		66.00							66.00
ROW		1,481.78							1,481.78
TOT	10,188.59	10,458.44	4,564.66	4,754.19	1,248.32	1,069.63	66.00	1,481.78	

Source: Author calculation from GTAP database version 6.

Note All values are in billions of US dollar.
Note: ACT is activity account, COM is commodity account, VA is factor or value-added account, HH is household account, GOV is government account, INV is saving-investment account. TRN is international transport or trade margin account, ROW is rest of the world account, and TOT is total account.

5C Micro-SAM of the 14 regions

(1) Micro-SAM of Indonesia

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK
A															19																					2	22
B																29																				4	34
C																	17																			12	29
D																		9																		9	18
E																			1																	3	4
F																				6																9	16
G																					13															5	18
H																						11														5	16
I																							6													1	7
J																								3												9	12
K																									3											4	6
L																										1										1	2
M																											11								1	1	13
N																												91								3	94
O	2	11	0	1	0	0	0	1	0	0	0	0	0	1																		7	0	0			22
P	1	4	0	0	0	0	0	0	0	0	0	0	0	3																		22	0	0			31
Q	0	1	1	0	0	3	9	1	0	0	0	0	0	3																		2	0	0			19
R	0	0	0	8	0	0	0	0	0	0	0	0	0	0																		3	0	0			12
S	0	0	0	0	0	0	0	0	0	0	0	0	0	0																		0	0	0			1
T	0	0	0	0	0	3	0	0	0	0	0	0	0	2																		1	0	0			7
U	0	0	1	0	0	0	3	1	1	1	0	0	3	5																		4	0	0			19
V	1	0	0	2	1	1	0	6	0	1	0	0	0	2																		3	0	0			17
W	0	0	0	0	0	0	0	0	2	0	0	0	1	1																		3	0	2			10
X	0	0	0	0	0	0	0	0	0	3	0	0	0	1																		2	0	1			6
Y	0	0	0	0	0	0	0	0	0	1	3	0	0	1																		0	0	3			9
Z	0	0	0	0	0	0	0	0	0	0	0	0	0	0																		1	0	0			1
AA	0	1	0	0	0	1	0	1	0	1	0	0	1	2																		4	0	0			13
AB	1	3	2	2	0	2	2	3	1	2	1	0	2	18																		36	10	16			100
AC	10	8	20	3	1	4	2	3	2	2	1	0	5	31																							92
AD	7	3	2	1	1	1	1	1	1	1	1	0	1	14																							35
AE	0	0	1	0	0	0	0	0	0	0	0	0	0	7																							10
AF																													92	34	10		9				144
AG	0	1	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	9					19
AH																																47			1	-25	23
AI															0	0	0	0	0	0	0	0	0	0	0	0											2
AJ															2	2	1	2	0	1	5	6	3	3	6	0	2	9									44
AK	22	34	29	18	4	16	18	16	7	12	6	2	13	94	22	31	19	12	1	7	19	17	10	6	9	1	13	100	92	35	10	144	19	23	2	44	

Source: Author calculation from GTAP database version 6.

Note All values are in billions of US dollar

Note A to N are activity account of 14 sectors, O to AB are commodity account of 14 sectors, AC to AE are value-added account, AF is household account, AG is government account, AH is saving-investment account. AI is international transport or trade margin account, AJ is rest of the world account, and AK is total account.

(2) Micro-SAM of Malaysia

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK
A															2																					1	4
B																4																				5	10
C																	7																			5	12
D																		1																		3	4
E																			0																	0	0
F																				2																5	7
G																					9															4	14
H																						6														7	14
I																							3													1	4
J																								2												62	64
K																									4											8	12
L																										6										2	8
M																											4								3	3	9
N																												42								18	60
O	0	1	0	0	0	0	0	1	0	0	0	0	0	0																		1	0	0			5
P	0	3	0	0	0	0	0	0	0	0	0	0	0	0																		2	0	0			7
Q	0	0	0	0	0	2	5	0	0	0	0	0	0	1																		0	0	0			8
R	0	0	0	1	0	0	0	0	0	0	0	0	0	0																		1	0	0			3
S	0	0	0	0	0	0	0	0	0	0	0	0	0	0																		0	0	0			0
T	0	0	0	0	0	1	0	0	0	1	0	0	0	1																		0	0	0			4
U	0	0	0	0	0	0	3	1	0	4	1	1	2	3																		1	0	0			18
V	0	0	0	0	0	0	0	4	1	4	0	0	0	1																		1	0	0			13
W	0	0	0	0	0	0	0	0	2	1	0	0	1	1																		1	0	1			6
X	0	0	0	0	0	0	0	0	0	20	0	0	0	0																		2	0	4			27
Y	0	0	1	0	0	1	1	1	0	3	5	1	0	2																		1	0	3			17
Z	0	0	0	0	0	0	0	0	0	1	0	1	0	1																		2	0	0			6
AA	0	0	0	0	0	0	0	0	0	2	0	0	1	1																		0	0	0			5
AB	0	1	1	0	0	1	1	2	0	8	1	1	1	19																		5	5	5			52
AC	1	2	8	0	0	1	1	2	0	10	1	1	1	13																							42
AD	1	1	2	0	0	1	1	2	1	9	1	1	2	11																							32
AE	0	0	0	0	0	0	0	0	0	2	0	0	0	5																							10
AF																													42	32	10		6				90
AG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	7					12
AH																																64			0	-51	13
AI															0	0	0	0	0	0	1	0	0	0	0	0											3
AJ															2	3	1	1	0	1	7	6	3	24	12	1	2	11									74
AK	4	10	12	4	0	7	14	14	4	64	12	8	9	60	5	7	8	3	0	4	18	13	6	27	17	6	5	52	42	32	10	90	12	13	3	74	

Source: Author calculation from GTAP database version 6.

Note All values are in billions of US dollar

Note A to N are activity account of 14 sectors, O to AB are commodity account of 14 sectors, AC to AE are value-added account, AF is household account, AG is government account, AH is saving-investment account. AI is international transport or trade margin account, AJ is rest of the world account, and AK is total account.

(3) Micro-SAM of Philippines

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK
A															16																					1	17
B																20																				2	21
C																	4																			0	4
D																		2																		3	5
E																			0																	0	0
F																				1																1	2
G																					8															1	9
H																						4														1	5
I																							1													1	1
J																								1												22	23
K																									1											4	4
L																										1										1	1
M																											4								1	1	5
N																												51								1	53
O	3	8	0	0	0	0	0	0	0	0	0	0	0	0																		5	0	0			17
P	0	3	0	0	0	0	0	0	0	0	0	0	0	1																		18	0	0			22
Q	0	1	0	0	0	0	3	0	0	0	0	0	0	1																		2	0	0			7
R	0	0	0	2	0	0	0	0	0	0	0	0	0	0																		1	0	0			4
S	0	0	0	0	0	0	0	0	0	0	0	0	0	0																		0	0	0			0
T	0	0	0	0	0	1	0	0	0	0	0	0	0	1																		0	0	0			2
U	0	0	0	0	0	0	1	0	0	2	0	0	1	4																		1	0	0			11
V	1	0	0	1	0	0	0	2	0	1	0	0	0	1																		1	0	0			8
W	0	0	0	0	0	0	0	0	1	0	0	0	0	0																		0	0	1			2
X	0	0	0	0	0	0	0	0	0	13	1	0	0	2																		1	0	1			17
Y	0	0	0	0	0	0	0	0	0	0	1	0	0	0																		0	0	4			7
Z	0	0	0	0	0	0	0	0	0	0	0	0	0	0																		0	0	0			1
AA	0	0	0	0	0	0	0	0	0	0	0	0	0	1																		3	0	0			5
AB	1	1	0	0	0	0	2	0	0	1	0	0	1	9																		20	10	7			54
AC	5	5	3	1	0	0	1	1	0	2	1	0	2	20																							40
AD	6	1	0	0	0	0	0	0	0	0	0	0	1	6																							14
AE	0	0	0	0	0	0	0	0	0	0	0	0	0	5																							6
AF																													40	14	6		6				66
AG	1	1	0	1	0	0	1	1	0	3	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4					16
AH																																9			1	4	14
AI															0	0	0	0	0	0	0	0	0	0	0	0											2
AJ															1	2	3	2	0	1	3	4	1	16	6	0	1	3									42
AK	17	21	4	5	0	2	9	5	1	23	4	1	5	53	17	22	7	4	0	2	11	8	2	17	7	1	5	54	40	14	6	66	16	14	2	42	

Source: Author calculation from GTAP database version 6.

Note All values are in billions of US dollar

Note A to N are activity account of 14 sectors, O to AB are commodity account of 14 sectors, AC to AE are value-added account, AF is household account, AG is government account, AH is saving-investment account. AI is international transport or trade margin account, AJ is rest of the world account, and AK is total account.

(4) Micro-SAM of Singapore

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK
A															0																					1	1
B																2																				2	4
C																	0																			0	0
D																		0																		1	2
E																			0																	0	0
F																				2																2	4
G																					6															7	13
H																						2														10	12
I																							2													2	4
J																								2												50	52
K																									2											12	14
L																										1										1	2
M																											10								6	3	19
N																												82								18	101
O	0	0	0	0	0	0	0	0	0	0	0	0	0	0																		1	0	0			2
P	0	1	0	0	0	0	0	0	0	0	0	0	0	1																		3	0	0			5
Q	0	0	0	0	0	0	6	0	0	0	0	0	0	0																		0	0	0			6
R	0	0	0	1	0	0	0	1	0	0	0	0	0	0																		1	0	0			3
S	0	0	0	0	0	0	0	0	0	0	0	0	0	0																		0	0	0			1
T	0	0	0	0	0	1	0	0	0	0	0	0	0	1																		1	0	0			4
U	0	0	0	0	0	0	4	1	0	1	2	0	1	5																		1	0	0			15
V	0	0	0	0	0	0	0	4	0	1	0	0	0	3																		1	0	0			11
W	0	0	0	0	0	0	0	0	1	0	0	0	1	1																		1	0	5			9
X	0	0	0	0	0	0	0	0	0	37	1	0	0	3																		3	0	4			48
Y	0	0	0	0	0	0	0	0	0	4	5	0	0	3																		2	0	7			22
Z	0	0	0	0	0	0	0	0	0	0	0	0	0	0																		1	0	0			3
AA	0	0	0	0	0	0	0	0	0	0	0	0	5	4																		4	0	0			14
AB	0	1	0	0	0	1	2	2	0	4	2	0	3	29																		31	12	12			99
AC	0	1	0	0	0	1	1	3	0	4	1	0	4	23																							38
AD	0	0	0	0	0	1	1	1	1	1	1	0	2	14																							23
AE	0	0	0	0	0	0	0	1	0	1	1	0	1	10																							14
AF																													38	22	14		-1				73
AG	0	0	0	0	0	0	-1	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	1	5	0	0	0	0					11
AH																																22			-2	10	30
AI															0	0	0	0	0	0	1	0	0	1	1	0											4
AJ															1	3	6	3	0	2	9	8	7	45	20	2	4	12									121
AK	1	4	0	2	0	4	13	12	4	52	14	2	19	101	2	5	6	3	1	4	15	11	9	48	22	3	14	99	38	23	14	73	11	30	4	121	

Source: Author calculation from GTAP database version 6.

Note All values are in billions of US dollar

Note A to N are activity account of 14 sectors, O to AB are commodity account of 14 sectors, AC to AE are value-added account, AF is household account, AG is government account, AH is saving-investment account. AI is international transport or trade margin account, AJ is rest of the world account, and AK is total account.

(5) Micro-SAM of Thailand

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK
A															11																					3	14
B																14																				9	23
C																	5																			0	6
D																		12																		6	18
E																			2																	2	4
F																				4																3	6
G																					13															5	18
H																						5														7	13
I																							9													2	11
J																								4												19	24
K																									3											10	13
L																										3										3	7
M																											8								1	5	15
N																												81								5	86
O	1	7	0	1	0	0	0	2	0	0	0	0	0	1																		2	0	0			13
P	1	4	0	0	0	0	0	0	0	0	0	0	0	3																		9	0	0			17
Q	0	1	0	0	0	0	6	0	0	0	0	0	0	2																		1	0	0			11
R	0	0	0	7	0	0	0	0	0	0	0	0	0	0																		5	0	0			14
S	0	0	0	0	0	0	0	0	0	0	0	0	0	0																		1	0	0			2
T	0	0	0	0	0	1	0	0	0	0	0	1	0	1																		1	0	0			5
U	0	1	0	0	0	0	3	1	1	2	2	1	3	3																		2	0	0			20
V	1	0	0	2	0	0	0	4	1	1	0	0	0	1																		2	0	0			13
W	0	0	0	0	0	0	0	0	3	0	0	0	2	0																		4	0	4			13
X	0	0	0	0	0	0	0	0	1	12	0	0	0	1																		1	0	2			18
Y	0	0	0	0	0	0	0	0	1	0	6	0	0	1																		1	0	5			15
Z	0	0	0	0	0	0	0	0	0	0	0	2	0	0																		2	0	0			5
AA	0	0	0	0	0	0	0	0	0	0	0	0	1	2																		5	0	0			10
AB	1	3	1	2	0	1	2	2	1	3	2	1	2	17																		26	12	11			87
AC	5	3	3	3	1	1	2	2	2	4	2	1	4	33																							68
AD	4	1	1	2	0	0	1	1	1	1	1	1	1	9																							22
AE	0	0	0	0	0	0	0	0	0	0	0	0	0	7																							8
AF																													68	22	8		11				109
AG	0	2	0	0	0	0	2	0	0	0	0	0	0	4	0	1	0	0	0	0	1	1	1	1	1	0	0	0	0	1	0	6					23
AH																																41			1	-19	23
AI															0	0	0	0	0	0	0	0	0	0	0	0											2
AJ															1	2	5	2	0	1	6	7	4	13	10	2	2	6									62
AK	14	23	6	18	4	6	18	13	11	24	13	7	15	86	13	17	11	14	2	5	20	13	13	18	15	5	10	87	68	22	8	109	23	23	2	62	

Source: Author calculation from GTAP database version 6.

Note All values are in billions of US dollar

Note A to N are activity account of 14 sectors, O to AB are commodity account of 14 sectors, AC to AE are value-added account, AF is household account, AG is government account, AH is saving-investment account. AI is international transport or trade margin account, AJ is rest of the world account, and AK is total account.

(6) Micro-SAM of Vietnam

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK
A															5																					1	6
B																4																				2	5
C																	3																			2	5
D																		1																		2	3
E																			0																	3	3
F																				1																1	2
G																					3															0	4
H																						1														0	2
I																							0													0	0
J																								1												0	1
K																									1											1	1
L																										1										0	1
M																											1								0	0	2
N																												29								2	31
O	1	3	0	0	0	0	0	0	0	0	0	0	0	0																		2	0	0			5
P	0	0	0	0	0	0	0	0	0	0	0	0	0	0																		4	0	0			5
Q	0	0	0	0	0	0	1	0	0	0	0	0	0	1																		1	0	0			3
R	0	0	0	1	0	0	0	0	0	0	0	0	0	0																		1	0	0			3
S	0	0	0	0	0	0	0	0	0	0	0	0	0	0																		0	0	0			1
T	0	0	0	0	0	1	0	0	0	0	0	0	0	1																		0	0	0			2
U	0	0	0	0	0	0	1	0	0	0	0	0	1	4																		0	0	0			7
V	1	0	0	0	0	0	0	1	0	0	0	0	0	1																		0	0	0			4
W	0	0	0	0	0	0	0	0	0	0	0	0	0	1																		1	0	0			2
X	0	0	0	0	0	0	0	0	0	0	0	0	0	0																		0	0	1			2
Y	0	0	0	0	0	0	0	0	0	0	0	0	0	0																		0	0	2			4
Z	0	0	0	0	0	0	0	0	0	0	0	0	0	0																		0	0	0			1
AA	0	0	0	0	0	0	1	0	0	0	0	0	0	1																		0	0	0			3
AB	1	1	1	0	0	0	1	0	0	0	0	0	0	3																		16	3	10			37
AC	2	0	2	0	0	0	0	0	0	0	0	0	0	11																							16
AD	1	0	0	0	0	0	0	0	0	0	0	0	0	6																							9
AE	0	0	0	0	0	0	0	0	0	0	0	0	0	2																							2
AF																													16	9	2		4				32
AG	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0	0		0	0	0	0	2					7
AH																																3			1	9	13
AI															0	0	0	0	0	0	0	0	0	0	0	0											1
AJ															0	1	0	1	0	0	3	3	1	1	3	0	2	8									24
AK	6	5	5	3	3	2	4	2	0	1	1	1	2	31	5	5	3	3	1	2	7	4	2	2	4	1	3	37	16	9	2	32	7	13	1	24	

Source: Author calculation from GTAP database version 6.

Note All values are in billions of US dollar

Note A to N are activity account of 14 sectors, O to AB are commodity account of 14 sectors, AC to AE are value-added account, AF is household account, AG is government account, AH is saving-investment account. AI is international transport or trade margin account, AJ is rest of the world account, and AK is total account.

(7) Micro-SAM of other ASEAN

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK
A															7																					0	7
B																11																				0	11
C																	3																			3	6
D																		9																		3	12
E																			1																	0	1
F																				3																0	3
G																					6															0	6
H																						3														0	4
I																							7													0	7
J																								3												0	3
K																									2											0	2
L																										3										0	3
M																											7								0	0	8
N																												66								1	67
O	0	3	0	0	0	0	0	0	0	0	0	0	0	0																		2	0	0			7
P	1	1	0	0	0	0	0	0	0	0	0	0	0	2																		7	0	0			12
Q	0	0	0	0	0	0	1	0	0	0	0	0	0	1																		1	0	0			3
R	0	0	0	5	0	0	0	0	0	0	0	0	0	0																		4	0	0			10
S	0	0	0	0	0	0	0	0	0	0	0	0	0	0																		1	0	0			1
T	0	0	0	0	0	1	0	0	0	0	0	0	0	1																		0	0	0			3
U	0	0	0	0	0	0	1	0	0	0	0	0	0	3																		1	0	0			7
V	0	0	0	1	0	0	0	1	0	0	0	0	0	1																		1	0	0			4
W	0	0	0	0	0	0	0	0	1	0	0	0	1	0																		3	0	2			7
X	0	0	0	0	0	0	0	0	0	1	0	0	0	0																		0	0	1			3
Y	0	0	0	0	0	0	0	0	1	0	0	0	0	0																		0	0	1			3
Z	0	0	0	0	0	0	0	0	0	0	0	1	0	0																		1	0	0			3
AA	0	0	0	0	0	0	0	0	0	0	0	0	1	2																		3	0	0			7
AB	1	1	1	1	0	1	1	1	1	0	0	0	1	11																		24	8	13			67
AC	3	2	3	2	0	1	2	1	2	1	1	1	3	26																							47
AD	2	1	1	1	0	0	1	0	1	0	0	0	1	9																							18
AE	0	0	0	0	0	0	0	0	0	0	0	0	0	6																							7
AF																													46	18	7		9				79
AG	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	9					17
AH																																21			0	-2	19
AI															0	0	0	0	0	0	0	0	0	0	0	0											0
AJ															0	1	0	1	0	0	1	1	0	0	1	0	0	1									6
AK	7	11	6	12	1	3	6	4	7	3	2	3	8	67	7	12	3	10	1	3	7	4	7	3	3	3	7	67	47	18	7	79	17	19	0	6	

Source: Author calculation from GTAP database version 6.

Note All values are in billions of US dollar

Note A to N are activity account of 14 sectors, O to AB are commodity account of 14 sectors, AC to AE are value-added account, AF is household account, AG is government account, AH is saving-investment account. AI is international transport or trade margin account, AJ is rest of the world account, and AK is total account.

(8) Micro-SAM of China

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK
A															275																					7	282
B																163																				9	172
C																	116																			5	122
D																		161																		61	223
E																			24																	32	56
F																				79																16	95
G																					395															31	426
H																						193														24	218
I																							74													9	83
J																								57												68	125
K																									218											58	276
L																										47										43	90
M																											69								4	6	79
N																												881								16	897
O	47	70	2	18	5	4	0	5	0	0	0	4	0	7																		119	0	7			288
P	19	22	3	0	6	0	0	3	0	0	0	0	0	17																		100	0	0			170
Q	1	7	10	0	0	4	57	11	0	0	2	1	0	18																		16	0	2			131
R	1	1	1	100	7	5	4	9	1	0	2	11	0	10																		34	0	0			186
S	0	0	0	0	14	1	0	0	0	0	0	1	0	0																		9	0	0			27
T	1	4	0	1	0	25	9	3	1	1	4	7	0	27																		5	0	1			89
U	4	3	6	1	1	4	138	13	11	9	62	8	12	134																		19	0	3			427
V	25	4	6	11	3	6	15	80	5	9	21	7	2	28																		14	0	0			235
W	0	0	2	0	0	1	2	1	25	0	4	0	5	9																		8	0	30			89
X	0	0	0	0	0	0	1	0	1	58	11	1	0	16																		11	0	15			115
Y	3	1	7	3	0	2	17	5	12	10	58	1	4	60																		14	0	75			272
Z	1	1	1	2	0	4	11	1	1	1	4	5	0	8																		10	0	2			50
AA	3	2	4	2	0	2	13	4	1	1	4	1	4	24																		9	0	1			74
AB	15	12	14	17	6	11	52	25	6	8	23	7	8	164																		128	148	273			915
AC	65	18	31	24	4	10	36	23	8	13	33	21	19	127																							432
AD	92	10	26	24	6	12	39	18	7	9	28	10	15	132																							428
AE	1	2	2	4	1	2	7	4	1	2	6	1	3	68																							103
AF																													432	428	103		59				1022
AG	5	16	6	16	2	4	24	13	4	5	13	3	4	49	4	1	0	4	0	1	2	5	3	5	6	0	0					11					207
AH																																516			6	-113	409
AI															0	0	1	1	0	1	2	2	0	1	1	0											10
AJ															8	5	13	19	2	9	27	35	12	52	47	3	5	34									272
AK	282	172	122	223	56	95	426	218	83	125	276	90	79	897	288	170	131	186	27	89	427	235	89	115	272	50	74	915	432	428	103	1022	207	409	10	272	

Source: Author calculation from GTAP database version 6.

Note All values are in billions of US dollar

Note A to N are activity account of 14 sectors, O to AB are commodity account of 14 sectors, AC to AE are value-added account, AF is household account, AG is government account, AH is saving-investment account. AI is international transport or trade margin account, AJ is rest of the world account, and AK is total account.

(9) Micro-SAM of Japan

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK
A															72																					1	73
B																314																				2	317
C																	37																			0	37
D																		85																		10	95
E																			8																	0	8
F																				184																3	188
G																					424															36	460
H																						267														42	309
I																							251													98	349
J																								273												95	368
K																									178											118	296
L																										65										9	74
M																											371								25	11	408
N																												4323								29	4351
O	8	45	0	0	0	0	0	1	0	0	0	1	0	6																		27	0	2			90
P	6	45	1	0	1	0	0	1	0	0	0	0	0	47																		257	7	0			366
Q	0	11	3	0	0	6	42	1	0	0	0	1	0	19																		8	0	0			90
R	0	1	0	27	0	1	1	1	1	1	0	1	1	12																		66	0	3			117
S	0	0	0	0	1	0	0	0	0	0	0	0	0	0																		13	0	0			15
T	1	9	0	2	0	50	3	5	1	4	2	8	4	97																		16	0	0			203
U	1	9	2	1	0	2	142	15	26	25	40	6	18	143																		57	0	5			490
V	5	8	1	7	1	8	7	95	17	15	8	6	2	82																		38	0	0			298
W	0	0	1	0	0	0	0	0	142	0	0	0	5	18																		52	0	52			270
X	0	0	0	0	0	0	1	0	15	108	12	2	0	21																		62	0	116			336
Y	0	0	0	0	0	0	1	0	5	4	58	0	0	20																		13	0	124			226
Z	0	0	0	2	0	0	1	0	1	1	0	4	0	30																		26	0	13			78
AA	3	14	4	2	0	8	21	7	6	7	6	3	42	127																		136	5	7			399
AB	8	53	5	17	1	34	83	68	46	73	50	14	110	865																		1563	704	738			4433
AC	21	37	12	9	1	26	56	42	28	47	39	9	52	1023																							1401
AD	21	31	5	18	2	26	51	29	32	41	41	10	83	988																							1378
AE	0	15	1	5	0	18	29	17	22	26	25	5	53	624																							840
AF																													1358	1160	707		598				3823
AG	-2	39	4	5	0	11	24	27	7	15	13	3	38	229	5	22	1	6	1	1	34	2	5	7	5	2	3	50	43	218	133	363					1316
AH																																1125			-7	-58	1060
AI															1	2	5	1	0	2	2	1	0	1	1	0											18
AJ															12	28	47	24	6	15	29	27	14	55	42	10	24	61									395
AK	73	317	37	95	8	188	460	309	349	368	296	74	408	4351	90	366	90	117	15	203	490	298	270	336	226	78	399	4433	1401	1378	840	3823	1316	1060	18	395	

Source: Author calculation from GTAP database version 6.

Note All values are in billions of US dollar

Note A to N are activity account of 14 sectors, O to AB are commodity account of 14 sectors, AC to AE are value-added account, AF is household account, AG is government account, AH is saving-investment account. AI is international transport or trade margin account, AJ is rest of the world account, and AK is total account.

(10) Micro-SAM of Korea

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK
A														27																				1	27
B															41																			2	43
C																5																		0	5
D																	14																	17	31
E																		2																2	4
F																			18															3	20
G																				75														18	93
H																					47													18	65
I																						30												25	55
J																							19											50	69
K																								54										21	75
L																									3									3	6
M																										21							15	6	41
N																											423							12	435
O	3	20	0	1	0	0	0	0	0	0	0	0	0	2																	12	0	0			38
P	3	5	0	0	1	0	0	0	0	0	0	0	0	10																	30	0	0			49
Q	0	1	0	0	0	1	22	1	0	0	0	0	0	3																	2	0	0			30
R	0	0	0	10	0	0	0	0	1	0	0	0	0	1																	7	0	0			21
S	0	0	0	0	1	0	0	0	0	0	0	0	0	0																	2	0	0			3
T	0	1	0	0	0	8	0	1	0	0	1	0	0	6																	3	0	0			22
U	0	1	0	0	0	0	38	7	7	1	11	1	5	18																	4	0	0			94
V	2	1	0	4	0	1	2	27	4	2	4	1	0	10																	4	0	0			62
W	0	0	0	0	0	0	0	0	17	0	0	0	2	3																	5	0	10			37
X	0	0	0	0	0	0	0	0	1	18	0	0	0	2																	10	0	18			49
Y	0	0	0	0	0	0	1	1	6	22	21	0	0	8																	4	0	16			79
Z	0	0	0	0	0	0	0	0	0	0	0	0	0	1																	2	0	1			5
AA	0	0	0	0	0	0	1	1	0	1	1	0	8	5																	12	0	0			30
AB	3	4	1	5	1	4	10	11	6	11	12	1	7	110																	150	42	64			441
AC	10	3	2	4	0	2	11	9	5	8	14	1	7	115																						192
AD	6	2	1	4	1	2	6	5	6	4	7	1	8	81																						134
AE	0	1	0	1	0	1	2	2	2	1	3	0	2	43																						57
AF																												192	127	54		35				408
AG	0	4	0	1	0	0	0	1	2	1	1	0	0	17	7	2	1	1	0	0	1	1	0	3	2	1		0	0	6	3	23					78
AH																															139			-8	-21	110
AI														0	0	2	0	0	0	1	1	0	0	1	0										7
AJ														4	5	22	5	1	3	17	13	6	26	22	1	10	18								156
AK	27	43	5	31	4	20	93	65	55	69	75	6	41	435	38	49	30	21	3	22	94	62	37	49	79	5	30	441	192	134	57	408	78	110	7	156	

Source: Author calculation from GTAP database version 6.

Note All values are in billions of US dollar

Note A to N are activity account of 14 sectors, O to AB are commodity account of 14 sectors, AC to AE are value-added account, AF is household account, AG is government account, AH is saving-investment account. AI is international transport or trade margin account, AJ is rest of the world account, and AK is total account.

(11) Micro-SAM of NAFTA

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
A														
B														
C														
D														
E														
F														
G														
H														
I														
J														
K														
L														
M														
N														
O	26	138	0	4	0	0	0	2	0	0	0	0	0	16
P	31	162	1	0	2	1	0	6	0	0	0	0	1	127
Q	0	5	8	0	0	23	156	12	1	0	0	0	2	53
R	1	2	1	105	1	9	1	7	13	0	3	2	1	20
S	0	0	0	2	6	0	0	0	0	0	0	0	0	3
T	3	32	1	2	0	175	10	17	9	5	11	4	5	258
U	4	33	5	1	0	19	231	31	103	26	116	7	77	266
V	16	27	5	36	2	36	29	223	42	10	34	7	8	153
W	0	1	1	0	0	1	1	0	179	1	6	0	12	55
X	0	0	1	0	0	1	2	1	16	110	30	1	1	57
Y	3	3	8	2	0	8	31	7	56	15	108	1	7	163
Z	0	0	0	1	0	1	1	1	0	0	0	5	1	21
AA	9	31	8	6	1	25	40	32	19	6	16	2	114	189
AB	48	146	56	41	3	114	147	158	130	77	131	15	181	3237
AC	81	184	92	35	4	130	104	159	55	57	148	13	165	3207
AD	50	106	27	59	4	129	163	93	104	57	150	15	216	2858
AE	3	31	7	14	1	55	53	69	62	48	132	6	55	2222
AF														
AG	-19	2	2	2	0	3	4	4	2	2	2	0	26	57
AH														
AI														
AJ														
AK	259	905	223	310	25	729	972	821	791	415	887	77	871	12960

	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK
A	216																					43	259
B		861																				44	905
C			186																			37	223
D				277																		33	310
E					23																	3	25
F						660																69	729
G							884															89	972
H								696														125	821
I									596													195	791
J										255												160	415
K											647											241	887
L												58										19	77
M													784								23	64	871
N														12758								202	12960
O																		55	2	1			246
P																		570	13	0			915
Q																		10	0	0			273
R																		208	5	6			384
S																		40	0	0			51
T																		135	23	54			742
U																		118	7	19			1062
V																		188	24	6			845
W																		241	65	295			858
X																		70	19	169			476
Y																		114	78	326			928
Z																		73	4	14			123
AA																		299	35	23			855
AB																		5652	1459	1344			12937
AC																							4433
AD																							4030
AE																							2760
AF															4329	3486	2385		1085				11285
AG	1	6	0	10	3	1	38	3	5	2	4	1	-2	28	104	544	375	1603					2818
AH																		1908			26	322	2257
AI	3	2	5	4	2	5	8	5	4	4	7	2											50
AJ	26	46	81	93	24	76	132	141	252	215	270	61	73	152									1644
AK	246	915	273	384	51	742	1062	845	858	476	928	123	855	12937	4433	4030	2760	11285	2818	2257	50	1644	

Source: Author calculation from GTAP database version 6.

Note All values are in billions of US dollar

Note A to N are activity account of 14 sectors, O to AB are commodity account of 14 sectors, AC to AE are value-added account, AF is household account, AG is government account, AH is saving-investment account. AI is international transport or trade margin account, AJ is rest of the world account, and AK is total account.

(12) Micro-SAM of EU

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK
A															192																					42	234
B																609																				131	741
C																	81																			23	105
D																		134																		89	223
E																			24																	27	52
F																				357																113	470
G																					709															236	945
H																						417														341	758
I																							276													331	607
J																								180												191	371
K																									286											418	704
L																										157										57	214
M																											524								93	122	740
N																												8049								389	8437
O	21	142	1	3	0	1	0	2	0	0	0	1	0	16																		77	0	1			265
P	29	118	1	1	3	2	0	8	1	0	0	0	2	111																		491	3	0			771
Q	0	8	4	1	0	14	99	8	0	0	0	3	0	31																		37	0	1			208
R	0	0	0	70	1	3	1	5	4	0	1	3	1	18																		157	1	1			269
S	0	0	0	1	13	1	0	0	1	0	0	0	0	4																		39	0	0			59
T	1	19	1	3	1	122	9	15	5	6	8	8	6	149																		112	4	12			479
U	4	18	3	1	1	7	288	35	70	33	95	19	45	215																		186	2	68			1091
V	16	25	2	18	5	25	28	233	37	21	23	15	8	111																		130	11	3			711
W	1	1	1	0	0	1	2	1	127	3	11	4	18	53																		191	9	163			586
X	0	1	0	0	0	3	6	3	26	77	40	2	2	70																		63	7	118			420
Y	4	5	3	2	0	4	18	9	39	20	121	4	4	83																		43	14	277			650
Z	1	4	0	1	0	4	6	2	5	3	5	32	2	38																		97	4	24			227
AA	5	24	5	5	1	18	36	22	12	8	16	5	108	181																		190	10	9			656
AB	37	137	18	43	9	93	165	145	114	76	139	33	132	2193																		2843	1560	935			8674
AC	38	120	47	22	5	56	93	85	46	34	53	33	131	2355																							3117
AD	73	78	14	40	8	79	130	90	92	61	122	38	129	1385																							2338
AE	5	26	3	10	2	30	44	53	36	38	75	12	48	1219																							1600
AF																													3088	1690	1160		1331				7270
AG	-3	14	1	3	1	6	20	44	-9	-9	-4	4	103	204	7	34	6	12	3	7	135	9	22	11	18	6	8	221	29	648	439	966					2957
AH																																1647			-26	-7	1614
AI															5	5	9	5	1	6	10	8	4	4	8	2											68
AJ															61	123	111	119	30	108	237	278	285	226	338	62	123	404									2504
AK	234	741	105	223	52	470	945	758	607	371	704	214	740	8437	265	771	208	269	59	479	1091	711	586	420	650	227	656	8674	3117	2338	1600	7270	2957	1614	68	2504	

Source: Author calculation from GTAP database version 6.

Note All values are in billions of US dollar

Note A to N are activity account of 14 sectors, O to AB are commodity account of 14 sectors, AC to AE are value-added account, AF is household account, AG is government account, AH is saving-investment account. AI is international transport or trade margin account, AJ is rest of the world account, and AK is total account.

(13) Micro-SAM of Australia-New Zealand CER

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK
A															20																					9	30
B																28																				16	44
C																	19																			16	35
D																		6																		1	7
E																			1																	1	1
F																				20																3	23
G																					34															13	48
H																						17														5	22
I																							12													4	16
J																								3												1	5
K																									10											5	15
L																										4										1	5
M																											38								2	6	46
N																												453								11	465
O	3	11	0	0	0	0	0	0	0	0	0	0	0	2																		4	0	1			21
P	1	5	0	0	0	0	0	0	0	0	0	0	0	4																		25	0	0			36
Q	0	1	3	0	0	1	10	0	0	0	0	0	0	5																		1	0	1			22
R	0	0	0	2	0	0	0	0	0	0	0	0	0	2																		6	0	0			11
S	0	0	0	0	0	0	0	0	0	0	0	0	0	0																		1	0	0			2
T	0	1	0	0	0	5	0	0	0	0	0	1	0	12																		4	0	0			25
U	0	1	1	0	0	0	11	1	2	0	3	1	5	11																		7	0	1			46
V	2	2	1	0	0	1	1	7	1	0	1	0	1	5																		4	2	0			29
W	0	0	0	0	0	0	0	0	4	0	0	0	2	3																		8	0	10			27
X	0	0	0	0	0	0	0	0	0	1	0	0	0	4																		2	0	6			13
Y	0	0	2	0	0	0	0	0	1	0	3	0	0	7																		3	0	10			27
Z	0	0	0	0	0	0	0	0	0	0	0	0	0	1																		3	0	2			7
AA	1	3	1	0	0	1	2	1	0	0	0	0	5	14																		10	3	1			42
AB	6	7	6	1	0	4	8	5	2	1	2	1	11	126																		166	67	56			469
AC	8	5	16	1	0	4	5	3	2	1	1	1	8	99																							154
AD	8	5	3	1	0	4	5	2	2	1	2	1	9	85																							128
AE	0	2	1	0	0	1	2	1	1	0	1	0	3	74																							87
AF																													151	124	84		45				404
AG	0	0	1	0	0	0	1	0	0	0	0	0	2	11	0	4	0	1	0	1	4	1	5	1	1	0	-2	5	4	5	3	69					118
AH																																92			2	-6	87
AI															0	0	0	0	0	0	1	0	0	0	1	0											3
AJ															1	3	2	4	1	4	7	10	11	9	15	2	6	10									86
AK	30	44	35	7	1	23	48	22	16	5	15	5	46	465	21	36	22	11	2	25	46	29	27	13	27	7	42	469	154	128	87	404	118	87	3	86	

Source: Author calculation from GTAP database version 6.

Note All values are in billions of US dollar

Note A to N are activity account of 14 sectors, O to AB are commodity account of 14 sectors, AC to AE are value-added account, AF is household account, AG is government account, AH is saving-investment account. AI is international transport or trade margin account, AJ is rest of the world account, and AK is total account.

(14) Micro-SAM of ROW

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK
A															703																					56	759
B																666																				70	736
C																	326																			263	588
D																		215																		118	334
E																			38																	16	54
F																				225																47	272
G																					630															201	831
H																						346														119	465
I																							188													66	254
J																								96												90	186
K																									174											124	298
L																										85										44	129
M																											571								61	91	723
N																												4340								220	4559
O	144	197	3	18	2	3	5	16	0	1	2	1	10	41																		308	3	10			764
P	33	163	3	2	2	2	3	6	1	1	1	1	3	70																		515	2	3			811
Q	3	12	36	1	0	11	194	15	1	0	1	4	3	78																		48	0	4			410
R	4	4	3	120	2	3	3	6	3	1	1	4	2	18																		145	2	1			322
S	1	1	1	2	16	1	1	1	0	0	0	1	0	3																		39	1	0			67
T	4	14	8	4	1	71	9	8	2	2	3	12	5	81																		56	1	6			289
U	12	16	20	3	1	7	224	32	40	18	58	12	66	208																		114	1	24			857
V	41	22	15	27	5	15	21	135	13	10	14	8	17	88																		97	6	6			539
W	3	3	8	1	0	2	4	2	60	2	7	1	28	35																		75	1	122			354
X	1	2	5	1	0	1	3	1	5	62	9	2	7	33																		52	1	57			241
Y	5	7	19	3	0	4	13	5	19	12	52	2	7	60																		36	2	192			440
Z	3	2	6	1	0	2	3	2	2	1	1	7	3	28																		52	4	21			137
AA	18	25	35	13	1	11	27	17	6	5	7	4	83	162																		207	8	9			638
AB	67	87	99	43	6	43	132	80	32	25	43	18	136	901																		1487	776	615			4591
AC	215	94	241	41	7	42	77	68	27	24	43	24	152	1193																							2246
AD	199	66	55	42	7	38	66	40	29	15	37	20	131	841																							1586
AE	3	14	8	8	1	9	15	12	8	6	14	4	38	593																							732
AF																													2217	1439	655		442				4754
AG	3	9	26	5	1	7	31	18	5	3	5	3	33	126	9	64	5	20	4	7	53	18	28	10	27	11	0	52	29	147	76	414					1248
AH																																1107			5	-42	1070
AI															5	6	7	5	2	5	13	9	4	3	8	1											66
AJ															47	75	73	82	24	51	162	166	134	132	230	39	68	199									1482
AK	759	736	588	334	54	272	831	465	254	186	298	129	723	4559	764	811	410	322	67	289	857	539	354	241	440	137	638	4591	2246	1586	732	4754	1248	1070	66	1482	

Source: Author calculation from GTAP database version 6.

Note All values are in billions of US dollar

Note A to N are activity account of 14 sectors, O to AB are commodity account of 14 sectors, AC to AE are value-added account, AF is household account, AG is government account, AH is saving-investment account. AI is international transport or trade margin account, AJ is rest of the world account, and AK is total account.

7A Data aggregation of 10 sectors

			GTAP	Thai Household Survey
No.	**Code**	**Description**	**Code[5]**	**Code[6]**
1	PLPR	Plants and products	PDR, WHT, GRO, V_F, OSD, C_B, PFB, OCR, VOL, PCR, SGR	J010, J014, J015, J016, J017, J018
2	ANPR	Animals and products	CTL, OAP, RMK, WOL, CMT, OMT, MIL	J011, J012, J013
3	OAGR	Other agriculture	OFD, B_T	J019, J020, J021, J022, J023, J101
4	TEXT	Textile and apparel	TEX, WAP	J111, J123
5	SHOE	Leather and shoes	LEA	J112
6	MOTR	Motor and equipment	MVH, OTN	J153, J154
7	ENER	Energy	COA, OIL, GAS, OMN	J122
8	OMAN	Other manufactures	FRS, FSH, LUM, PPP, P_C, NMM, I_S, NFM, FMP, CRP, ELE, OMF, OME	J121, J124, J125, J126, J131, J141, J156, J162, J163, J164
9	TRAN	Transports	OTP, WTP, ATP	J151, J152
10	SVCS	Other services	ELY, GDT, WTR, CNS, TRD, CMN, OFI, ISR, OFI, ROS, OSG, DWE	J127, J132, J133, J142, J155, J161, J165, J171, J181, J182

[5] Full details of these codes are provided in Appendix 4A.
[6] Full details of these codes are provided in section 3.2 of Chapter 7.

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