General Equilibrium Estimates on the Potential Effects of the ASEAN Economic Community*

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Abstract

Consequences of the ASEAN Economic Community (AEC) are investigated using a dynamic computable general equilibrium (CGE) model. Quantitative assessments of the effects on economic welfare, trade flows and sectoral output are offered. When the removal of trade barriers are combined with reductions in administrative and technical barriers and lowering the trade and transport margins under the assumption of endogenously determined productivity, the estimated welfare gains for the year 2015 range from 1.1% in Indonesia to 9.4% in Thailand. The results suggest that streamlining customs procedures and other reductions in administrative and technical barriers, as well as increased competition and improvements in infrastructure, are significant in enlarging the benefits of the AEC.

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1. Introduction

Founded in 1967 with the Bangkok Declaration, the Association of Southeast Asian Nations (ASEAN) is the most advanced institution of regional cooperation in Asia and one of the oldest. At first, its goals were mainly political in nature. In particular, it sought to promote peace in what was at that time a volatile region. ASEAN did not attempt any significant economic cooperation initiatives until the new international political environment emerged at the end of the 1980s. Its first major initiative was ASEAN Free Trade Area (AFTA), which was established in 1992 and originally only covered trade in manufactured goods to be liberalized over a 15-year period.[1] However, ASEAN subsequently broadened the scope and shortened the implementation period of AFTA so that it was technically in full effect at the beginning of 2004 for the original ASEAN countries[2] and Brunei Darussalam ("ASEAN-6"), although there are transitional periods for products on the temporary exclusion lists, including some agricultural and food products and automobiles.

At the 2002 ASEAN Summit in Phnom Penh, it was proposed that the region should consider the possibility of creating an ASEAN Economic Community (AEC) by 2020. In the 2007 "Cebu Declaration" the ASEAN leaders not only formalized this commitment but actually pushed up the deadline to 2015. The action plan for the implementation of the AEC was published in the form of the "ASEAN Blueprint" in November 2007. As part of the AEC process, ASEAN developed the ASEAN Charter, which was ratified by each ASEAN member state and went into effect in December 2008. Specifically, the AEC has the following four goals:

1. ***A single market and production base***, characterized by a free flow of goods, services, investment and skilled labor, as well as a freer flow of capital.
2. ***A competitive economic region***, characterized by sound competition policy, consumer protection, intellectual property rights protection, infrastructure development, sectoral competition in energy and mining, rationalized taxation and e-commerce.

[1] Liberalization was somewhat loosely defined, as it left tariffs in the 0–5% range rather than the traditional 0%.

[2] Indonesia, Malaysia, the Philippines, Singapore and Thailand.

3. ***Equitable economic development***, characterized by small and medium enterprise development and enhancement of initiatives geared to help the least-developed ASEAN member states.
4. ***Integration into the global economy***, with ASEAN centrality and participation in global supply networks.

In sum, the primary goal of economic integration in ASEAN, as articulated by its leaders, is to reduce transactions costs associated with economic interchange and to make the region more attractive to multinational corporations wishing to take advantage of its diversity and openness in rationalizing production networks. In this sense, it is both determining and determined by the new wave of outward-oriented regionalism in Asia.

The objective of this paper is to evaluate the potential effects of the AEC on economic welfare, trade flows and sectoral output of the member states using a dynamic computable general equilibrium (CGE) model. The model incorporates endogenously determined sectoral productivity and reductions in transactions costs, including the trade and transport margins and frictional trade costs (i.e. trade-related risks and administrative and technical barriers to trade). The next section gives an overview of the model. Section 3 provides a brief description of the baseline and policy scenarios, followed by assessments of computational results in section 4. The final section offers conclusions and possible extensions of the paper.

2. Overview of the CGE Modeling Framework

The model used in this study is a modified version of the LINKAGE model developed by van der Mensbrugghe (2005). This model has been extensively used for the comparative analysis of alternative trade integration scenarios, including an assessment of various Doha Round proposals by Anderson et al. (2006) and the evaluation of various free-trade agreement scenarios in East Asia by Lee and van der Mensbrugghe (2008). In many respects the structure of the LINKAGE model is similar to two other widely used and cited global trade models, specifically, the Purdue-based GTAP, as elaborated in Hertel

(1997) and MIRAGE, sponsored by CEPII in Paris and discussed by Bchir et al. (2002).[3] The core of all three frameworks is a comparative static CGE model, although all three incorporate specific variations. For example, LINKAGE and MIRAGE are typically used for undertaking a recursive dynamic analysis, where specific assumptions regarding population and labor growth, capital accumulation and productivity are invoked in order to develop a baseline scenario from which different policy shocks are then examined.[4]

The LINKAGE model entails a standard CGE paradigm, built around the circular flow of the economy, where on the supply side, goods and services are produced by combining intermediate inputs and factors (e.g., labor, capital and land). A nested constant elasticity of substitution (CES) structure captures the substitution and complementary effects across intermediate goods and factors. In most sectors, the degree of substitution between capital and labor constitutes the core relation, while intermediate goods are taken to be a fixed proportion of output.[5] A second node of the circular flow, relating to economic agents' supply of the needed factors of production and their factor earnings, is specified in the LINKAGE framework by a single representative household that receives all factor income. Finally, a third node, characterizing agents' demand for final goods and services, uses the extended linear expenditure system (ELES) whereby purchases of goods and services are simultaneously determined with savings (Lluch, 1973). As in the conventional CGE model, such as those developed by Dervis et al. (1982) and Löfgren et al. (2002), constant returns to scale and perfect competition are assumed in the goods and services market, and product and factor prices are determined by equilibrium in their respective markets.

An open-economy CGE model entails a somewhat more complicated structure, since domestic production needs to be allocated between domestic and multiple foreign

[3] van der Mensbrugghe (2006) offers a discussion of representative numerical results based on the LINKAGE model, along with a summary comparison to those using GTAP.

[4] Although a dynamic version of GTAP has been developed by Ianchovichina and McDougall (2000), a majority of GTAP applications involve a static version of that model.

[5] One strength of the LINKAGE model is a rather detailed formulation for agricultural production, in which land use plays a key role, as, for example, in the choice between intensive versus extensive crop production, or range-fed, as compared to other smaller livestock undertakings. The energy sector also constitutes a separate activity, which is assumed to be a near-complement to capital in the short run, but a substitute for capital in the long run.

markets, while domestic demand can be met by goods produced either domestically or from abroad. In this regard, the standard LINKAGE model assumes that domestic output is supplied homogeneously from all markets, with the law of one price holding, so that producers can switch their sales across market destinations costlessly.[6] On the demand side, products are differentiated for both producers and final consumers on the basis of their origin, in keeping with the so-called Armington assumption.[7] More specifically, the LINKAGE framework relies on a nested CES structure, where at the top nested level, each agent chooses to allocate aggregate demand between locally produced goods and an aggregate import bundle, while minimizing the overall cost of the aggregate demand bundle. At the second level, aggregate import demand is allocated across different trading partners, again using a CES specification, wherein the aggregate costs of imports are minimized. This open-economy formulation generates a much broader set of market equilibria, whereby the supply and demand for each traded good is required to be equal. Hence, if the closed economy model had n equilibria for n goods, the global model has r x n equilibria for domestic goods and r x r x n equilibria for traded goods, where r is the number of modeled countries/regions.

The model distinguishes between four interrelated price categories for traded goods, which entail four separate instruments. The initial price producers receive for their exported goods is designated as *PE*, while the FOB price, denoted as *WPE*, reflects domestic export taxes or subsidies. The CIF price, *WPM*, includes the trade and transport margins, represented by the ad valorem wedge ζ, as well as frictional trade costs, corresponding to an iceberg parameter λ.[8] Thus, the relationship between the FOB and CIF prices is given by

[6] The model also allows for a finite constant elasticity of transformation (CET) function, which applies across market destinations, and uses a two-level nested CET specification. At the top nested level, production is allocated between the domestic market and aggregate exports, so as to maximize revenue. At the second level, a CET function is used to allocate aggregate exports across foreign markets, while maximizing total export revenue.

[7] See Armington (1969).

[8] Such an iceberg specification for transportation costs was formulated by Samuelson (1952), based on a concept developed earlier by von Thünen.

$$WPM_{r,r',i} = \left(1+\zeta_{r,r',i}\right) WPE_{r,r',i} \Big/ \lambda_{r,r',i} \quad (1)$$

for the different *r* and *r*' combinations of exporting and importing regions/countries and *i* commodities. Finally, the domestic price of imports, *PM*, equals the CIF price, *WPM*, plus tariffs and/or the tariff-equivalent effects of a range of possible commercial policies. In the subsequent analysis, an increase in $\lambda_{r,r',i}$ corresponds to a reduction in trade-related risks, lower administrative barriers to trade (e.g., customs procedures), and/or a fall in technical barriers (e.g., mutual recognition of product standards). In sum, trade facilitating policy initiatives imply an increase in the value of $\lambda_{r,r',i}$.

Final demand in the model is split into three categories, involving a representative household, the public sector and the investment account. Public expenditure is specified as fixed as a share of GDP and investment is determined by the total savings of the economy, thereby leading to a different pattern of demand expenditures relative to that of households. There are three closure rules relating to final goods expenditures in each country. First, the government deficit is assumed to be fixed, while a lump sum tax borne by the representative household is endogenously determined, so as to meet the public deficit target. Thus, trade reform can generate an increase in the direct taxation of consumers, as a result of reduced tariff revenues. Second, investment equals the sum of private, public and foreign savings. Third, the level of foreign saving is fixed; i.e., the current account balance is taken as exogenously given. The latter implies that an *ex ante* change in import demand generates an offsetting adjustment in the real exchange rate.

The model was calibrated to a 2004 base year using version 7 of the GTAP database.[9] Although the LINKAGE model can be analyzed for 113 countries/regions and 57 sectors, this more detailed database has been aggregated in the current analysis, and relates to 14 countries/regions and 20 sectors as shown in Table 1. More specifically, the country/region breakdown includes five individual ASEAN economies (Singapore, Indonesia, Malaysia, the Philippines and Thailand), an aggregation of other ASEAN economies (Brunei, Cambodia, Laos, Myanmar and Vietnam), four East Asian economies

[9] A detailed description of version 7 of the GTAP database is offered by Narayanan and Walmsley (2008).

(China, Japan, Korea and Taiwan), as well as regional country groupings for Australia/New Zealand, North America, Europe (EU and EAFTA) and the rest of the world. The values of key parameters, such as demand, supply and substitution elasticities, are based upon the previous empirical estimates. The model calibration primarily consists of calculating share and shift parameters to fit the model specifications to the observed data, so as to be able to reproduce a solution for the base year.[10] The Appendix provides the values of the key elasticities used in the model.

3. The Baseline and Policy Scenarios

3.1 The Baseline Scenario

In order to evaluate the effects of the ASEAN Economic Community, the baseline scenario is first established, showing the path of each of the 14 economies/regions in the absence of ASEAN economic integration over the period 2004-2020. Population and labor force growth are assumed exogenous, in line with assumptions made by the UN, such that the growth of the labor force growth equals the growth of the working age population (ages 15-64). Real GDP growth rates are also exogenous in the baseline in order to be consistent with the actual growth rates for 2004-2008 and the World Bank's growth forecast for 2009-2020. The basic capital accumulation function equates the current capital stock to the depreciated stock inherited from the previous period plus gross investment. In the baseline the trade and transport margins are assumed to decline by 1 percent per annum in every country/region, which is consistent with the recent trends.

Sectoral productivity is determined by three components: a uniform economy-wide factor that is calibrated to achieve the given GDP target, a sector-specific factor related to the degree of openness, and a shift term that permits constant deviations across sectors beyond the differences in openness. More specifically, the sector-specific factor intended to capture the sensitivity of changes in productivity to an economy's openness, $\chi_{i,t}$, is given by the formula:

[10] Some of the calibrated parameters are adjusted in the dynamic scenario, as explained by van der Mensbrugghe (2006).

$$\chi_{i,t} = \phi_{i,t}\left(\frac{E_{i,t}}{X_{i,t}}\right)^{\eta_i} \tag{2}$$

where $E_{i,t}$ is exports of commodity i, $X_{i,t}$ is the output of commodity i, $\phi_{i,t}$ is a shift parameter, and η_i is the elasticity of productivity with respect to openness. The parameter $\phi_{i,t}$ is calibrated in the baseline scenario so that the trade-sensitive portion of sectoral productivity is a constant share of total productivity.[11]

The four types of taxes included in the model consist of commodity, production, income and trade taxes, where the latter include both tariffs and export taxes. Whereas commodity and production taxes are held constant throughout the simulation period, the marginal income tax rate adjusts to maintain a given government budget surplus or deficit.

The sectoral tariff rates for five ASEAN countries and the aggregated other ASEAN region on imports from the ASEAN members in 2004 are summarized in Table 2. There are striking differences in the tariff structures across the member states. Singapore is duty free and has low barriers to services trade. The ASEAN-4 countries' tariff rates on intra-ASEAN trade are relatively low except some agricultural products, processed food and services. Other ASEAN (mainly CLMV)'s average tariff rate is significantly higher than the other five members. In particular, the tariff rates on transportation equipment and petroleum products are substantially higher.

3.2 Policy Scenarios

The economic implications of the creation of an ASEAN Economic Community are to be examined here. Specifically, the following four interrelated scenarios are considered:

[11] Openness has been linked to increased productivity via three main channels. These consist of the imports of technology-intensive intermediate inputs (for example fertilizers in agriculture), imports of capital goods, and export market penetration. The latter effect can arise because of the higher standards required to access and penetrate foreign markets, relative to those prevailing at home. The expansion of sales to foreign markets can also create scale economies. There is considerable empirical work aimed at ascertaining the extent to which each one of these different channels operates. For example, Das et al. (2007) have explored some firm-level characteristics of export supply responses. The link between trade openness and productivity formulated by de Melo and Robinson (1992) and Dessus et al. (1999) is similar to that proposed here.

Scenario 1: The ASEAN members remove bilateral trade barriers by 2015. The sector-specific productivity factors capturing the impact of openness, $\chi_{i,t}$, are fixed at the baseline levels.

Scenario 2: A 2.5% reduction in frictional trade costs among the ASEAN members over the period 2010-2015 is introduced under Scenario 1, while the sector-specific productivity factors related to the degree of openness, $\chi_{i,t}$, are, again, fixed at the baseline levels.

Scenario 3: The sector-specific productivity factors related to the degree of openness ($\chi_{i,t}$) are now endogenously determined, in keeping with equation (2), while maintaining the other assumptions of scenario 2.

Scenario 4: A 10% reduction in the trade and transport margins among the ASEAN countries relative to the baseline over the period 2010-2015 is incorporated in scenario 3.

Bilateral tariffs, nontariff barriers and export taxes/subsidies in all the sectors are gradually removed among the ASEAN members over the 2010-2015 period. It is assumed that frictional trade costs, such as administrative barriers and trade-related risks would be reduced by 2.5%.[12] In scenarios 3 and 4, the elasticities of productivity in relation to the degree of openness, η_i, are set equal to values of 0.5 and 1.0 in agriculture and all other sectors, respectively. Finally, improvements in transport infrastructure and increases in competition within the region are assumed to reduce the trade and transport margins among the ASEAN members by 10% over the period 2010-2015 relative to the baseline.

4. Empirical Findings

4.1 Effects on Welfare

The welfare results for the four policy scenarios, as deviations in equivalent variations (EV) from the baseline in 2015, are summarized in Table 3. When bilateral trade

[12] Keuschnigg and Kohler (2002) and Madsen and Sorensen (2002) consider a 5% reduction in real costs of trade between the EU-15 and Central and East European countries. However, a smaller reduction in these costs is invoked here, since the reductions in technical barriers are expected to be quite small for the AEC, as compared with those under EU enlargement.

barriers among the member states are removed under scenario 1, economic welfare of Singapore is expected to increase most substantially. In terms of percentage deviations from the baseline, Thailand, Malaysia and the Philippines are also expected to realize welfare gains of more than 1%, while 'Other ASEAN' region would incur a welfare loss. This finding may initially appear surprising since consumers in countries with higher initial tariff rates are generally expected to benefit more from regional integration. Nonetheless, this result is clearly driven by the Armington assumption of nationally-differentiated products, which implies that each country has a monopoly in the market for its exports.[13] Thus, the terms of trade of countries with zero or low initial tariff rates (e.g., Singapore and Malaysia) improve, while those of countries with high initial tariff rates (Other ASEAN) deteriorate, often dominating other welfare effects. Although non-ASEAN countries incur some welfare losses, they are extremely small in percentage terms.

When a 2.5% reduction in trade costs among the ASEAN countries is added in scenario 2, the magnitudes of welfare gains for the members are amplified considerably. Principally, this is a trade-creating policy initiative, since lower administrative and technical barriers facilitate trade by generating greater intra-ASEAN market access. Other ASEAN's economic welfare is predicted to become positive under this scenario. Overall, ASEAN-10's welfare gain would double from 1.06% under scenario 1 to 2.10% under scenario 2.

In the next two scenarios, the sector-specific productivity levels actually respond to changes in the sectoral export-output ratios. A comparison of the results in scenario 3 with those in scenario 2 shows that endogenizing $\chi_{i,t}$ leads to an increase in welfare gains for all ASEAN members, but the increases are relatively small.

Under scenario 4, it is hypothesized that improved infrastructure and increased competition within the region lead to a significant reduction in the trade and transport margins, $\zeta_{r,r',i}$. Specifically, it is assumed that $\zeta_{r,r',i}$ will be reduced by 10% over the period 2010-2015 compared with the baseline. The associated increases in welfare gains for the ASEAN countries are striking, ranging from a 37% increase in Singapore to a sixfold

[13] Brown (1987) shows that monopoly power implicit in national product differentiation is the source of strong terms-of-trade effects resulting from tariff changes in Armington-type models.

increase in Other ASEAN. The substantial variations in the extents of additional welfare gains across members result from large disparities in the initial trade and transport margins both among countries and across commodities, as well as from substantial differences in the trade structures among the ASEAN members. For example, Singapore, Malaysia and the Philippines have the highest export share in electronic equipment, which has the lowest $\zeta_{r,r',i}$ among all products except services. In contrast, Other ASEAN's main export items are apparel, coal, oil and gas, agricultural products, processed food and other manufacturing, but $\zeta_{r,r',i}$ for these products except apparel are relatively high. Thus, an improvement in infrastructure is expected to benefit the CLMV countries by a much greater extent than the other ASEAN members.[14]

4.2 Effects on Intra- and Extra-regional Trade Flows

In this sub-section, the effects of ASEAN integration on intra- and extra-regional trade flows are examined under the assumptions invoked under scenario 4. Accordingly, sectoral productivity levels are endogenously determined, while it is assumed that there are removals of trade barriers, a 2.5% fall in administrative and technical barriers to trade, and a 10% reduction in the trade and transport margins among the member states over the period 2010-2015. Table 4 summarizes the results, where the trade flow effects are expressed as percent deviations from the baseline for the year 2015.

Not surprisingly, intra-ASEAN trade is predicted to increase drastically. The percent increase in a member's intra-ASEAN imports is positively correlated with its initial tariff rates. For example, intra-ASEAN imports of Other ASEAN are estimated to increase by 111%, whereas those of Singapore increase by only 26%. On average, intra-ASEAN trade would expand 54% while ASEAN-10's imports from non-ASEAN countries would contract by 6.1%. Since world trade flows increase by 0.4%, the extent of trade creation effects is greater than that of trade diversion.

[14] Stone and Struttt (2009) find that trade and transport cost reductions in the Greater Mekong Subregion (GMS) would greatly expand intraregional trade and increase economic welfare of the GMS countries.

While Other ASEAN's imports from all the member states increase significantly, increases in the Philippines' imports from Other ASEAN, Indonesia's imports from Thailand and Malaysia's imports from the Philippines stand out. Although changes in trade flows by sector are not presented in Table 4, these dramatic increases mostly stem from extraordinarily large increases in bilateral imports of particular products. For example, the Philippines' imports of rice, fossil fuel and apparel from Other ASEAN are predicted to increase by 970%, 163% and 134%, respectively, compared with the baseline in 2015. However, the enormous increase in rice imports is the main reason for a 264% increase in the Philippines' imports from Other ASEAN because rice constitutes about one-fifth of the former's imports from the latter. Similarly, a 556% increase in Indonesia's imports of processed food from Thailand and over a 1,000% rise in Malaysia's imports of other crops from the Philippines are major causes of the drastic increases in Indonesia-Thailand and Malaysia-Philippines trade, respectively.

4.3 Effects on Sectoral Output

Estimates of the impact of ASEAN integration are provided for the 20 sectors under scenario 4. The expected changes are again expressed in percent deviations from the baseline in 2015. Evidently, the differences in the initial tariff rates across sectors play a critical role in determining the direction of the adjustments in sectoral output. Other factors that affect the magnitude and direction of output adjustments for each product category include the import-demand ratio, the export-output ratio, the share of each imported intermediate input in total costs, and the elasticity of substitution between domestic and imported products.[15]

[15] A sector with a larger import-demand ratio generally suffers from proportionately larger output contraction through greater import penetration when initial tariff levels are relatively high. In contrast, a sector with a higher export-output ratio typically experiences a larger extent of output expansion, as a result of the removal of tariffs in the member countries. The share of imported intermediate inputs in the total cost of a downstream industry (e.g., the share of imported textiles in the cost of the apparel industry) would evidently affect the magnitude and direction of output adjustments in the latter sector. Finally, the greater the values of substitution elasticities between domestic and imported products, the greater the sensitivity of the import-domestic demand ratio to changes in the relative price of imports, thereby magnifying the effects of regional integration.

Among agricultural sectors, output of rice in Thailand and Other ASEAN (particularly Vietnam) and that of other crops in the Philippines expand through large increases in intra-ASEAN exports. By contrast, output of rice in the Philippines and Indonesia, as well as that of other crops in Malaysia, Thailand and Other ASEAN, contract mainly because of large import penetrations resulting from the removal of relatively high tariffs. Finally, since the share of Singapore's agricultural sectors in total output is only 0.3%, the results for Singapore are unimportant. Overall, changes in output of agricultural sectors among the ASEAN members are consistent with a priori expectations.

Sectoral output results for manufacturing and services sectors need to be interpreted with caution. Output expansions of processed food in Thailand, textiles and apparel in Other ASEAN, machinery in Singapore and Malaysia, electronic equipment in Singapore, transportation equipment (mainly motor vehicles) in Thailand and financial services in Singapore and Malaysia are consistent with comparative advantage of these countries. However, output expansions of processed food, textiles and apparel in Singapore and Malaysia and machinery and electronic equipment in Other ASEAN, as well as an output contraction of electronic equipment in Malaysia, seem to be counter-intuitive and need some explanations.

The tariff rates on processed food are among the highest in the region except in Singapore and the Philippines. Thus, a significant increase in Singapore and Malaysia's intraregional exports appears to be a major cause for their output expansion of processed food, including palm oil in Malaysia. Expansions of output in textiles and apparel in the two countries also results from the elimination of relatively high tariffs in these products, but absolute increases are very small because textiles and apparel account for less than 1% and 2%, respectively, of Singapore and Malaysia's total output. The predicted contraction of Malaysia's electronic industry might be explained by a small percent increase in the exports relative to other industries. Almost 70% of Malaysia's intra-ASEAN exports of electronic equipment are shipped to Singapore, while about 60% of its intra-ASEAN imports of this product originate from Singapore. Malaysia's exports of electronic equipment to Singapore are predicted to increase by only 9.7%, whereas its imports from Singapore are estimated to increase by 13.6%, which eventually results in a reduction in demand for domestic electronic equipment in Malaysia.

In the machinery and electronic equipment sectors, international fragmentation has dramatically developed in East Asia since the 1990s (Ando and Kimura, 2005a; Kimura, 2006). Paralleling this development is a significant rise in the shares of parts and components in both exports and imports of machinery and electronic equipment in the region. More specifically, over the 1990-2003 period, intra-East Asian exports of parts and components of these products increased by 452%, which accounted for about a half of intraregional export growth (Ando and Kimura, 2005b). Thus, it is quite plausible for Other ASEAN to expand exports of low-quality machinery and electronic equipment (including parts and components), imports of high-quality products and output of these products simultaneously. It should be noted that absolute changes in Other ASEAN's output of machinery and electronic equipment are rather small since these products are projected to constitute only 7% of Other ASEAN's total output for 2015 in the baseline, compared with 27% in Singapore, 34% in Malaysia, 20% in the Philippines and 26% in Thailand.

5. Conclusion

In this paper, we have used a dynamic CGE model to examine the effects of the ASEAN Economic Community on economic welfare, trade flows and sectoral output of the member states. The simulation experiments are conducted for four different nested scenarios, starting with the removal of bilateral tariffs and export taxes/subsidies. Subsequently, a reduction in frictional trade costs (e.g. administrative and technical barriers) is examined. In two final scenarios, productivity levels are assumed to be positively correlated with economic openness, while the incremental effects of lowering the trade and transport margins are also assessed.

Large disparities in the initial tariff rates across members and the incorporation of the Armington assumption result in large terms-of-trade effects, particularly for Singapore (positive) and Other ASEAN (negative), which might dominate other welfare effects under the first scenario. It is found that reductions in frictional trade costs and the trade and transport margins have large effects on economic welfare while allowing for endogenously determined productivity levels has a small impact. When these factors are incorporated, the

estimated welfare gains for the year 2015 range from 1.1% in Indonesia to 9.4% in Thailand. The results suggest that reductions in administrative and technical barriers (e.g. streamlining customs procedures and mutual recognition of product standards) and lowering the trade and transport margins (e.g. through increased competition and improvements in infrastructure) are significant in enlarging the benefits of the AEC.

A challenging extension of the paper would be to endogenize FDI flows to consider attraction of these flows to ASEAN countries, which may have greater effects than the removal of trade barriers, as in the cases of Mexico joining NAFTA and Spain and Portugal joining the EU. Changes in FDI flows deriving from the AEC in the Plummer and Chia's (2009) study are estimated to result in an increase in ASEAN's FDI stocks to the tune of 28-63 percent ($117-$264 billion relative to 2006 inward FDI stocks). Endogenizing an FDI effect would require the construction of a world investment matrix by industry, but the data on bilateral FDI flows by source and host countries and industry are currently available only in a few developed countries. Nevertheless, such an extension will allow us to shed new light on the trade-FDI nexus and international production and distribution networks in the region.

Appendix: Values of the Key Elasticities

Most of the elasticities in the LINKAGE model have a long vintage, in some cases going back to the late 1980s. Many have been gleaned from the literature using econometric estimates when available. Others can be attributed to guess-estimates.

Production is based on a series of nested CES functions. Production elasticities, summarized in Table A.1, are differentiated between installed or *old* capital and capital installed at the beginning of the year, which is called *new* capital. New capital has more flexibility in general than old capital. The aggregate sectoral substitution patterns will be a function of the share of new capital in total sectoral capital with that share higher in countries with higher savings rate.

Table A.1: Production elasticities

	Old	New
Elasticity across inputs (excl. sector-specific and energy inputs)	0.0	
Elasticity between value added (including energy) and other inputs	0.0	0.0
Elasticity between capital & energy bundle and labor	0.1	1.0
Elasticity across labor inputs	0.5	0.5
Elasticity between capital and energy	0.0	0.8
Elasticity between capital and sector-specific factors	0.0	0.0
Elasticity across fuel inputs	0.3	2.0

The trade elasticities are presented in Table A.2 and are divided into four sets. There are two sets of import elasticities, or the so-called Armington elasticities. The top-level Armington elasticity reflects the degree of substitution between domestically produced goods and aggregate imports. The second-level Armington elasticity describes the degree of substitution of imports across region of origin. The next two set of trade elasticities reflect the degree of transformation of domestic production across domestic and export markets. Similar to imports, this transformation is implemented in a two-nested structure.

Table A.2: Trade elasticities

Top-level Armington elasticity	
Rice	4.45
Other crops	4.36
Other agriculture	3.94
Coal, oil and gas	4.93
Other natural resources	2.80
Processed food	4.01
Textiles	3.94
Apparel	4.27
Petroleum products	4.93
Chemical products	3.94
Metal and products	3.94
Machinery	3.94
Electronic equipment	3.94
Transportation equipment	4.71
Other manufacturing	3.94
Construction and utilities	1.76
Trade and transport	2.09
Financial services	2.09
Other private services	2.09
Government services	2.09
Elasticity of substitution across imports by region of origin	Twice the value of top-level Armington elasticity
Elasticity of transformation between output supplied domestically and exported	Infinity
Elasticity of transformation across exports by region of destination	Infinity

References

Anderson, K., Martin, W., and van der Mensbrugghe, D. (2006). Market and welfare implications of Doha reform scenarios. In: K. Anderson and W. Martin (eds.), *Agricultural Trade Reform and the Doha Development Agenda*. New York and Washington, DC: Palgrave Macmillan and World Bank.

Ando, M., and Kimura, F. (2005a). The formation of international production and distribution networks in East Asia. In: T. Ito and A. K. Rose (eds.), *International Trade in East Asia*. Chicago: University of Chicago Press.

Ando, M., and Kimura, F. (2005b). *Global supply chains in machinery trade and sophisticated nature of production/distribution networks in East Asia*. KUMQRP Discussion Paper No. 2005-15. Tokyo: Keio University.

Armington, P. (1969). A theory of demand for products distinguished by place of production. *IMF Staff Papers*, *16*, 159-178.

Asian Development Bank (ADB) (2008). *Emerging Asian Regionalism*. Manila: Asian Development Bank.

Bchir, H., Decreux, Y., Guérin, J-L., and Jean, S. (2002). *MIRAGE, A Computable General Equilibrium Model for Trade Policy Analysis*. CEPII Working Paper No. 2002-17. Paris: CEPII.

Brown, D. K. (1987). Tariffs, the terms of trade, and national product differentiation. *Journal of Policy Modeling*, *9*, 503-526.

Das, S., Roberts, M. J., and Tybout, J. R. (2007). Market entry costs, producer heterogeneity, and export dynamics. *Econometrica*, *75*, 837-873.

de Melo, J., and Robinson, S. (1992). Productivity and externalities: Models of export-led growth. *Journal of International Trade & Economic Development*, *1*, 41-68.

Dervis, K., de Melo, J., and Robinson, S. (1982). *General Equilibrium Models for Development Policy*. Cambridge: Cambridge University Press.

Dessus, S., Fukasaku, K., and Safadi, R. (1999). *Multilateral Tariff Liberalization and the Developing Countries*. OECD Development Centre Policy Brief No. 18. Paris: OECD.

Hertel, T. W., ed. (1997). *Global Trade Analysis: Modeling and Applications*. Cambridge: Cambridge University Press.

Hoekman, B. (2000). The next round of services negotiations: Identifying priorities and options. *Federal Reserve Bank of St. Louis Review*, *82*(4), 31-48.

Ianchovichina, E., and McDougall, R. (2000). *Theoretical Structure of Dynamic GTAP*. GTAP Technical Paper No. 17. West Lafayette: Center for Global Trade Analysis, Purdue University.

Kawai, M., and Wignaraja, G. (2007). *ASEAN+3 or ASEAN+6: Which Way Forward?* ADB Institute Discussion Paper No. 77. Tokyo: ADB Institute.

Keuschnigg, C., and Kohler, W. (2002). Eastern enlargement of the EU: How much is it worth for Austria? *Review of International Economics, 10*, 324-342.

Kimura, F. (2006). International production and distribution networks in East Asia: Eighteen facts, mechanics, and policy implication. *Asian Economic Policy Review*, *1*, 326-344.

Kiyota, K., and Stern, R. M. (2008). *Computational Analysis of APEC Trade Liberalization*. RSIE Discussion Paper No. 578, University of Michigan.

Lee, H., and van der Mensbrugghe, D. (2005). Interactions between foreign direct investment and trade in a general equilibrium framework. Paper presented at the ADB Experts' Meeting on Long-term Scenarios of Asia's Growth and Trade, Asian Development Bank, Manila, 10-11 November.

Lee, H., and van der Mensbrugghe, D. (2008). Regional integration, sectoral adjustments and natural groupings in East Asia. *International Journal of Applied Economics*, *5*(2), 57-79.

Lluch, C. (1973). The extended linear expenditure system. *European Economic Review, 4*, 21-32.

Löfgren, H., Harris, R. L., and Robinson, S. (2002). *A Standard Computable General Equilibrium (CGE) Model in GAMS*. Microcomputers in Policy Research 5. Washington, DC: International Food Policy Research Institute.

Madsen, A. D., and Sorensen, M. L. (2002). Economic consequences for Denmark of EU enlargement. Paper presented at the International Conference on Policy Modeling, Brussels, 4-6 July.

Martin, W., and Mitra, D. (2001). Productivity growth and convergence in agriculture and manufacturing. *Economic Development and Cultural Change*, *49*, 403-422.

Narayanan, B., and Walmsley, T. L. (eds.) (2008). *Global Trade, Assistance, and Production: The GTAP 7 Data Base*. West Lafayette: Center for Global Trade Analysis, Purdue University.

Plummer, M. G., and Chia, S. Y., eds. (2009). *Realizing the ASEAN Economic Community: A Comprehensive Assessment*. Singapore: ISEAS.

Samuelson, P. A. (1952). The transfer problem and transport costs: The terms of trade when impediments are absent. *Economic Journal, 62*, 278-304.

Stone, S., and Strutt, A. (2009), *Transport Infrastructure and Trade Facilitation in the Greater Mekong Subregion*. ADBI Working Paper No. 130. Tokyo: Asian Development Bank Institute.

van der Mensbrugghe, D. (2005). *LINKAGE Technical Reference Document: Version 6.0*. Washington, DC: World Bank.

van der Mensbrugghe, D. (2006). Estimating the benefits: Why numbers change. In: R. Newfarmer (ed.), *Trade, Doha and Development: A Window into the Issues*. New York and Washington, DC: Palgrave Macmillan and World Bank.

Verikos, G., and Zhang, X-G. (2001). *Global Gains from Liberalizing Trade in Telecommunications and Financial Services*. Staff Research Paper. Canberra: Productivity Commission.

Table 1: Regional and sectoral aggregation

A. Regional aggregation

Country/region	Corresponding economies/regions in the GTAP database
Singapore	Singapore
Indonesia	Indonesia
Malaysia	Malaysia
Philippines	Philippines
Thailand	Thailand
Other ASEAN	Brunei, Cambodia, Laos, Myanmar, Vietnam
China	China, Hong Kong
Japan	Japan
Korea	Korea
Taiwan	Taiwan
Australia/New Zealand	Australia, New Zealand
North America	United States, Canada
EU and EAFTA	EU-27, Iceland, Liechtenstein, Norway, Switzerland
Rest of world	All the other economies/regions

B. Sectoral aggregation

Sector	Corresponding commodities/sectors in the GTAP database
Rice	Paddy rice, processed rice
Other crops	Wheat, cereal grains nec, vegetables and fruits, oil seeds, sugar cane and sugar beet, plant-based fibers, crops nec
Other agriculture	Livestock, fishing
Coal, oil and gas	Coal, oil, gas
Natural resources	forestry, minerals
Food products	meat products, dairy products, other food products, beverages and tobacco products
Textiles	Textiles
Apparel	Wearing apparel and leather
Petroleum products	Petroleum and coal products
Chemical products	Chemical, rubber and plastic products
Metal and products	Iron and steel, nonferrous metal, fabricated metal products
Machinery	Machinery and equipment
Electronic equipment	Electronic equipment
Transportation equipment	Motor vehicles and parts, other transportation equipment
Other manufactures	Wood products, paper products, publishing, mineral products, manufactures nec
Construction and utilities	Construction, public utilities
Trade and transport	Trade, sea transport, air transport, transport nec
Financial services	Insurance, financial services nec
Other private services	Communication, business services, recreation and other services
Government services	Public administration and defense, education, health services

Source: GTAP database, version 7.

Note: nec = not elsewhere classified.

Table 2: ASEAN countries' tariff rates on imports from ASEAN members, 2004
(percent)

	Sector	Singapore	Indonesia	Malaysia	Philippines	Thailand	Other ASEAN
1	Rice	0.0	18.7	0.0	50.0	0.0	2.4
2	Other crops	0.0	3.3	11.8	4.6	20.6	7.3
3	Other agriculture	0.0	2.7	0.4	2.3	4.1	7.2
4	Coal, oil and gas	0.0	0.0	1.2	3.0	0.0	0.2
5	Other natural resources	0.0	1.5	0.0	2.9	0.2	1.2
6	Processed food	0.0	18.5	19.8	3.6	34.7	21.8
7	Textiles	0.0	2.5	4.4	2.6	12.5	8.9
8	Apparel	0.0	2.2	2.8	4.5	6.4	7.4
9	Petroleum products	0.0	1.3	0.3	1.5	0.7	13.9
10	Chemical products	0.0	2.2	1.4	2.8	6.3	3.9
11	Metal and products	0.0	2.1	2.2	1.5	3.7	3.4
12	Machinery	0.0	1.5	1.8	0.9	2.6	5.5
13	Electronic equipment	0.0	0.6	0.1	0.2	0.9	5.1
14	Transportation equipment	0.0	2.8	5.8	3.8	4.5	22.8
15	Other manufacturing	0.0	2.9	2.0	2.8	10.1	7.3
16	Construction and utilities	0.0	6.0	4.0	15.0	13.5	6.0
17	Trade and transport	2.5	12.0	4.5	17.0	17.0	7.5
18	Financial services	5.6	10.3	11.6	13.8	12.5	17.7
19	Other private services	3.0	21.5	3.5	17.5	17.0	9.5
20	Government services	5.5	10.5	5.5	10.5	13.0	10.5
	Weighted average	0.0	3.2	2.4	3.3	4.4	9.4

Sources: Sectors 1-15: GTAP database, version 7. Sectors 16-20: Authors' calculation based on ad valorem equivalents of nontariff barriers in Hoekman (2000), Kiyota and Stern (2008), and Verikos and Zhang (2001).

Table 3: The welfare effects of the AEC
(Deviations in equivalent variations from the baseline in 2015)

Region	Scenario 1	Scenario 2	Scenario 3	Scenario 4
A. Absolute deviations (US$ billion in 2004 prices)				
Singapore	5.25	8.09	8.13	11.16
Indonesia	0.48	1.76	2.06	4.37
Malaysia	2.73	5.37	5.47	8.99
Philippines	1.15	1.80	1.91	2.69
Thailand	1.80	3.50	3.88	7.47
Other ASEAN	-1.00	0.10	0.42	2.50
China	-0.91	-1.59	-0.99	-1.62
Japan	-0.30	-0.84	-0.65	-1.07
Korea	0.04	-0.29	-0.21	-0.54
Taiwan	-0.11	-0.31	-0.27	-0.39
Australia/New Zealand	-0.45	-0.51	-0.46	-0.60
North America	-0.42	-0.79	-0.50	-0.89
EU and EFTA	-0.37	-1.43	-1.08	-1.99
Rest of world	-1.13	-1.59	-1.12	-1.55
ASEAN-10	10.41	20.61	21.88	37.19
World	6.76	13.26	16.60	28.54
B. Percent deviations				
Singapore	3.83	5.90	5.93	8.14
Indonesia	0.12	0.46	0.53	1.13
Malaysia	1.72	3.38	3.45	5.66
Philippines	1.01	1.58	1.67	2.35
Thailand	2.26	4.39	4.87	9.38
Other ASEAN	-0.94	0.09	0.39	2.33
China	-0.03	-0.05	-0.03	-0.05
Japan	-0.01	-0.02	-0.02	-0.03
Korea	0.00	-0.03	-0.02	-0.06
Taiwan	-0.03	-0.08	-0.07	-0.10
Australia/New Zealand	-0.06	-0.07	-0.06	-0.08
North America	0.00	-0.01	0.00	-0.01
EU and EFTA	0.00	-0.01	-0.01	-0.02
Rest of world	-0.01	-0.02	-0.01	-0.02
ASEAN-10	1.06	2.10	2.23	3.78
World	0.02	0.03	0.04	0.07

Definitions of scenarios:

Scenario 1: The ASEAN members remove bilateral tariffs and export taxes/subsidies by 2015. The sector-specific productivity factors related to openness ($\chi_{i,t}$) are fixed at the baseline levels.

Scenario 2: Scenario 1 plus a 2.5% reduction in administrative and technical barriers among the ASEAN members over the period 2010-2015. $\chi_{i,t}$ are fixed at the baseline levels.

Scenario 3: Same as scenario 2 except that $\chi_{i,t}$ are endogenous and determined by equation (2).

Scenario 4: Scenario 3 plus a 10% reduction in the trade and transport margins among the ASEAN countries over the period 2010-2015.

Source: Model simulations.

Table 4: Intra- and extra-regional trade flow adjustments resulting from the AEC under scenario 4
(Percent deviations from the baseline for the year 2015)

Exporting countries/regions	Importing countries/regions								
	Singapore	Indonesia	Malaysia	Philippines	Thailand	Other ASEAN	ASEAN-10	Non-ASEAN	World
Singapore		26.6	35.4	27.8	50.3	83.4	40.1	-9.5	3.7
Indonesia	31.1		85.3	61.5	99.4	106.6	61.9	-4.9	8.3
Malaysia	25.6	55.1		52.8	69.3	106.1	45.3	-5.0	5.6
Philippines	17.0	27.0	124.5		83.2	144.3	70.9	-7.0	6.7
Thailand	29.5	159.0	38.9	61.2		138.8	71.5	-5.7	7.9
Other ASEAN	15.8	49.7	58.8	263.9	80.9	120.7	69.3	1.4	13.7
ASEAN-10	26.2	53.8	49.8	56.5	70.6	111.4	54.0	-5.8	6.8
Non-ASEAN	-2.6	-4.6	-9.2	-4.7	-4.2	-20.3	-6.1	0.2	-0.1
World	3.9	9.6	7.7	7.2	8.9	15.0	7.7	-0.1	0.4

Source: Model simulations.

Table 5: Sectoral output adjustments resulting from the AEC under scenario 4
(Percent deviations from the baseline for the year 2015)

Sector	Singapore	Indonesia	Malaysia	Philippines	Thailand	Other ASEAN
Rice	6.7	-2.6	2.6	-30.0	6.3	10.5
Other crops	0.7	0.2	-7.4	23.8	-6.6	-4.7
Other agriculture	-0.1	0.2	9.9	-2.2	10.0	-7.6
Coal, oil and gas	-2.6	-2.0	-4.3	-1.4	-0.6	-0.2
Other natural resources	6.0	0.9	-5.9	-7.1	-6.2	-3.2
Processed food	11.3	-3.7	18.8	-0.8	13.0	-18.1
Textiles	30.5	2.8	24.1	-4.3	-2.9	7.2
Apparel	7.5	-2.3	13.0	-4.3	0.4	5.1
Petroleum products	-19.1	1.1	4.6	3.8	7.5	-19.7
Chemical products	-0.2	-1.0	10.3	-3.1	5.6	5.3
Metal and products	9.7	2.0	3.0	0.3	3.7	12.9
Machinery	2.4	6.1	2.9	-2.2	3.0	16.3
Electronic equipment	3.4	6.4	-6.2	-1.6	-3.2	9.8
Transportation equipment	-4.6	9.3	-1.0	20.1	17.8	-1.3
Other manufacturing	7.3	1.7	-2.9	-2.4	-4.5	-0.6
Construction and utilities	4.9	0.1	3.4	1.2	1.5	1.5
Trade and transport	-2.6	0.3	-2.3	0.9	-1.2	2.8
Financial services	3.4	-0.8	2.6	1.0	0.0	-1.6
Other private services	2.2	-1.3	-3.4	0.7	1.9	-1.6
Government services	0.5	0.0	-0.2	0.9	-2.2	-0.2

Source: Model simulations.