Discussion Paper No.147

Regional Economic Integration and its Impacts on Growth, Poverty and Income Distribution: The Case of Thailand *

by

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September 2006

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* This research was financially supported by the Core University Program and the Grant-in-Aid for Scientific Research (B) of the Japan Society for the Promotion of Sciences (JSPS) in the fiscal year 2005. The socio-economic survey of Thailand was processed for the data base of our CGE modelling by Miss Sasipen Bhuvapanich (Ph.D. candidate, Graduate School of International Development, Nagoya University). We acknowledge them with appreciation.

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Abstract

Along with the regional frameworks, Thailand has made serious efforts to establish Economic Partnership Agreements, including Free Trade Agreements (FTAs), with several countries: China, India, Australia, New Zealand, Japan and the US. The aim of this paper is to discuss a policy simulation analysis on the economic impacts on Thailand's economy of free trade agreements using a Global Computable General Equilibrium (CGE) model. Suffice it to say that the FTA strategy and the formation of Free Trade Areas in East Asia would stimulate growth and investment, and improve welfare for Thailand. However, the impacts on income distribution vary with the integration scenarios, depending on the pattern of production and trade and the extent of trade liberalization in Thailand's FTA partners. The simulation results show that Thailand would gain most from the FTA with Japan both in terms of welfare and improved income distribution; and that Thailand could realize most of the potential gain from free trade by promoting the process of regional economic integration in East Asia.

Table of Contents

1. Introduction

Regional integration has become a coexistence with the principle of multilateral trade in the process of globalization of the world economy. According to a recent report published by WTO, more than 259 regional trade agreements are in place (WTO secretariat, 2003). Since the European Union (EU) and the North America Free Trade Agreement (NAFTA) significantly had the effect of promoting intra-regional trade, other countries have become active to explore options for such regional agreements.

In Asia, such trend has recently come to surface. The ASEAN Free Trade Area (AFTA) has become effective since 2003. The Japan-Singapore Economic Agreement for a New Age Partnership was concluded and took effect in 2002. China and ASEAN also concluded a framework agreement toward the establishment of their free trade agreement.

Along with these regional frameworks, Thailand has made serious efforts to conclude Economic Partnership Agreements (EPAs), including Free Trade Agreements (FTAs) with several countries. In particular, it has concluded the agreements with China, India, Australia, New Zealand, and most recently Japan. Now, it is negotiating with the US.

It should be noted that most of the FTAs between Thailand and its partners cover not only liberalization of trade, but also various types of economic cooperation. Some of them are termed as Closer Economic Partnership Agreement (Thailand-Japan, Thailand-Australia) or Trade and Investment Framework Agreement (Thailand-US). The main elements of these new types of FTAs involve bilateral liberalization and facilitation of trade through reduction of tariff and non-tariff barriers as well as the mutual recognition of national standards, streamlining customs procedures, facilitation of increased services trade and establishment of a framework for foreign investment. They also enhance collaboration on intellectual property, education and tourism. In some extent, the basic philosophy of these new types of FTAs is similar to that of Asia Pacific Economic Cooperation (APEC) forum.

Theoretically, when an FTA is used as a market integration mechanism, it will bring about tangible economic benefits when trade creation exceeds trade diversion effect. The total economic effects are likely to be positive due to market expansion and cost reduction. However, opponents of FTAs may raise strong criticisms that the agreements

are not sufficient for growth. Thailand, for example, also needs other supportive policies. The protection of infant industries against imports will provide an opportunity of learning and growing up. The openness of the country has been accompanied also by concerns that it will cause some negative impacts, and that the poverty incidence and distribution of income in Thailand will deteriorate. Accordingly, the issue of trade liberalization and poverty in Thailand has become the focus of much research in the last several years.

The argument is also based on the truth that the potential advantages gained from an FTA will vary in accordance with the counterpart's economic structure and trade patterns. Moreover, integration of the domestic market with that of another country will create winners and losers for both parties. In this context, political consideration must be paid to alleviating and minimizing the internal discord that may stem from external integration.

It is obvious that Japan, China, India, Australia and New Zealand have regarded FTAs as a fundamental element of their external economic policy. In this context, Thailand would be an ideal FTA partner for them for several reasons. First, an agreement with Thailand should be manageable since Thailand's economic scale is much smaller than that of those countries. Moreover, Thailand's proximity (distance, size and area) is seen as a positive factor that could yield geographical benefits, in term of regional integration. Second, since Thailand's average tariff rate of 17.4 percent is still above the world level of 7 percent, the potential benefits for Thailand and its partners, related to an elimination of tariffs, would be considerably higher than that for other nations. Finally, the Thai government is still confident of pursuing FTA negotiations with other countries. With strong political power, the Thaksin administration has the potential to find ways to mitigate the negative impacts and emerging political conflicts.

The aim of this paper is to discuss a policy simulation analysis on the economic impact of FTAs and regional integration in East Asia applying Computable General Equilibrium (CGE) model. The simulation experiments of the Global Linked CGE model developed by Nguyen and Ezaki (2005) are to analyze the impact of FTAs between Thailand and its trading partners on the Thai economy with special reference to China, India, Australia, New Zealand, Japan and the US. The conclusion drawn from these

model simulations will help to clarify the main source of an economic impact of FTAs on growth, poverty and income distribution.

The paper is organized as follows. In sections 2 and 3, the descriptive analysis is provided to understand the background and political pressure behind the Thai trade policy, particularly a Thailand-Japan FTA. This will be followed by the development of regional integration in East Asia and the situation of poverty and income distribution in Thailand prior to the FTA policy in sections 4 and 5. An analytical framework of the CGE model used for the simulation experiments is then presented in section 6. The outcomes of the policy simulations are discussed in section 7. Finally, the paper will provide readers with concluding remarks and some policy options.

2. Pattern of Thailand's Trade Policy

Obviously, one of the main reasons of Thailand's free trade agreements is to make the country more attractive place for foreign investment. The FTAs provide investors with competitive advantages in the importation of raw materials, components and other production inputs. They also open new markets and industries to local and foreign direct investment, such as the ASEAN Investment Area (AIA) Agreement and the Thailand-Australia FTA, which enables Australian investors to own majority control of investments in selected industries in Thailand. Some FTAs harmonize customs codes and product standards to speed up trade flows that will increase Thailand's allure as a production and export base.

The pattern of concluded FTAs can be described as follows:

ASEAN Free Trade Area (AFTA)

AFTA was launched in 1992 to eliminate tariffs and integrate member economies into a single production base and regional market of about 550 million people. Tariffs were reduced to 0-5 percent in 2003 for ASEAN-6 (Brunei, Indonesia, Malaysia, the Philippines, Singapore and Thailand)and will be eliminated totally by 2015 for all ASEAN members. Relatively, trade within all of ASEAN members is already free, as more than 99 percent of traded goods are either duty free or face maximum tariffs of only 5 percent. In terms of liberalization of investment, the AIA agreement, a component of

AFTA, is supposed to facilitate member and non-member investors. Effective January 1, 2010, ASEAN-6 markets will be open to investors in most sectors, including manufacturing, agriculture, fishery, forestry, mining and related services. Moreover, the AIA will facilitate freer flows of capital, skilled labor, professional expertise and technology within ASEAN.[1]

Thailand-China

Prior to the establishment of the ASEAN-China FTA, Thailand entered into an FTA with China that took effect in October 2003. It eliminated duties on 188 fruits and vegetables. But negotiations regarding additional items are on hold, as they will be covered under the ASEAN-China agreement. China was the first important trading partner selected by Thailand for forming an FTA. At first, China's growing competitive edge was regarded as a threat because it induced FDI away from Thailand and other ASEAN countries. Such an attitude has changed since China joined the World Trade Organization (WTO) in 2001. This is incorporated with China's strategy of forming FTAs with neighboring countries. In addition to the export market for Thailand, China has offered various incentives such as an early harvest, or advanced trade liberalization, in agricultural products. The highest growth rate of Thailand's exports to China of about 60 percent is one of the main reasons direct to the point.

ASEAN-China

The ASEAN-China trade agreement on goods took effect on July 1, 2005, creating the world's largest free trade area of 1.7 billion consumers. Thai exports of tapioca, biochemicals, plastics and medical equipment are expected to profit from the FTA. Tariffs will be phased out between 2010 and 2018. But an Early Harvest Scheme (EHS) between China and ASEAN-6, begun in January 2004, cut tariffs on meat, fish,

[1] The study on the impacts of AFTA using GTAP model and CAMGEM of Chulalongkorn and Monash Universities found that trade liberalization within ASEAN would generate prosperity for the region as a whole. Singapore is likely to gain most from the implementation of AFTA policy. This benefit is gained from external impact caused by the tariff reduction on the part of other ASEAN members. In contrast, Thailand' benefit would come mostly from the internal impact due to its own tariff reduction. See Arunsmith, Mallikamas, Treerat and Pornchaiwiseskul (2002).

dairy products, other animal products, trees, vegetables, fruits and nuts. Duties on these goods are subject to be eliminated by 2006.

Thailand-India

An EHS, part of a broader Thailand-India FTA, took effect on September 1, 2004. The Scheme reduced tariffs on 82 agricultural and industrial items by 50 percent, including various fruits, wheat, sardines, salmon, mackerel and processed crab. It also covers other major Thai exports such as gems and jewelry, household electrical appliances, integrated circuits, furniture and auto parts. Tariffs on these items will be eliminated by September 1, 2006. Full liberalization will occur by 2010.

The main purpose of the Thailand-India FTA is to intensify trade and economic cooperation between the two countries. Thailand and India share not only age-old bonds of cultural affinity, commercial interests and common perceptions on various issues, but also the possibility to increase trade and investment (Das, Ratanakomut and Mallikamas, (2002)). In 2003, bilateral trade between the two countries was still at the low level, but the growth rate of Thailand's exports to India of about 54 percent was only second to China. In addition, for Thailand, India is a gateway to the trading blocs in South Asia, and promoting trade and cooperation with India can offset worries of China's dominance in the region. But for India, the deal is being viewed with concern for three reasons. First, the Indian industry is not yet sure about its competitive efficiency. Second, many sectors say they do not want competition on their homeland. And finally, there is a huge fear among Indian companies that the deal will be misused as a staging ground for cheaper exports to India. However, the deal can lead to an India-ASEAN FTA, and can bring India closer to the region's economic powers, such as Japan, China and South Korea.

Thailand-Australia

The Thailand-Australia FTA took effect on January 1, 2005. It eliminated Australia's 5 percent import tax on autos and parts. It also provided incentives to attract Australian foreign direct investment. Australian investors can now own up to 60 percent in Thai SMEs in telecommunications, computers, construction, education, distribution, tourism, mining and other sectors. The FTA is expected to boost bilateral trade

significantly. Besides, the agreement eliminated tariffs on 83 percent of Thai exports and 80 percent of Australian exports, and by 2010, 95 percent of all trade between Australia and Thailand will be free. Duties on all Thai agricultural products were eliminated, except for tuna, skipjack and bonito, which will be phased out by 2007. Import duties on Australian wheat barley, rye, oats, lactose, cocoa, copper bars and steel slab were eliminated, while tariffs on items such as wine, fruits, vegetables, plastics, paper, textile, garment, steel, machinery and electrical appliances will be eliminated by 2010.

Thailand-New Zealand

The Closer Economic Partnership Agreement between Thailand and New Zealand took effect on July 1, 2005, eliminating duties on 71 percent of annually traded goods. Tariff-free imports from New Zealand include machinery, wool, plastic products, paper, infant formula and vegetables. Thai exports, including electrical appliances, gems, canned tuna, furniture, glass and ceramics, are tariff-free.

The main objective of setting up the FTAs between Thailand and Australia and New Zealand is to enhance trade and improve welfare. Although trade between Thailand and the two countries is still playing small part in improving Thailand's welfare, better trade and crisis management are seen to be a main ingredient to promote trade and growth in Thailand. Since Australia and New Zealand are known to be more advanced and competitive in the technology and management sector, a good trade policy and economic cooperation will enhance Thailand's welfare.

3. Thailand-Japan FTA

In July 2005, Thailand and Japan reached basic agreement to sign a free trade agreement. Officials from the two sides have shown their hard works since the negotiations began in February 2004. Despite a lot of conflicts of interests, they have managed to conclude the negotiations in an uneventful manner. Upon close scrutiny of the working-level negotiations between the two governments and the consequences of FTA mainly with China, it seems that the Thai government has displayed competent negotiating skills.

Discussions of a Thailand-Japan FTA began with a Thai proposal in November 2001 that Thailand and Japan should explore together the possibility of establishing a bilateral Free Trade Agreement. In January 2002, Japan then proposed the "Initiative for Japan-ASEAN Comprehensive Economic Partnership". With these proposals serving as an impetus, Thailand and Japan decided to begin consultations for an agreement of Japan-Thailand Economic Partnership (JTEP) in April 2002. The working group was subsequently set up that resulted in the publication of a task force report in December 2003, which presented a positive assessment of the potential for JTEP agreement.

Under the agreement, Thailand is subject to lower its import duties on cars with an engine of 3000 cc or larger from the present 80 percent to 60 percent by 2010. Import duties on auto parts will be phased out entirely by 2011, and those on steel products will be eliminated within 10 years of the implementation of the agreement. As for Japan's concessions, rice is to be exempted, while import duties on pork are to be lowered from 21.3 percent to 10.65 percent in five years after the agreement goes into effect and a low import-duty framework will be set for bananas. Thai care workers will be permitted to enter into Japan, while the length of previous work experience as a precondition for Thai cooks residence in Japan will be shortened from the present 10 years to 5 years.[2]

The Thailand-Japan FTA would enhance intra-industry trade, while trade and investment between the two countries would expand as a result of elimination of tariff and non-tariff barriers. This would contribute to economy of scale advantages and enhanced production efficiency. Furthermore, the FTA would involve such positive

[2] The quantitative effects of trade liberalization between Thailand and Japan were shown in the appendix of the task force report in December 2003. Taking into account the dynamic impacts such that through capital formation mechanism, one by the accumulation of induced income, savings and investment, and another by international capital movements and through pro-competitive productivity growth effects, the macroeconomic gains from trade liberalization is estimated to be larger than the static impacts. Japanese real GDP would increase by 0.24 percent. In contrast, real GDP in Thailand would increase by 20.09 percent. Macroeconomic gains measured in terms of rate of changes are much more significant in Thailand. Welfare improvements measured by Equivalent Variation (EV) are estimated to be around US$ 13 billion in Japan, while US$ 23 billion in Thailand. Moreover, the benefits of trade liberalization could be higher for this region if Thailand-Japan FTA leads to Japan-ASEAN FTA and further global trade liberalization.

economic effects as an expansion of foreign direct investment (FDI) through promotion of the standardization of advanced technologies, development of human resources and establishment of a more transparent and sound investment environment. The importance of the Thailand-Japan FTA can be recognized that it is hailed by the Thaksin administration as one of its major achievements in the conducts of its international economic policy.

However, there have been those who have adopted a more negative view of the FTA, due to concerns that the actual benefits received by Thai traders will depend in large part on how much access is actually gained to the Japanese market, and that the Thai industrial and business sectors cannot effectively improve their competitiveness. Very little information has been made public by the Thaksin government, despite persistent calls for transparency from civic groups and business operators concerned about the negative impact of the FTA. The government has not tabled the matter for debate in the House of Representatives, claiming that the FTA is not a treaty. Previous FTAs signed between Thailand and its partners, particularly China, have adversely affected a large number of Thai farmers and small business operators, while the business elite benefited handsomely. In the case of Japan, the effects on Thai farmers and small business operators will be greater because the FTA covers diverse areas of trade and investment.

In Japan, most newspaper commentaries also echoed the criticism of the agreement with Thailand, calling it far short of what a free trade agreement should achieve. Along with these comments, it was criticism of the Japanese government for failing to take an initiative in opening Japan's own market as a major trading power that should play role of promoter of the principal of free trade.[3]

4. Regional Integration in East Asia

The shift towards regional integration in East Asia during the last decade might be rooted in the financial crisis started in Thailand in July 1997. The cooperation in particular among the ASEAN+3 (ASEAN, Japan, South Korea and China) has been proceeding firstly on financial issues. Urata (2004) explained that based on this platform

[3] See Foreign Press Center Japan, August 15, 2005.

East Asia will develop to become a Free Trade Area for three reasons. First, the Doha Round has encountered difficulties to promote freer trade on a global scale. Second, East Asian economies have become interested in using FTAs as a way of promoting deregulation and structural reforms in the domestic market. And third, the lack of adequate international assistance during the recent economic crisis illustrated the need for solidarity between the countries of the region.

During the recent economic crisis, it was argued that Japan was more complementary than competitive to the rest of Asia, and potentially could benefit greatly from a free trade area in East Asia. Moreover, Japan was the sole developed country in the region, and should become a major impetus to regional integration (Lau (2003)). In January 2002, Japan then signed the Japan-Singapore Economic Partnership Agreement (JSEPA), indicating the shift of the Japanese policy on FTA. Japan's position is that to establish an East Asia free-trade Zone in 2010 (Japan Times (2002)). It would encompass Japan, ASEAN, China, South Korea and Taiwan or the so-called ASEAN+5. In the future, the area could be extended to Australia and New Zealand, as well as the US. The aim is to offset the economic challenges posed by the European Union and the North American Free Trade Agreement Zone. It would also overcome the difficulties that the World Trade Organization has encountered in trying to promote freer trade on a global scale.

China also proposed the trade area in 2003. Since joining the WTO in 2001, China has not only secured access to the world market, it has also started to develop regional trade. It signed the China-Hong Kong Economic Partnership Agreement (CEPA) in June 2003. But the plan to establish an ASEAN+3 trade zone made no progress, China then decided to negotiate with ASEAN and concluded the FTA in 2005. From China's point of view, Korea and Japan would follow the same strategy, exploring the possibility of similar negotiations with ASEAN.

In the case of ASEAN, it prefers to deal with the partner countries on separate basis. Its strategy is to become a hub. It has negotiated and signed FTAs with many countries inside and outside the region such as Japan, China, the US, the EU, India, Australia and New Zealand. This strategy of ASEAN has created fears for some of its members that foreign companies would use Singapore as an assembly site or distribution center from which their products would be exported to other member countries duty free.

As mentioned before, Thailand has also set its position to deal with partner countries on separate basis. But it supports the establishment of an East Asia Study Group (EASG) to explore practical ways to expand existing cooperation and to form new linkages in all sectors. From Thailand's point of view, the ASEAN+3 integration process would focus its activities on narrowing the development gap within ASEAN and between ASEAN and East Asia.[4]

There are several approaches that could help establish an East Asia Free Trade Zone. But Lu (2003) saw that the most possible path would take two stages of process. The initial stage is to establish various FTAs among pairs and groups of regional economies. Then the final stage is to merge individual FTAs into a region-wide framework. From this point of view, the first stage has already well started.

5. Situation of Poverty and Income Distribution

Generally, it can be said that FTA has the potential to act as a significant catalyst for poverty reduction. It can provide poor people in the partner countries with access to the market, technologies, and ideas needed to sustain higher and more equitable patterns of growth. However, to understand it clearly, one has to recognize that growth is a necessary, but not a sufficient condition, for a sustained reduction in poverty reduction. Even if trade liberalization is linked to more rapid growth, this does not necessarily imply that it is an effective instrument for reducing poverty. For instance, if a growth strategy based on the reduction of trade restrictions leads to a considerable decline in income of households at the bottom of the income strata, it may not make any inroad in alleviating poverty. The effectiveness of FTA measures then depends on the linkage between trade liberalization and income distribution.

The World Bank (2001a and 2001b) recognizes that there may not be a direct link between trade policy measures and income distribution. The Kuznets curve hypothesis, which claims to be the existence of a U-shaped link between growth and inequality due to the shift from the agricultural to the nonagricultural sectors, seems not to be empirically valid in many cases. It still depends on appropriate macroeconomic and exchange rate policies. In other words, to be successful, trade reforms must be part of a

[4] Ministry of Foreign Affairs of Thailand, July 8, 2003.

logically consistent package of sound macroeconomic and exchange rate policies and structural reforms.

The last point to be concerned about is the link between FTAs and rural and agricultural sector. Take Thailand for instance, while it has seen a significant increase in the share of manufactures in their exports after trade liberalization, a large proportion of the population is still closely tied to the rural sector and in agriculture. This sector is where the bulk of the poverty is concentrated (Chaipan and Grosskopf (1995)).

To quantify the effect of trade agreements on poverty and income distribution in Thailand, it is worth to mention the situation prior to the policy measures. The latest data complied by National Statistical Office of Thailand and Office of the National Economic and Social Development Board indicated that Thailand is the land of inequality. In 2004, the Gini coefficient was 0.408, among the highest in Asia. The richest 20 percent of the population in this country earned 48.6 percent, while the poorest 20 percent earned only 6.1 percent of total income in that year. Moreover, while Thailand can reach the more developed country status, income inequality in this country has increased significantly since the 1960s (Ikemoto (1991), Ikemoto and Uehara (2000)). Although during the last two decades, Thailand's poverty incidence was decreased from 32.5 percent in 1992 to 12.0 percent in 2004, mainly due to its economic growth, the increase in inequality could still be problematic from the perspective that it might slow the GDP growth rate in the years to come. The inequality has been found particular significance in the agricultural sector for two reasons. First, while the share of the agricultural sector in GDP decreased from 27 percent in 1974 to 10 percent in 2003, the labor force in this sector in 2003/2004 still accounted for 42 percent of the total labor force. Second, income level in agricultural sector was low and volatile because farm prices and harvest directly affect the value of agricultural output. For many authors, this characteristic of the Thai economy leads to the conclusion that the Kuznets Hypothesis is the most importance for understanding changes in Thailand income distribution.

Moreover, Thailand has also faced the interregional inequality. The average household income in the Bangkok Metropolitan area was 2.6 times higher than that of the rural area in the Northeast region in 1975-76. The figure had increased to 3.4 in 1998 and 4.5 in 2001. Motonishi (2003) found that total inequality in Thailand increased in the

1980s, and was relatively stable in the 1990s. But interregional inequality increased in the late 1980s till the early 1990s, and decreased afterward. The main determining factor of inequality in Thailand is the inequality between the agricultural and nonagricultural sectors. The other determinants, including financial development, education level disparity and aging, are not significantly responsible for the increase in inequality in Thailand.

6. The Model Specification

The global CGE model employed in this paper is an extension of the global model developed by Nguyen and Ezaki (2005) to analyze the impacts of regional integration on Vietnam's economy. We extended the model by Nguyen and Ezaki (2005) basically in line with GTAP world model (Hertel (1997)) to allow for a greater regional and industrial disaggregation, a detailed treatment of taxes and subsidies, international capital mobility and transportation costs. The current global CGE model specifies 20 industries and 16 regions. The regional classification is focussed on East Asia, consisting of all major economies in the region as well as the US, the EU and Oceania. Industrial activities are specified with an emphasis on the agricultural and manufacturing sectors, taking into consideration the diversified pattern of production and comparative advantage as well as the structure of protection in each individual country and region. The details of the regional and industrial classification are given in appendix A.

Country models

The global CGE model consists of 16 country models, which are linked together through international trade and foreign investment. Country models generally follow the standard neoclassical CGE model (Dervis et al. (1982)), in which capital and labor are mobile across economic sectors with the assumption of full employment. For each country model, there are three production factors, i.e. capital, skilled labor and unskilled labor. Skilled and unskilled labor are combined in a Constant Elasticity of Substitution (CES) function to form a composite labor input, and sectoral output is a CES function of capital and composite labor.

In each country model, nine kinds of taxes and subsidies were specified, consisting of tariffs, export duties, production taxes, capital and output subsidies, and sales taxes imposed on consumer goods, intermediate inputs and capital goods. The detailed treatment of taxes and subsidies makes it possible to analyze other policy instruments in addition to tariffs. Government revenue consists of revenues from all taxes and subsidies. Total government revenue is allocated to savings and consumption in fixed proportions. The government demand for final goods is defined using fixed expenditure shares of government real spending.

Household income consists of labor and capital income. To allow for a detailed inspection of the impact of trade liberalization on income distribution in Thailand, the household sector in Thailand's model is disaggregated into 20 household groups according to the level of income, consisting of 10 urban groups and 10 rural groups. On the demand side, household consumption demand is determined using the Linear Expenditure System (LES) function. The major advantage of the LES function is that it allows for the effect of the change in income on the structure of consumption. As income rises, people tend to spend less on agricultural goods and other necessities, and consume more manufacturing goods.

The external sector in country models is modeled with the assumption of product differentiation, in which domestic and foreign goods are imperfect substitutes. Sectoral output is a Constant Elasticity of Transformation (CET) function of exports and domestically produced products. The supply for domestic and foreign markets is determined from the revenue maximization condition, depending on the relative prices at home and abroad. Total domestic demand is satisfied through domestic production and imports, and the demand for imports and domestically produced goods is modeled using the Armington structure. In this treatment, the demand for imports and domestic products varies with the changes in the relative prices of domestic products and imports.

International Linkages

Country models are linked together through trade and investment flows. Domestic consumers and producers differentiate imports by sources, that is, imports coming from different countries are considered as imperfect substitutes. This

characteristic is also modeled with the Armington structure. At the aggregate level, total imports is a CES function of imports from different sources, and then the demand for imports from each sources is derived from the cost minimization condition. On the export side, exporters do not differentiate exports by countries of destination, that is, commodities supplied to foreign countries are seen as perfectly homogenous and are sold at the same price. The trade consistency is held so that total exports supplied by home countries are equal to the sum of imports by foreign countries. To put it more specifically, imports from a country or region must be summed up to total exports by that country or region.

International transportation services create a wedge between the f.o.b prices in exporting countries and the c.i.f. prices in importing countries. The transportation cost is determined from the value of exports at f.o.b prices. The global demand for transportation services is computed by summing across all countries and industries. The demand for transportation services is then determined for countries and regions from the cost minimization condition based on the CES functional form. Thus the regional demand for transportation services will depend on the regional prices of transportation services, which are converted into a global currency unit using the corresponding exchange rates.

The complementarity between trade and investment has been the subject in many empirical studies. Trade liberalization changes the relative prices of production factors, thereby affecting foreign capital inflows. Indeed, several studies have indicated that the change in capital inflows resulting from trade liberalization could produce considerable additional welfare gains. The link between trade and investment has been accounted for in some recent studies using CGE models, such as those by Lee and Mensbrugghe (2001) or Bchir et al. (2002). In these studies, investment or capital stock is allocated across regions and industries, depending on the rate of return to capital. However, both these approaches require detailed information on foreign investment and capital at the sectoral level, which is not available at the level of the industrial and regional disaggregation adopted in this paper.

In our model, we employed a somewhat simple approach discussed in Hertel (1997) to allow for international capital mobility. In this approach, the expected return on capital is assumed to decline with the addition to the capital stock at the rate determined

by a flexibility parameter. Investment decisions are made in such a way that the rates of return on capital are equalized across countries and regions. Thus the change in global savings is allocated across country and regions to equalize the regional expected rates of return. In this treatment, investment only partially adjusts in response to the changes in the rate of return caused by trade liberalization. At a low value of the flexibility parameter, the expected rate of return to capital is not very sensitive to the change in capital stock, thus a large change in investment is required to equalize the expected rate of return to capital. A low flexibility parameter means a greater capital mobility and vice versa.

Equilibrium Conditions

Equilibrium conditions consist of the conditions in factor, commodity and foreign exchange markets. In the factor market, we adopted the assumption of full employment, and factor prices serve as equilibrating variables. In the labor market, total supply of skilled and unskilled labor is held fixed at the base-run level, and the labor market equilibrium determines wage rates. Capital rents adjust to maintain the equilibrium between the supply of and demand for capital in the capital market. Equilibrium in product markets equates the supply of domestic goods in each sector to the demand for domestically produced products, with domestic prices serving as equilibrating variables.

The fiscal balance is implied in the treatment of the government sector, in which government consumption and savings are determined as fixed shares of government revenue. In the foreign exchange market, the exchange rates are fixed for all countries and regions, and foreign savings are assumed to adjust to the change in demand for and supply of the foreign exchanges. Savings and invest are determined independently in each country or region but the savings-investment identity is guaranteed automatically by the local Walras' Law. We do not introduce the general price equation for each country or region to control its price level except for the United States, in which the general price level is fixed as the world numeraire by allowing for the global Walras' Law. All the exchange rates are fixed but the real exchange rates change because of the flexible domestic price levels relative to the world numeraire.

7. Simulation Analysis

Data and the Model calibration

To run the model, we made use of GTAP database version 6.0 constructed for 2001.[5] 57 industries and 87 regions originally specified in GTAP database are aggregated into 20 industries and 16 countries or regions in accordance with the model. We used GTAP data to calculate most of the parameters in the model, such as consumption shares, saving rates, tax rates, wage rates and capital rents. The elasticities of substitution in trade and production functions are taken from GTAP database, consisting of the elasticity of substitution between labour and capital, the elasticity of substitution between domestically produced goods and imports and the elasticity of substitution between imports from different sources. GTAP database gives high values to the elasticities in trade functions, while assigning relatively low values to the elasticity of substitution in production functions. We assigned a value of 1.2 to the elasticity of transformation in the export supply function for all industries. Given the type of functions and the value of the elasticities, the scale and share parameters can be calculated directly from the benchmark data.

In Thailand's model, household data is constructed using the socio-economic survey conducted by the National Statistical Office of Thailand in 2000.[6] The survey data are grouped into urban and rural households, and each group is further divided into deciles according to income ranges. Municipal areas are classified as urban areas, while sanitary districts and villages are classified as rural areas in a broad sense. Types of enterprise in which households belong to, together with the occupation of household heads are used to define the sectors of households. Skilled labor and unskilled labor are separated by level of education. Those with education attainment less than third-year elementary (grade ninth) are categorized as unskilled labor. Consequently, income of each labor type in twenty industries is obtained through total monthly income of members of households aged equal or over 15 years old using criteria explained above to

[5] More details about GTAP database version 6 can be found in GTAP homepage (http://www.gtap.agecon.purdue.edu/).

[6] The socio-economic survey is conducted every two years of even numbers. The survey of 2001 is exceptionally available for 2001 but only for a half of the year, so that the survey of 2000 is used in the model.

classify. Labor income is defined as wages and salaries, whereas capital income is profit from non-farm business. Profit from farming is divided equally into labor and capital income. Consumption data is based on household consumption expenditure on goods and services provided in the survey.

The survey data is then incorporated into GTAP data using a relatively simple procedure. Income shares are computed from the survey data, and are used to allocate the data on factor income taken from GTAP database to each household groups and industries. Similarly, the expenditure shares are computed, and are used to allocate GTAP data on private consumption to household groups. Data on household employment is also derived from the socio-economic survey 2000. This data is computed for each type of workers, i.e. skilled and unskilled workers, and is used to allocate employment data derived from GTAP database to household groups.

Simulation scenarios

We employed the CGE model described in the previous section to analyze the impacts of regional economic integration on Thailand's economy. Eleven simulation scenarios have been performed and are described briefly in table 1. These simulations are designed to cover all the major integration options currently facing Thailand, including the bilateral FTAs between Thailand and China, Japan, India, Oceania and the US. In addition, we also included in the simulation analysis the ASEAN free trade area (AFTA) and the possible formation of the East Asian free trade area.

Table 1: Simulation Scenarios

S0	Base run
S1	ASEAN FTA
S2	Thailand-China FTA
S3a	Thailand-Japan FTA, removal of tariffs
S3b	Thailand-Japan FTA, removal of tariffs and agricultural subsidies
S4a	Thailand –US FTA, removal of tariffs
S4b	Thailand –US FTA, removal of tariffs and agricultural subsidies
S5	Thailand-India FTA
S6a	Thailand-Oceania FTA, removal of tariffs
S6b	Thailand-Oceania FTA, removal of tariffs and agricultural subsidies
S7a	East Asian FTA, removal of tariffs
S7b	East Asian FTA, removal of tariffs and agricultural subsidies

In both developing and industrial countries, domestic industries have been protected not only by tariffs, but also non-tariff barriers and domestic subsidies. In many cases, it is not tariffs but non-tariff barriers and subsidies that play a major role in protecting domestic industries. The current version of GTAP database provides detailed information on the tariffs and certain production subsidies in the form of output and capital subsidies. However, it does not quantify the tariff-equivalent effect of non-tariff barriers. Thus our simulation analysis focused mainly on the removal of tariff barriers and quantified its impacts on Thailand's economy. In addition to the tariff removal, agricultural subsidies were also taken into account when they are found significant in GTAP database. For the FTAs with developed countries like Japan, the US, Oceania countries and the East Asian free trade area, two sets of simulations are performed. The first set takes into account only the impacts of the tariff removal, while the second one quantifies the combined effect of removing both tariffs and agricultural subsidies.

Macroeconomic Impacts of Economic Integration

The simulation results show that Thailand would gain significantly in terms of output and welfare in all the FTAs in consideration. The magnitude of the gains, however, is different, varying with the Thailand's FTA partners. In the CGE model employed in this paper, we can specify several sources for the gains in welfare and output. The first source of the welfare gain is the level of protection prior to trade liberalization in Thailand. Tariff reductions in Thailand reduce the prices of imported goods and improve efficiency of resource allocation. The second source of welfare gains is trade liberalization in Thailand's trading partners. The removal of tariffs in trading partners would expand the market for Thailand's exports, thus stimulating the development of the industries in which Thailand possesses a comparative advantage. Thus the gain from FTAs depends on the geographical composition of Thailand's trade as well as the level and structure of protection in Thailand and its trading partners.. An FTA with a larger trading partner would have a greater impact and bring about a greater welfare gain. The third source of the welfare gain in this model comes from the linkage between trade and investment. When trade liberalization is accompanied with an increase in investment, the

latter would further stimulate growth through its impacts both on the supply and demand side.

The impact of AFTA on Thai economy was first investigated in simulation S1, in which we removed the tariffs imposed on bilateral trade between Thailand and five major ASEAN countries, namely Vietnam, Malaysia, Singapore, Philippines and Indonesia. Combined together, these ASEAN economies occupy a large share in Thailand's trade, with Singapore and Malaysia being the largest trading partners in Southeast Asia region. This indicates that trade liberalization in this region could bring about significant gains for Thailand. As shown in the simulation results, real GDP of Thailand increases by 0.4%, while the welfare index increase by 2.3%. In addition to Thailand, Vietnam, Malaysia and Singapore are also the big gainers from AFTA liberalization.

One of the major motives lying behind economic integration in ASEAN is to improve the competitiveness of ASEAN countries and make them a production hub capable of competing with China and India in attracting foreign investment. It is interesting to see in S1 that, AFTA would significantly improve the investment environment in ASEAN countries, as reflected in the increase in the return to capital across the region. Since the model allows for capital to partially adjust in response to the difference in the rate of return to capital, foreign investment would flow in ASEAN countries following AFTA liberalization. For Thailand, the increase in real investment amounts to 8.7%, largely compensating for the decline in government consumption and leading to an overall output gain.

Table 2: Macroeconomic Impacts of Economic Integration on Thailand
(Percentage changes compared to the base-run)

	S1	S2	S3a	S3b	S4a	S4b	S5	S6a	S6b	S7a	S7b
GDP deflator	-0.08	1.95	1.98	2.03	0.61	0.88	0.27	-0.42	-0.41	2.24	2.30
Consumer price index	-0.43	1.08	0.72	0.75	-0.01	0.22	-0.03	-0.65	-0.64	0.61	0.63
Wage rate of skilled labor	1.65	3.07	3.47	3.50	1.45	1.53	0.69	0.13	0.13	6.58	6.60
Wage rate of unskilled labor	1.87	2.75	5.63	5.73	1.60	2.12	0.56	-0.13	-0.12	8.78	8.88
Capital rent	1.41	2.64	3.68	3.73	1.22	1.44	0.55	0.00	0.00	6.44	6.49
Real GDP	0.41	0.65	0.54	0.54	0.16	0.14	0.12	-0.01	-0.01	1.66	1.66
Output	0.82	0.87	0.62	0.60	0.36	0.17	0.19	0.17	0.17	1.72	1.69
Private consumption	2.32	1.90	4.33	4.37	1.56	1.65	0.65	0.64	0.63	7.80	7.84
Government consumption	-9.63	-2.56	-13.98	-14.04	-4.81	-5.02	-1.51	-2.76	-2.75	-25.45	-25.50
Real investment	8.68	9.12	18.26	18.47	5.42	5.62	1.84	0.77	0.78	30.21	30.42
Imports	5.92	5.57	7.94	7.95	2.83	2.49	1.43	1.23	1.23	16.64	16.63
Exports	2.63	1.84	0.64	0.56	0.60	0.18	0.55	0.80	0.79	4.29	4.19
Household income	1.90	3.09	4.89	4.96	1.56	1.84	0.64	0.01	0.02	8.32	8.39
Labor income (skilled labor)	1.65	3.07	3.47	3.50	1.45	1.53	0.69	0.13	0.13	6.58	6.60
Labor income (unskilled labor)	1.87	2.75	5.63	5.73	1.60	2.12	0.56	-0.13	-0.12	8.78	8.88
Capital income	1.94	3.20	4.83	4.89	1.55	1.79	0.66	0.05	0.05	8.39	8.45
Government revenue	-8.91	-0.57	-11.67	-11.69	-3.96	-3.94	-1.15	-2.95	-2.94	-22.12	-22.14
Welfare	2.32	1.90	4.31	4.35	1.55	1.65	0.65	0.64	0.63	7.75	7.79

Sources: Authors' calculation

The trade relation between Thailand and China has been on a rapid rise in recent years, and is expected to further increase in the future following the implementation of Thailand-China FTA and China-ASEAN FTA. China currently accounts for 5.2 percent of Thailand's total imports and 6.1 percent of total exports. The FTA between Thailand and China was examined in simulation S2, in which tariffs were removed for bilateral trade between countries. The simulation results show that this FTA would bring benefits to both Thailand and China. On a relative term, Thailand would gain 0.7 percent in real GDP and 1.9 percent in welfare. The FTA with China also increases foreign investment, exports and imports in Thailand. However, the gain for China is only marginally given the large size of its economy. . .

Unlike China, Japan has traditionally been the largest trading partner and foreign investor in Thailand, and thus the FTA with Japan plays a very important role in Thailand's integration strategy. The FTA with Japan could not only brings about a greater market for Thailand's exports, but also luring Japanese FDI into Thailand and expanding opportunities for other economic and technical cooperation. The impact on Thai economy of the FTA with Japan was analyzed in simulations S3a and S3b. The first one only takes into account the impact of the tariff removal, whereas the second one analyzes the combined effect resulting from the removal of both tariffs and Japanese agricultural subsidies.

The FTA with Japan would substantially increase the gain for Thailand as compared to those with China and ASEAN countries. For Thailand, real GDP increases by 0.5 percent, but the increase in welfare amounts to 4.3%, which is around two times higher than the gain resulting from Thailand-China FTA. The increase in real investment is also impressive, amounting to nearly 20 percent. The big welfare gain from Thailand-Japan FTA not only results from the large trade volume, but also from the fact that the two economies are more complementary than competitive. It should be noted that the inclusion of Japanese agricultural subsidies in S3b does not significantly raise the welfare gain for Thailand, even it may have some significant effect at the sectoral level as discussed later.

While Japan is the largest import market of Thailand, the US is the largest market for Thailand's exports. As shown in simulations S4a and S4b, the FTA with the

US could bring benefits to Thailand, but to a lesser extent compared to the FTAs with East Asian countries. Real GDP rises by only 0.2%, and the increase in welfare amounts to 1.6%. Investment, exports and imports also increase less as compared to the previous simulations. The removal of agricultural subsidies in S4b does not significantly affect the results at the aggregate level. The relatively small gain from the FTA with the US is largely due to the low level of protection in the US. Indeed the US market has been largely liberalized for manufacturing products, while the US tariffs imposed on processed food, textile and leather are well below the level adopted in Japan, China or ASEAN countries.

The next three simulations examine the impacts of the FTAs with India, New Zealand and Australia. All these countries, however, are not the major trading partners of Thailand, accounting for only some percents of Thailand's trade. The simulation results show very modest gains from these FTAs. Real GDP of Thailand even declines slightly in the case of Thailand-Oceania FTA, and this decline is largely due to the contraction in agricultural production and food processing industries.

In the recent years, there has been an increasing interest in the establishment of a free trade area in East Asia. The last two simulations (S7a and S7b) were designed to examine the impact of the possible formation of the East Asian free trade area. This simulation scenario takes into account all major economies in the region, consisting of Vietnam, Indonesia, Malaysia, Philippines, Thailand, Singapore, China, Korea, Hong kong, Taiwan and Japan. The first simulation (S7a) only investigates the removal of tariffs, while the second one takes into account the removal of agricultural subsidies in Japan and Korea together with the tariff removal. As shown in table 2, Thailand, together with Malaysia, Korea and Vietnam, are the biggest gainers. For Thailand, GDP increase by 1.7 percent in real terms, and the welfare index increases by 7.8 percent. Thailand also gains a lot in terms of foreign capital inflows, with the increase in real investment amounting to over 30%. Similar to the case of the FTA with Japan, the removal of agricultural subsidies could bring about some additional benefits at the aggregate level, but only to a marginal extent[7].

[7] The East Asian Free Trade Area has been investigated in some recent studies, including Urata and Kiyota (2003) and Kawasaki (2003). These studies have also reached conclusions similar to our analysis, showing

It is interesting to note that the welfare gain of Thailand is largely attributed to trade liberalization in Japan. Thailand-Japan FTA contributes more than half of total gains in welfare and investment under the East Asian free trade area. Among the bilateral FTAs, Thailand gains most from the FTA with Japan, which is the largest trading partner of Thailand. The simulation results also indicate that Thailand could gain more from the FTAs with the trading partners in East Asia than those with the partners outside the region. Furthermore Thailand could realize most of the potential gain from free trade by promoting economic integration in East Asia.

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Sectoral Impacts of Economic Integration

We continued the discussion in this section with an analysis of the impacts of the FTAs at the sectoral level. The sectoral impacts of regional integration are largely determined by the structure of trade and protection in Thailand and its trading partners. The industries, which are highly protected prior to trade liberalization, are likely to contract when tariffs are reduced. By contrast, the industries facing high protection in foreign markets are expected to grow following the removal of trade barriers in foreign markets. Since the trading partners involved in the investigated FTAs are very diversified in the level of development, the pattern of comparative advantage and the resulting structure of protection, these FTAs are likely to have different impacts on Thailand's production and trade at the sectoral level.

In regards to ASEAN, Thailand trades mainly in electronics, transportation means and some other heavy industries. Although agricultural and labor-intensive products are the major exports in many ASEAN members, Thailand's trade with ASEAN countries in these products is rather small. This reflects the fact that most ASEAN members have a comparative advantage in agricultural and labor-intensive products, and that these products are usually protected with high tariffs in Thailand's domestic market. For Thailand and more advanced ASEAN countries, AFTA trade liberalization leads to

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positive impacts on all East Asian economies. The welfare gains from our simulation analysis, however, are lower than those found in Urata and Kiyota (2003) and Kawasaki (2003). This is largely due to the differences in the database and model structure. Urata and Kiyota (2003) and Kawasaki (2003) employed GTAP database version 5.0, and thus are able to quantify the impacts of both tariffs and non-tariff barriers. Furthermore, the very high welfare gains found in Kawasaki (2003) are largely attributable to the productivity and capital accumulation effects incorporated in his model.

an expansion in trade and production in electronics, transportation means and some other heavy industries, but a contraction in agriculture and labor-intensive industries. Vietnam and less developed ASEAN members experience an expansion in the production of agriculture and labor intensive industries, where they possess a comparative advantage.

For Thailand, the changes in the pattern of trade and production resulting from Thailand-China FTA are generally similar to those under AFTA trade liberalization. Output declines in agriculture, textile and leather, but expands in most heavy industries with capital intensiveness. The changes in the production pattern occur in an opposite direction in China, with a contraction in heavy manufactures and an expansion in agriculture and light manufactures. For some industries like electronics and transportation means, production expands in both countries largely due to the increase in intra-industry trade. The similar changes in production and output are also observed in the case of Thailand-India FTA, although the extent of changes is much smaller.

Unlike the FTAs discussed above, the other FTAs involve trading partners from industrial countries like Japan, the US and Oceania. Since all these economies are more complementary to Thailand in economic terms, forming FTA with them is expected to have greater impacts on resource reallocation. In the FTA with Japan, agriculture and food processing industries experience a big gain in output, and this expansion occurs at the expense of other manufacturing industries. Whereas the contraction in some of Thailand's heavy industries like automobile or electronics is expected, the decline in textile and leather industries seems not be in line with the conventional thinking that Thailand must have a comparative advantage in these labor-intensive industries. However our result is conformable to the fact that the protection level provided to textile and leather industries in Thailand is considerably higher than that in Japan. The removal of Japanese agricultural subsidies in S3b further stimulates the expansion in agriculture and also leads to a greater contraction in most of manufacturing industries.

Different from Japan, both the US and Oceania have a highly competitive agricultural sector, and the FTAs with these countries adversely affect the agricultural sector in Thailand, which experiences a small decline in output. However, the simulation analysis shows that agricultural subsidies are indeed an important protective instrument in these countries, and particularly in the US. When these subsidies are removed, the

agricultural sector in Thailand declines to a lesser extent, and even expands in the case of Thailand-US FTA. As for non-agricultural activities, the simulation results show an expansion in Thailand's labor-intensive industries in the FTA with the US, which is accompanied by a decline in capital-intensive industries. For the FTA with Oceania countries, output increases in all manufacturing sectors in Thailand with the exception of food processing industry.

The formation of an East Asian free trade area could have a significant impact on the pattern of trade and production in the region. With some exceptions, the reallocation of industrial production in East Asian countries is generally in line with the current structure of protection and the pattern of comparative advantage. Automobile production tends to move to the developed economies like Japan and Korea, while the less capital-intensive manufactures like electronics and other transportation means moves to China and middle-income ASEAN countries, such as Thailand and Malaysia. As for labor-intensive industries, Vietnam becomes the biggest gainer in textile and leather, but these industries also unexpectedly expand in some high income countries like Malaysia and Korea.

For Thailand, agriculture and relating industries experience a large expansion in output, and this is largely attributable to the removal of Japanese tariffs imposed on agricultural products. Different from Thailand-Japan FTA, however, the inclusion of East Asian developing countries mostly benefits the manufacturing sectors in Thailand. This reflects the fact that Thailand still has a comparative advantage over China and some ASEAN countries in capital intensive industries. The simulation results show an expansion in the electronics, chemical and metal industries, while in the shrinking sectors like automobile, output declines to a lesser extent.

Table 3: Sectoral Impacts of Economic Integration on Thailand
(Percentage changes compared to the base-run)

	S1	S2	S3a	S3b	S4a	S4b	S5	S6a	S6b	S7a	S7b
Crop	-0.36	-1.49	9.08	9.52	-2.53	0.52	-1.17	-2.11	-2.07	8.95	9.42
Livestock	-2.02	-3.66	20.76	21.13	-0.03	0.34	-1.48	-1.85	-1.74	15.74	16.19
Forestry	-1.26	-1.47	-3.49	-3.59	-1.62	-2.12	-0.19	0.49	0.48	-4.86	-4.97
Fishing	-1.69	-1.82	14.86	15.09	-0.51	-0.32	-1.26	-1.67	-1.63	11.86	12.12
Mining	-2.80	-0.07	-11.36	-11.55	-3.31	-3.97	-0.62	0.87	0.84	-11.45	-11.63
Food processing	-3.49	-3.78	27.66	28.11	-1.26	-0.96	-2.54	-3.48	-3.40	21.34	21.84
Beverage	-0.68	0.17	0.38	0.38	0.01	-0.01	0.11	0.12	0.12	-0.40	-0.39
Wood	-1.67	-2.15	-6.46	-6.62	-2.15	-2.82	0.02	0.83	0.81	-8.57	-8.73
Chemical	-0.59	8.03	-5.68	-5.78	-1.05	-1.45	0.60	0.67	0.66	0.53	0.41
Automobile	2.20	3.15	-9.06	-9.09	-1.55	-1.70	1.44	0.28	0.28	-6.45	-6.48
Other Transport means	83.04	0.34	13.14	13.08	3.54	3.25	1.80	0.86	0.86	23.68	23.59
Electronics	5.20	4.93	-6.57	-6.90	-2.20	-3.33	0.23	0.79	0.77	1.78	1.36
Machine	5.04	2.35	-0.19	-0.46	0.37	-0.59	2.33	2.99	2.96	7.77	7.47
Metal	3.26	-1.87	-8.77	-9.00	-2.12	-2.94	2.99	1.12	1.09	-6.43	-6.69
Textile	-1.26	-4.87	-6.64	-6.77	10.21	9.71	0.05	1.13	1.12	-13.56	-13.68
Leather	-1.63	-5.33	-2.11	-2.22	13.39	12.90	0.27	1.99	1.96	-9.73	-9.80
Other manufactures	-0.67	-4.95	-4.81	-4.97	-1.24	-1.92	0.97	1.08	1.06	-8.26	-8.40
Utility	0.52	1.11	0.36	0.33	0.51	0.28	0.30	0.33	0.32	1.66	1.63
Construction	8.06	8.40	16.84	17.03	5.00	5.18	1.71	0.75	0.76	27.93	28.12
Services	-0.22	0.20	-0.74	-0.76	-0.15	-0.30	0.05	0.05	0.05	-0.86	-0.88

Sources: Authors' calculation

Impacts on income distribution and poverty

CGE models have been widely used in analyzing the income distribution outcomes of trade liberalization. The advantage of CGE models is that they could take into account the inter-industry linkage and the relative price changes, through which macroeconomic shocks are translated into microeconomic impacts. In particular, CGE models offer two channels, through which trade liberalization and regional economic integration affects household welfare. The first channel works through the changes in consumer prices resulting from trade liberalization. Consumers will have a gain when prices decline, and they lose otherwise. Since households have different patterns of consumption, trade liberalization will have different impacts on their welfare.

The second channel translates factor incomes to the income of individual households. Since the impacts of trade liberalization vary from industries to industries, it has different impacts on factor remuneration. The prices of the production factors that are intensively employed in the expanding industries would increase, and for those production factors involved mainly in the shrinking industries, the factor prices could decline. Since households have different compositions of factor endowment, their income will be differently affected by trade liberalization and the resulting changes in the production structure and factor prices.

The impacts of trade liberalization and regional integration on Thailand's household welfare vary greatly, depending on the FTA partners selected. The expansion of certain manufacturing sectors under AFTA liberalization raises the wage rate for urban unskilled labor and benefits mainly urban low-income groups. In general, urban poor groups have greater gains compared to the rich. However, because of the contraction in agriculture and food processing industries, the pattern of income changes in the rural areas goes in the opposite direction. Rural households have smaller welfare gains as compared to urban households, and the poor rural households gain less than the rural rich. Thus, while AFTA trade liberalization could improve income distribution in urban areas, it seems increase income inequality in rural areas as well as the income gap between the urban and rural area..

Different from AFTA, Thailand-China FTA would lead to a worsening of income distribution in both rural and urban areas. The expansion of relatively capital-intensive

industries benefits mostly skilled labor, and thus resulting in higher income gains for high-income groups. Meanwhile, the contraction in agricultural production adversely affects rural households and the rural poor in particular. As a result, urban households gain more than rural households and the rich get more benefits than the poor. Thailand's income distribution is also likely to worsen under the FTAs with India and Oceania countries. Because of the contraction in agricultural production and food processing industries, both these FTAs result in an income loss for rural households, and poor households in particular. In the FTAs with India, the contraction in agriculture is not fully compensated for by the expansion in manufacturing sectors and leads to a decline in the return to unskilled labor, thus affecting the welfare of the urban poor.

Unlike the FTAs discussed above, the FTA with Japan seems to have a very significant impact on income distribution and poverty reductions in Thailand. The large expansion in agricultural production and food processing industries resulting from the removal of Japanese tariffs benefits mainly poor and rural households. In relative terms, the income gain of rural households is nearly three times higher than that of urban households. In addition, poor households also gain more than rich ones. The impact on income distribution and poverty reductions is also found positive under the East Asian free trade area. It should be noted that the positive impact under the East Asian free trade area mostly come from trade liberalization in Japan. Meanwhile the inclusion of China and ASEAN countries mainly benefits urban households through the positive impacts on the manufacturing sectors.

Table 4: Impacts of Economic Integration on Thailand's Household Income
(Percentage changes compared to the base-run)

	S1	S2	S3a	S3b	S4a	S4b	S5	S6a	S6b	S7a	S7b
Urban households											
Group 1	3.27	3.01	4.55	4.57	2.02	2.09	0.79	0.23	0.23	8.38	8.39
Group 2	2.76	2.91	4.68	4.68	1.88	1.82	0.81	0.25	0.25	8.42	8.42
Group 3	2.28	2.51	2.73	2.71	2.77	2.72	0.90	0.49	0.49	5.60	5.58
Group 4	1.96	2.47	5.24	5.28	1.84	1.84	0.57	0.00	0.01	7.93	7.96
Group 5	2.02	3.12	2.93	2.93	2.09	2.04	0.84	0.34	0.34	6.33	6.31
Group 6	1.76	3.19	2.14	2.14	1.67	1.63	0.83	0.35	0.35	5.47	5.46
Group 7	1.91	3.26	3.01	3.02	1.83	1.80	0.74	0.24	0.24	6.40	6.40
Group 8	1.79	2.79	2.81	2.82	2.15	2.18	0.79	0.29	0.29	5.69	5.69
Group 9	1.56	5.80	1.65	1.65	0.86	0.88	0.91	0.27	0.27	6.99	6.99
Group 10	2.13	3.80	4.52	4.56	1.64	1.74	0.85	0.20	0.20	8.64	8.67
Rural households											
Group 1	1.12	1.15	11.63	12.01	0.16	2.35	-0.29	-1.43	-1.40	13.83	14.24
Group 2	1.40	1.64	10.65	10.94	0.70	2.29	-0.06	-1.05	-1.02	13.14	13.45
Group 3	1.59	1.78	9.77	10.00	1.01	2.21	0.04	-0.83	-0.81	12.22	12.47
Group 4	1.66	1.69	7.17	7.32	2.48	3.38	0.29	-0.26	-0.25	9.41	9.58
Group 5	2.24	2.56	6.84	6.99	1.31	2.11	0.44	-0.35	-0.34	10.33	10.48
Group 6	1.66	2.06	7.40	7.54	2.19	2.80	0.43	-0.23	-0.22	9.85	9.99
Group 7	1.64	2.18	6.61	6.73	1.30	1.87	0.39	-0.27	-0.26	9.32	9.45
Group 8	1.91	2.46	5.77	5.85	1.56	1.98	0.55	-0.09	-0.08	8.83	8.91
Group 9	1.88	2.68	6.24	6.33	1.26	1.59	0.54	-0.15	-0.14	9.44	9.53
Group 10	1.76	3.03	5.53	5.62	1.10	1.42	0.58	-0.10	-0.09	8.92	9.01
Average household income											
Urban areas	2.01	3.63	3.36	3.38	1.72	1.74	0.82	0.25	0.25	7.17	7.18
Rural areas	1.77	2.46	6.69	6.82	1.36	1.96	0.44	-0.27	-0.25	9.68	9.81

Sources: Authors' calculation

Finally, the simulation results show that Thailand-US FTA could have different implications for income distribution in Thailand, depending on the extent of trade liberalization in the US market. When only the tariff removal is taken into account, agricultural production shrinks in Thailand, and this lowers the welfare gain for rural and poor households. Consequently, the income gap between the rich and the poor as well as the gap between rural and urban areas become widened. These negative impacts, however, turn positive when we removed both the US tariffs and agricultural subsidies. Furthermore, most of the additional benefits from the removal of US agricultural subsidies accrue to rural households and the rural poor in particular. Actually, agricultural subsidy issues have been the most debated topic under the current negotiation round of the WTO. Our simulation results also confirm, in the case of Thailand, the importance of removing such subsidies in fighting poverty in developing countries.

8. Concluding remarks

Along with the regional frameworks such as APEC and AFTA, Thailand has made serious efforts to establish Economic Partnership Agreements, including Free Trade Agreements (FTAs), with several countries: China, India, Australia, New Zealand, Japan and the US. We have employed, in this paper, a global CGE model and made use of GTAP database to analyze the impacts of regional economic integration on Thailand's economy, focusing on growth, poverty reductions and income distribution. Several simulations scenarios have been performed, covering major integration options for Thailand. In addition to four bilateral FTAs, we have also examined the impact of the East Asian economic free trade area and the already implemented ASEAN free trade area.

As discussed above, the impacts of the investigated FTAs on Thailand's economy are basically positive. These FTAs not only bring about a higher output and welfare, they also stimulate the flow of foreign investment into Thailand. In regards to income distribution, however, the impacts of economic integration vary greatly with the simulation scenarios, reflecting the different sectoral impacts caused by the different FTAs. In general, the FTAs with ASEAN countries and China mostly benefit the manufacturing sectors with relatively high capital intensity, thereby generating greater income gains for urban and rich households. The welfare of rural and poor households is

also adversely affected by the contraction of agricultural production under the FTAs with the US and Oceania countries. In the case of the FTA with the US, the simulation analysis also shows that the extent of liberalization in the US agricultural sector is an important factor that determines income distribution consequences in Thailand.

Among the bilateral FTAs investigated, Japan appears to be the best FTA option for Thailand. The FTA with Japan not only results in significant gains in welfare and output, but also leads to a substantial improvement in income distribution in Thailand. It is advisable for Thailand to pursue the FTA with Japan to offset the adverse impacts on income distribution from the already concluded FTAs with China and ASEAN countries as well as those under negotiation. It is also recommended for Thailand to promote a broader economic integration in East Asia, where the major trading partners of Thailand are located.

The global CGE model employed in this paper has proved to be useful in analyzing ongoing regional economic integration in Thailand. Our model, however, has mainly focused on the removal of tariffs imposed on the merchandise trade, and thus is not capable of fully capturing the impacts of economic integration. In addition to tariffs, non-tariff barriers are also the important protective instruments in Thailand and its trading partners. Incorporating such barriers into the simulation analysis could allow for a better quantification of the impacts of economic integration on Thailand's economy. Furthermore, the FTAs in investigation cover not only merchandise trade, but also liberalization in investment regimes and services trade, which obviously have important implications for the pattern of trade and production and income distribution in Thailand. The CGE model and the database need to be further elaborated to take into account such liberalization measures.

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Appendix A: Regional and Industrial Classification

Table A1: Regional Mapping

Regions and Countries	Description
1. Vietnam	Vietnam
2. Indonesia	Indonesia
3. Malaysia	Malaysia
4. Philippines	Philippines
5. Thailand	Thailand
6. Singapore	Singapore
7. China	China
8. Korea	Korea
9. Hong kong	Hong kong
10. Taiwan	Taiwan
11. Japan	Japan
12. India	India
13. Oceania	Australia, New Zealand and other Oceania countries
14. The United of States	The United States
15. European Union	Austria, Belgium, Denmark, Finland, France, Germany, England, Greece, Ireland, Italia, Luxemburg, Netherlands, Portugal, Spain, Sweden
16. Rest of the World	Other countries

Table A2: Industrial Mapping

Industries	Description
1. Crop	Paddy rice, wheat, cereal grains nec, vegetable, fruit, nuts, oil seeds, sugar cane, sugar beet, plant-based fibers, other crops
2. Livestock	Cattle, sheep, goats, horses, other animal products, raw milk, wool, silk-worm, cocoons
3. Forestry	Forestry
4. Fishing	Fishing
5. Mining	Coal, oil, gas, other minerals
6.Food processing	Processed meat, vegetable, oils and fats, diary products, processed rice, sugar, other food products
7. Beverages	Beverages and tobacco products
8. Wood	Wood products, paper, publishing
9. Chemical.	Petroleum, coal product, chemical products, plastic products, rubber, other mineral products
10. Automobile	Motor vehicles and parts
11. Other transportation means	Transportation equipments nec
12. Electronics	Electronic equipments
13. Machinery	Other machinery and equipment
14. Metal	Ferrous and non-ferrous metals
15. Textiles	Textiles and wearing apparel
16. Leather	Leather products
17. Other manufactures	Other manufactures
18. Utility	Electricity, gas manufactures and distribution, water
19. Construction	Construction
20. Services	Public and private services

Appendix B: The Global CGE Model

B1. Equations of the Model

Price Relations

(1) $PMS_{irk} = PM\$_{irk} \times ER_r \times (1+ tm_{irk})$

(2) $PM_{ir} = a_{S_{ir}}^{-1}(\sum_k \omega_{S_{irk}}^{1/(1+\theta_{ir})} PMS_{irk}^{\theta_{ir}/(1+\theta_{ir})})^{(1+\theta_{ir})/\theta_{ir}}$

$$where \quad M_{ir} PM_{ir} = \sum_k MS_{irk} PMS_{irk}$$

(3) $PE_{ir} = PE\$_{ir} \times ER_r / (1+ te_{ir})$

(4) $P_{ir} = a_{M_{ir}}^{-1}(\omega_{M_{ir}}^{1/(1+\delta_{ir})} PM_{ir}^{\delta_{ir}/(\delta_{ir}+1)} + (1-\omega_{M_{ir}})^{1/(1+\delta_{ir})} PD_{ir}^{\delta_{ir}/(\delta_{ir}+1)})^{(\delta_{ir}+1)/\delta_{ir}}$

$$where \ P_{ir} Q_{ir} = PM_{ir} M_{ir} + PD_{ir} D_{ir}$$

(5) $PX_{ir} = a_{E_{ir}}^{-1}(\omega_{E_{ir}}^{1/(1-\gamma_{ir})} PE_{ir}^{\gamma_{ir}/(\gamma_{ir}-1)} + (1-\omega_{E_{ir}})^{1/(1-\gamma_{ir})} PD_{ir}^{\gamma_{ir}/(\gamma_{ir}-1)})^{(\gamma_{ir}-1)/\gamma_{ir}}$

$$where \ PX_{ir} X_{ir} = PE_{ir} E_{ir} + PD_{ir} D_{ir}$$

(6) $WM_{ir} = a_{L_{ir}}^{-1}(\sum_l \omega_{L_{lir}}^{1/(1+\lambda_{ir})} WKM_{lir}^{\lambda_{ir}/(\lambda_{ir}+1)})^{(\lambda_{ir}+1)/\lambda_{ir}}$

$$where \ WM_{ir} L_{ir} = \sum_l WKM_{lir} LK_{lir}$$

(7) $PVA_{ir} = PX_{ir}(1-tp_{ir}) - \sum_j iocf_{jir} PNM_{jir}$

(8) $PINDEX_r = \sum_i cpcf_{ir} \times P_{ir}$

Definition of Market Prices

(9) $PCM_{ir} = P_{ir}(1+tc_{ir})$

(10) $PGM_{ir} = P_{ir}(1+tg_{ir})$

(11) $PNM_{ijr} = P_{ir}(1+tn_{ijr})$

(12) $PKM_{ir} = P_{ir}(1+tk_{ir})$

(13) $WKM_{lir} = WK_{lir}(1+tw_{lir})$

(14) $RM_{ir} = R_{ir}(1+tr_{ir})$

Production and factor demand

(15) $X_{ir}^S = a_{X_{ir}} (\omega_{X_{ir}} L_{ir}^{-\rho_{ir}} + (1- \omega_{X_{ir}}) K_{ir}^{-\rho_{ir}})^{-1/\rho_{ir}}$

(16) $L_{ir} = a_{X_{ir}}^{-\rho_{ir}/(1+\rho_{ir})} (\omega_{X_{ir}} PVA_{ir} / WM_{ir})^{1/(1+\rho_{ir})} \times X_{ir}^S$

(17) $LK_{lir} = a_{L_{ir}}^{-\lambda_{ir}/(1+\lambda_{lir})} (\omega_{L_{lir}} WM_{ir} / WKM_{lir})^{1/(1+\lambda_{ir})} \times L_{ir}$

$$\text{where } L_{ir} = a_{L_{ir}} (\sum_l \omega_{L_{lir}} LK_{lir}^{-\lambda_{ir}})^{-1/\lambda_{ir}}$$

(18) $WK_{lir} = wagecf_{lir} WK_{lr}^e$, where $wagecf_{lir}$ = constant

(19) $K_{ir} = a_{X_{ir}}^{-\rho_{ir}/(1+\rho_{ir})} ((1-\omega_{X_{ir}}) PVA_{ir} / RM_{ir})^{1/(1+\rho_{ir})} X_{ir}^S$

(20) $R_{ir} = rentcf_{ir} R_r^e$, where $rentcf_{ir}$ = constant

Supply

(21) $D_{ir}^{S} = a_{E_{ir}}^{\gamma_{ir}/(1-\gamma_{ir})} ((1-\omega_{E_{ir}})\ PX_{ir} / PD_{ir})^{1/(1-\gamma_{ir})} \times X_{ir}^{S}$

where $X_{ir} = a_{E_{ir}} (\omega_{E_{ir}} E_{ir}^{\gamma_{ir}} + (1-\omega_{E_{ir}}) D_{ir}^{\gamma_{ir}})^{1/\gamma_{ir}}$

(22) $E_{ir} = a_{E_{ir}}^{\gamma_{ir}/(1-\gamma_{ir})} (\omega_{E_{ir}} \times PX_{ir} / PE_{ir})^{1/(1-\gamma_{ir})} \times X_{ir}^{S}$,

Income and saving

(23) $YH_r = \sum_i K_{ir} \times R_{ir} + \sum_{li} LK_{lir} \times WK_{lir} + \sum_i PR_{ir}$

for $r \neq Thailand$

(24) $YH_{hr} = (\sum_i ykcf_{hir} \times R_{ir} \times K_{ir} + \sum_i ylcf_{hlir} \times WK_{lir} \times LK_{lir})$

for $r = Thailand$

(25) $YG_r = \sum_i tp_{ir} PX_{ir} X_{ir} + \sum_i tc_{ir} P_{ir} C_{ir} + \sum_i tg_{ir} P_{ir} G_{ir} +$
$\sum_{ij} tn_{ijr} P_{ir} iocf_{ijr} X_{jr} + \sum_i tk_{ir} P_{ir} ID_{ir} +$
$\sum_{ik} tm_{irk} PM\$_{irk} MS_{irk} ER_r + \sum_i te_{ir} PE\$_{ir} E_{ir} +$
$\sum_{li} tw_{lir} WK_{lir} LK_{lir} + \sum_i tr_{ir} R_{ir} K_{ir}$

(26) $SH_r = s_{P_r} \times YH_r$

for $r \neq Thailand$

(27) $SH_r = \sum_h s_{P_{hr}} \times YH_{hr}$

for $r = Thailand$

(28) $SG_r = s_{G_r} \times YG_r$

(29) $S_r = SH_r + SG_r$

Consumers

(30) $C_{ir} = PCM_{ir} subs_{ir} + bshr_{ir} \left[(1-s_{P_r}) YH_r - PCM_{ir} subs_{ir}\right]$

for $r \neq Thailand$

(31) $C_{hir} = PCM_{ir} subs_{hir} + bshr_{hir} \left[(1-s_{P_{hr}}) YH_{hr} - PCM_{ir} subs_{hir}\right]$

for $r = Thailand$

(32) $C_{ir} = \sum_h C_{hir}$

for $r = Thailand$

(33) $C_r = \sum_i C_{ir}$

(34) $PC_r = (1\text{-}s_{P_r}) YH_r / C_r$

Government

(35) $G_r = (YG_r - SG_r) / PG_r$

(36) $G_{ir} = cgcf_{ir}\ G_r$

(37) $PG_r = \sum_i cgcf_{ir} PGM_{ir}$

External sectors

(38) $Q_{ir} = \sum_j X^S_{jr} \times iocf_{ijr} + C_{ir} + G_{ir} + ID_{ir} + V_{ir} + TMQ_{i'r}$ (i' = service industry)

where $Q_{ir} = a_{M_{ir}} (\omega_{M_{ir}} M_{ir}^{-\delta_{ir}} + (1-\omega_{M_{ir}}) D_{ir}^{-\delta_{ir}})^{-1/\delta_{ir}}$

(39) $D_{ir} = a_{M_{ir}}{}^{-\delta_{ir}/(1+\delta_{ir})} ((1-\omega_{M_{ir}})\ P_{ir} / PD_{ir})^{1/(1+\delta_{ir})} \times Q_{ir}$

(40) $M_{ir} = a_{M_{ir}}{}^{-\delta_{ir}/(1+\delta_{ir})} (\omega_{M_{ir}} P_{ir} / PM_{ir})^{1/(1+\delta_{ir})} \times Q_{ir}$

Linkage between Countries or Regions

(41) $MS_{irk} = a_{S_{ir}}{}^{-\theta_{ir}/(1+\theta_{ir})} (\omega_{S_{irk}} PMS_{irk} / PM_{ir})^{1/(1+\theta_{ir})} M_{ir}$

where $M_{ir} = a_{S_{ir}} (\sum_l \omega_{S_{irk}} MS_{irk}^{-\theta_{ir}})^{-1/\theta_{ir}}$

(42) $E^S_{ir} = \sum_k M_{ikr}$

(43) $PM\$_{irk} = PE\$_{ik}(1+tmr_{irk})$

(44) $\sum_r F\$_r = 0$

International transportation services

(45) $PTM.TMG = \sum_{irk} \frac{tmr_{irk}}{1+tmr_{irk}} PM\$_{irk} MS_{irk}$

(46) $TMQ_{i'r} = a_T{}^{1/(1+r)} \left[\omega_{Ti'r} (P_{i'r} / ER_r) / PTM\right]^{1/(1+\tau)} TMG$ (i' = service industry)

(47) $PTM = a_T{}^{-1} \left[\sum_r \omega_{Ti'r}{}^{1/(1+\tau)} (P_{i'r} / ER_r)^{\tau/(1+\tau)}\right]^{(1+\tau)/\tau}$ (i' = service industry)

Capital formation

(48) $I^n_r = PIM_r\ I_r$

(49) $ID_{ir} = invcf_{ir}\ I_r$

(50) $V_{ir} = invtr_{ir}\ X^S_{ir}$

(51) $DEP_r = depr_r K^S_r$

(52) $PIM_r = \sum_i invcf_{ir} PKM_{ir}$

(53) $PI_r = \sum_i invcf_{ir} P_{ir}$

International capital mobility

(54) $RA_r = R^e_r / PI_r - depr_r$

(55) $RE_r = RA_r (K^S_r / KLAG^S_r)^{\phi}$

(56) $RE_r = recf_r RGE$

(57) $K^S_r = KLAG^S_r - DEP_r + I_r$

GDP Indentities

(58) $$GDPR_r = \sum_i C_{ir} PCM0_{ir} + \sum_i G_{ir} PGM0_{ir} + \sum_i iocf_{ijr} X_{jr} PNM0_{ir} + \sum_i V_{ir} PX0_{ir} + \sum_i ID_{ir} PKM0_{ir} - \sum_{ik} MS_{irk} PM\$0_{irk} + \sum_i E_{ir} PE\$0_{ir}$$

(59) $$GDPN_r = \sum_i C_{ir} PCM_{ir} + \sum_i G_{ir} PGM_{ir} + \sum_i iocf_{ijr} X_{jr} PNM_{ir} + \sum_i V_{ir} PX_{ir} + \sum_i ID_{ir} PKM_{ir} - \sum_{ik} MS_{irk} PM\$_{irk} + \sum_i E_{ir} PE\$_{ir}$$

Equilibrium conditions

(60) $$\sum_i K_{ir} = K_r^S$$

(61) $$\sum_i L_{lir} = \overline{L_{lr}^S}$$

(62) $$D_{ir} = D_{ir}^S$$

(63) $$\sum_{ik} MS_{irk} \times PM\$_{irk} - \sum_i E_{ir} PE\$_{ir} - TMQ_{i'r} P_{i'r} / ER_{i'r} - F\$_r = 0$$

(*i'* = service industry)

Walrasian law

Local:

(64) $$\sum_i PD_{ir} \times (D_{ir} - D_{ir}^S) + (S_r + F_r - I_r^n - \sum_i P_{ir} \times V_{ir}) + ER_r \times (\sum_{ik} MS_{irk} \times PM\$_{irk} - \sum_i E_{ir} PE\$_{ir} - TMQ_{i'r} P_{i'r} / ER_r - F\$_r) = 0$$

Global:

(65) $$\sum_r \sum_i PD_r \times (D_{ir} - D_{ir}^S) / ER_r + \sum_r (S_r + F_r - I_r^n - \sum_r P_{ir} \times V_{ir}) / ER_r + \sum_{ri} PE\$_{ir} (\sum_k MS_{irk} - E_{ir}) + (PTM \times TMG - \sum_r (P_{i'r} / ER_r) TMQ_{i'r}) - \sum_r F\$_r = 0$$

N.B. $\sum_r F\$_r = 0$ if $\sum_{ri} (\sum_k MS_{irk} - E_{ir}) = 0$ and $PTM \times TMG = \sum_r (P_{i'r} / ER_r) TMQ_{i'r}$

B2. Model Notation

Sets

i,j	industries
r, k	countries or regions
l	labor types
h	households

Price Variables

$PM\$_{irk}$	world price of imports
PMS_{irk}	domestic prices of imports by sources of imports
PM_{ir}	domestic prices of imports
$PE\$_{ir}$	world price of exports
PE_{ir}	domestic prices of exports
PX_{ir}	output prices
PD_{ir}	domestic prices of domestically produced products
P_{ir}	prices of composite goods
PN_{i}	value added prices by sectors
PCM_{ir}	market prices of consumer's goods
PGM_{ir}	market prices of public goods
PNM_{ir}	market prices of intermediate inputs
PKM_{ir}	market prices of capital goods
PI_{r}	investment price index
PIM_{r}	investment price index
PC_{r}	consumer price index
PG_{r}	price index of public goods
PTM	price index of international transportation services
W_{ir}	wage rates by sectors
WK_{lir}	wage rates by sectors and types of labour
WM_{ir}	composite market wage rates
WKM_{lir}	composite market wage rates by sectors and types of labour
WK_{lr}^{e}	equilibrium wage rates by types of labour
R_{ir}	capital rents
RM_{ir}	market capital rents
R_{r}^{e}	equilibrium capital rent
RA_{r}	net real rate of return to capital
RE_{r}	expected rate of return to capital
RGE	global expected rate of return to capital
ER_{r}	exchange rate

Quantity variables

X_{ir}^{S}	domestic output
L_{ir}	composite labor demand
LK_{lir}	labor demand by types of labor
$\overline{L_{lr}^{S}}$	supply of labor by types

K_{ir} capital demand by sector

K_r^S total supply of capital

$KLAG_r^S$ total capital stock in the previous period

Q_{ir} composite good demand

D_{ir} domestic supply of domestically produced products

E_{ir} export supply

M_{ir} imports

MS_{ir} imports by country of origin

TMG total demand for international transportation services

TMQ_{ir} demand for international transportation services by countries and regions

C_{ir} household consumption by sectors

C_r total demand for household consumption

G_{ir} demand for government consumption

G_r total demand for government consumption

$F\$_r$ foreign savings

I_r total real fixed investment

ID_{ir} demand for capital goods

V_{ir} demand for inventory investment

DEP_r total depreciation expenditure

$GDPR_r$ Real GDP by countries

Nominal variables

YH_r household income

YG_r government revenue

SH_r household savings

SG_r government savings

S_r domestic savings

I_r^n nominal fixed investment

$GDPN_r$ nominal GDP by countries

Parameters

$a_{X_{ir}}$ scale parameters in production functions

$\omega_{X_{ir}}$ share parameters in production functions

ρ_{ir} exponent parameters in production functions

$a_{L_{ir}}$ scale parameters in labour demand functions

$\omega_{L_{lir}}$ share parameters in labour demand functions

λ_{ir} exponents in labour demand functions

$a_{M_{ir}}$	scale parameters in composite goods functions
$\omega_{M_{ir}}$	share parameters in composite goods functions
δ_{ir}	exponents in composite goods functions
$a_{S_{ir}}$	scale parameters in import demand functions
$\omega_{S_{irk}}$	share parameters in import demand functions
θ_{ir}	exponents in import demand functions
$a_{E_{ir}}$	scale parameters in export supply functions
$\omega_{E_{ir}}$	share parameters in export supply functions
γ_{ir}	exponents in export supply functions
$iocf_{ijr}$	intermediate input coefficient of good j in industry i
$ykcf_{hir}$	share of capital income accrued to household h
$ylcf_{hlir}$	share of labor income accrued to household h
$subs_{ir}$	subsistence consumption (for other countries rather than Thailand)
$subs_{hir}$	subsistence consumption (for Thailand)
$bshr_{ir}$, $bshr_{hir}$	marginal budget shares
$cgcf_{ir}$	government consumption shares
$invcf_{ir}$	fixed investment shares
$invtr_{ir}$	ratios of inventory investment to real production
s_{P_r} , $s_{P_{hr}}$	private saving rate
s_{G_r}	government saving rate
tm_{ir}	import tariff rates
te_{ir}	export duty rates
tc_{ir}	sale taxes on consumers' goods
tg_{ir}	sale taxes on public goods
tn_{ijr}	sale taxes on intermediate inputs
tk_{ir}	sale taxes on capital goods
tp_{ir}	production taxes/subsidies
tw_{lir}	labor taxes/subsidies
tr_{ir}	capital taxes/subsidies