ADB Working Paper Series on Regional Economic Integration

Methods for Ex Ante Economic Evaluation of Free Trade Agreements

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No. 52 | June 2010

Asian Development Bank

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The author would like to thank Michael Plummer, Shintaro Hamanaka, and Jayant Menon for their helpful comments.

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Asian Development Bank

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June 2010
Publication Stock No.

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Abstract

This paper provides practical techniques to policymakers for evaluating the potential economic effects of a Free Trade Agreement (FTA). To this end, the paper discusses how to apply three methods: (i) trade indicators, (ii) SMART (Software for Market Analysis and Restrictions on Trade) in WITS (World Integrated Trade Solutions), and (iii) the GTAP (Global Trade Analysis Project) model. The paper identifies the different aspects of an FTA that each method can evaluate, describes data sources and software requirements, specifies how to interpret the output from each method, and discusses the strengths and limitations of each method. To illustrate each method, there are examples applied to countries in the Association of Southeast Asian Nations (ASEAN), particularly Cambodia, Lao People's Democratic Republic, and Viet Nam.

Keywords: regionalization, evaluation methods, trade indicators, SMART model, CGE analysis, preferential trade agreements, Asia

JEL Classification: F13, F15

1. Introduction

The purpose of this paper is to provide practical methods to policymakers for determining the potential economic effects of a free trade agreement (FTA), which is defined as the preferential liberalization of trade within a group of countries. In theory, the net welfare effect of an FTA is ambiguous (Viner, 1950; Lipsey, 1970; and Panagariya, 2000). To determine how much a proposed FTA is worth, policymakers must turn to empirical methods. The methods differ mainly in terms of the questions about a proposed FTA that each method can answer. Broader and more multi-faceted questions will require more sophisticated, data-intensive methods. All of these methods require, at a minimum, some trade data, which come at different levels of aggregation and are bilateral in nature. The choice of aggregation level and trade partners will depend on the questions being asked.

The first section of this paper presents the simplest method, which makes use of trade indicators to draw specific inferences about the potential effects of joining an FTA. The trade indicators focus on the following questions:

(i) To what extent is trade intra-regional?
(ii) What is the comparative advantage of each FTA member?
(iii) Are a country's exports of a good regionally-oriented?
(iv) How complementary is trade between a given pair of FTA members?
(v) How similar are the exports of a given pair of FTA members?

The main advantage of this method is that the data requirements for trade indicators are minimal, and therefore this method is easy to implement. However, the main drawback of these trade indicators is that they do not provide precise numbers that quantify the effects of an FTA on trade, production, consumption, or welfare.

The second section of this paper presents a method, which is grounded in microeconomic theory, to provide some quantification of the economic effects of an FTA in an individual market. Policymakers may be interested in a particular market for its economic size, political importance, or for other reasons. This method is able to provide numeric answers to the following questions:

(i) How much will imports increase?
(ii) How much will exports from regional partners increase?
(iii) How much will exports from outsiders decrease?
(iv) How much will tariff revenue fall?

Besides trade data, this method requires data on the initial tariff protection and values for certain behavioral parameters. The main advantage of this method is that it can quantify the effects of an FTA in a specific market at the most disaggregated level. The main disadvantage of this method is that it is a partial equilibrium method, meaning that it ignores interactions with other markets.

The third section in this paper presents the most sophisticated method of evaluating a proposed FTA. The method is based on a general equilibrium model—a model where all markets clear and interactions between them are accounted for. The method essentially simulates a real-world scenario and introduces a policy shock such as an FTA. By studying the simulated changes caused by the FTA, this method is able to answer the following questions:

(i) How does real GDP change in a country that joins an FTA?
(ii) How does the country's trade balance change?
(iii) How do the country's terms of trade change?
(iv) How do import and export prices in a particular sector change?
(v) How does output and trade in different sectors within the country change?
(vi) Is there trade diversion?
(vii) How does the country's welfare change?
(viii) Where do these welfare effects come from?

The main advantage of this third method is that, given FTA-related policy changes in various markets, the analysis can quantitatively capture the effects of these changes on all markets and not just one. However, this comes at a cost of modeling complexity and substantial data requirements.

In general, the choice between methods will depend on which questions the policymaker wishes to answer as well as data availability. Each of the following methods contains examples with real-world data from regions encompassed by the Association of Southeast Asian Nations (ASEAN), the European Union (EU), and the North American Free Trade Agreement (NAFTA), as well as individual countries such as Cambodia and Viet Nam.

2. Trade Indicators to Evaluate the Potential Economic Effects of an FTA

A trade indicator is an index or a ratio used to describe and assess the state of trade flows and trade patterns of a particular economy (Mikic and Gilbert, 2007). These indicators are easily constructed with a country's trade statistics, which are readily available from national statistical offices or international sources.[1] In this section, we will present indicators of regional trade interdependence, revealed comparative advantage, regional orientation of a country's exports, and similarity or complementarity of a country's exports with other trading partners. Given the simplicity of these indicators, they can be used at the initial stage of any trade policy decision-making process, including the decision on whether or not to join an FTA. An important caveat is that these indicators cannot determine the causes of a particular state or trend in trade flows.

[1] The United Nations Commodity Trade (COMTRADE) statistical database (http://unstats.un.org/unsd/comrade/) is used most often for trade data, especially for disaggregated information. The World Trade Organization (WTO) and the International Monetary Fund's (IMF) Direction of Trade Statistics (DOTS) are good sources for aggregated trade data.

2.1 Indicators of Regional Trade Interdependence

Before the formation of an FTA, it is important to know to what extent countries in a proposed FTA already trade with each other. Trade here refers to the sum of imports and exports. The indicators normally used as measures of existing trade interdependence are the intra-regional trade share and regional trade intensity. In this section, we will also introduce the regional trade introversion index.

For each of these indicators, a high value may indicate that countries in the proposed FTA have lower trade costs with each other relative to trading with non-FTA countries. Here, trade costs are interpreted broadly to include all costs incurred in getting a good to the final user other than the marginal cost of producing the good itself, including transportation costs (both freight costs and time costs), policy barriers (tariffs and non-tariff barriers), information costs, contract enforcement costs, costs associated with the use of different currencies, legal and regulatory costs, and local distribution costs (wholesale and retail). If a high value is indeed due to lower trade costs, then an FTA may be beneficial as it encourages trade between "natural" trading partners. Conversely, if a low ratio is due to higher trade costs, then an FTA may be harmful as it promotes "unnatural" trade.

2.1.1 Intra-Regional Trade Share

The intra-regional trade share is defined as the ratio of trade between countries in the proposed region over the total trade of all these countries. This indicator shows the relative importance of trade within the region versus the total trade of all regional members. The intra-regional trade share of region i in mathematical form is:

Intra-Regional Trade Share$_i$ = T_{ii} / T_i

where
T_{ii} = exports of region i to region i plus imports of region i from region i
T_i = total exports of region i to the world plus total imports of region i from the world

The exports of region i to region i should be equal to the imports of region i from region i. Therefore, the numerator of this indicator can simply be twice the exports of region i to region i, or twice the imports of region i from region i. This indicator is simple to calculate and can be used by a single country or a group of countries to measure the regional direction of trade.

However, there are two important problems in its use as shown by Anderson and Norheim (1993). First, even if there were no regional bias in trade between members, the intra-regional trade share will tend to be higher simply because there are more member countries. To see why, consider what happens to the intra-regional trade share if a region was simply split into more countries, thus keeping the region's trade with outsiders constant. Intra-regional trade would increase because certain erstwhile domestic transactions would now become regional export and import flows. As this increase would raise the numerator more than the denominator of the intra-regional trade share, the indicator would also increase. Second, the higher the share of the region's total trade out of world trade, the more likely regional members will be trading with each other and the less likely they will do so with non-members. The intra-regional trade share would be higher simply because members conduct more of the world's trade regardless of with whom.[2] When making comparisons of the intra-regional trade share over time or across groups of countries, it is important to note if membership of the regional grouping changes and to compare how a region's total trade grows vis-à-vis the world's total trade.

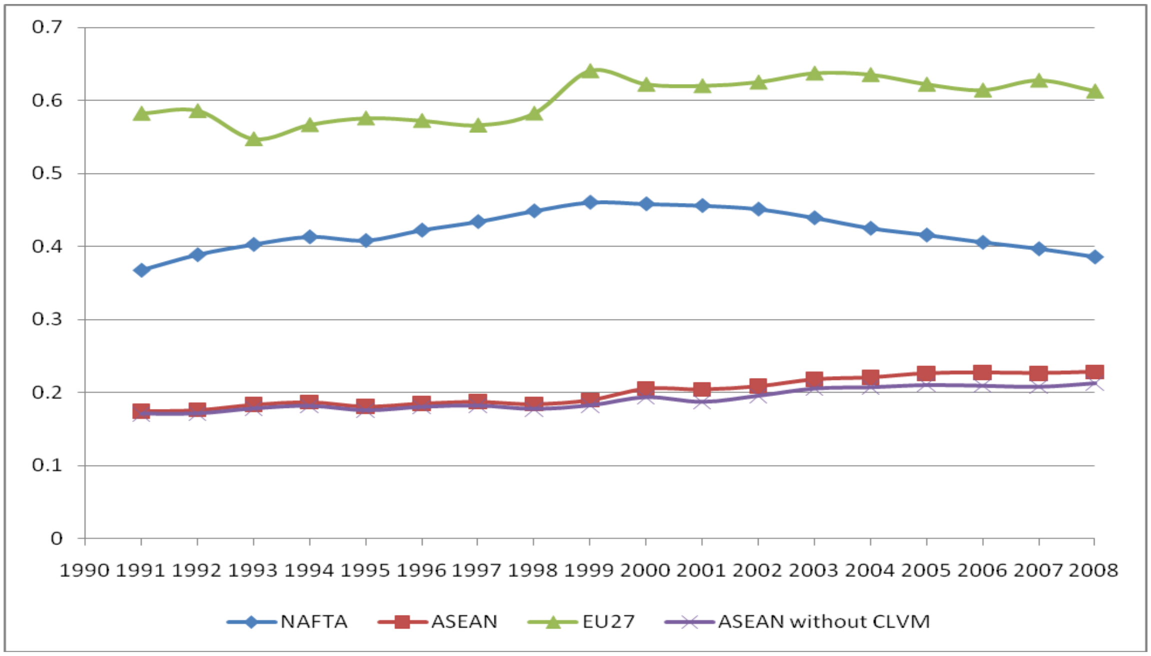
Figure 1 above shows trends in the intra-regional trade shares of three regional groupings: ASEAN, EU27, and NAFTA. Trade data was used for 1990–2008 for all countries that were members of the respective regional groupings in 2008, even though the membership of each regional grouping expanded during these two decades.[3] Therefore, the membership of each group is fixed in the calculations. It is clear that, on average, the share for the EU27 is larger than that for NAFTA, which in turn is larger than that for ASEAN. This shows that the higher the group's share of world trade, the higher the intra-regional share tends to be. Nevertheless, looking at the intra-regional trade shares over time, we can see that there is a slightly increasing trend for ASEAN from 17% in 1991 to 22% in 2008, a stabilizing trend for the EU27 over the same period, and a decreasing trend for NAFTA since 2001. Did the new members of ASEAN (Cambodia, Lao People's Democratic Republic [Lao PDR], Myanmar, and Viet Nam) contribute to the increasing intra-ASEAN trend? As shown in Figure 1, the trend is almost identical if the new members are excluded from the computations.[4] Although the total trade of these four new members increased from less than 1% of ASEAN's total trade in 2000 to about 9% in 2008 (ASEAN Statistical Yearbook, 2008), the trade of the ASEAN-6 (Brunei Darussalam, Indonesia, Malaysia, the Philippines, Singapore, and Thailand) is the primary driver of increasing intra-regional trade.

[2] For example, if the world were considered as a single region, then the intra-regional trade share would be equal to one, the maximum value.

[3] The EU had 12 members in 1990. Austria, Finland, and Sweden joined in 1995, followed by 10 new members (mainly Eastern European countries) in 2004, and Bulgaria and Romania in 2007. NAFTA was signed in 1994. Prior to that, the US and Canada had signed a bilateral FTA in 1989. ASEAN comprised 6 member countries in 1990, and over the 1990s membership expanded to include Viet Nam (1995), Lao PDR and Myanmar (1997), and Cambodia (1999).

[4] The bulk of trade data for Viet Nam and Cambodia is from 1999 onward. There is very little trade data for Myanmar and none for Lao PDR.

Figure 1: Intra-Regional Trade Shares of ASEAN, the EU27, and NAFTA (1990–2008)



Source: Author's computations with data sourced from UNComtrade.

2.1.2 Intra-Regional Trade Intensity

Intra-regional trade intensity is defined as the intra-regional trade share divided by the share of the region's total trade in world trade.[5] The numerator—the intra-regional trade share—can be thought of as the probability that any USD1 worth of total trade of regional members is an intra-regional transaction. The denominator—the region's total trade share in world trade—can be thought of as the probability that any USD1 worth of world trade is a transaction involving at least one regional member. The closer the numerator and denominator are in value (i.e., the closer is the intra-regional trade intensity to the value of 1), then the more neutral is regional members' trade.[6] In other words, the region tends to not have any bias towards trading between its members or with outsiders. If the indicator is more than 1, then the region has a bias towards trading within itself; if the indicator is less than 1, then the region has a bias towards trading with outsiders. The intra-regional trade intensity will tend to rise when the share of a region's

5 This ratio is also called the ''relative'' measure of trade intensity (Petri, 1993) because intra-regional trade is measured relative to the region's share of world trade.

6 This is in terms of "geographic neutrality" (Kunimoto, 1977). Geographic neutrality is defined as the absence of a trading bias with any country or region, so each trade transaction involves a country or region according to its share in world trade. For example, suppose a region's share of world trade is 10%. If geographic neutrality holds, then 10% of all trade transactions conducted by a regional member must involve another regional member. In other words, the assumption of geographic neutrality implies that the intra-regional trade share equals the region's share of world trade.

trade within itself rises faster than its share of world trade. The formula for the intra-regional trade intensity is:[7]

Intra-Regional Trade Intensity$_i$ = $[T_{ii} / T_i] / [T_i / T_W]$

where
T_{ii} = exports of region i to region i plus imports of region i from region i
T_i = total exports of region i to the world plus total imports of region i from the world
T_W = total world exports plus total world imports, which can be twice the value of world exports or twice the value of world imports since the value of world exports should equal world imports

Figure 2 below shows the evolution of the intra-regional trade intensity indices of ASEAN, the EU27, and NAFTA in the 1990s and 2000s. We observe that all three regions have a bias towards trading within themselves because their index values exceed one. The ASEAN region's index rose while the EU27's index stayed constant for the most part of these two decades, during which both regions' world trade shares were quite stable at around 6% and 40% respectively. As such, the rise in intra-ASEAN trade intensity was due to growth in intra-ASEAN trade, while intra-EU trade intensity hovered at 1.5 because intra-EU trade did not change much. During this period, the world trade share of NAFTA fell. As shown in Figure 2, the intra-regional trade intensity of NAFTA rose. This trend was due to a shrinking share of world trade as intra-NAFTA trade did not rise much over the period.

The intra-regional trade intensity index has some limitations, which affect its use and interpretation (Iapadre, 2006). First, the maximum value of the index is a decreasing function of the region's total trade. Therefore, indices computed for different regions and/or periods are not perfectly comparable with each other given their different ranges. Second, the range below the threshold value of 1 is much smaller than above 1, which makes index changes in different parts of the range uncomparable. Third, the index may be inconsistent with its complementary indicator—the extra-regional trade intensity index.[8] The extra-regional trade intensity index measures the intensity of trade of countries in the region with those outside. Mathematically, it is possible for both the intra-regional and extra-regional trade intensity indices to move in the same direction over time. This creates a problem of interpretation because regional trade cannot be simultaneously biased towards countries within the region and those outside.

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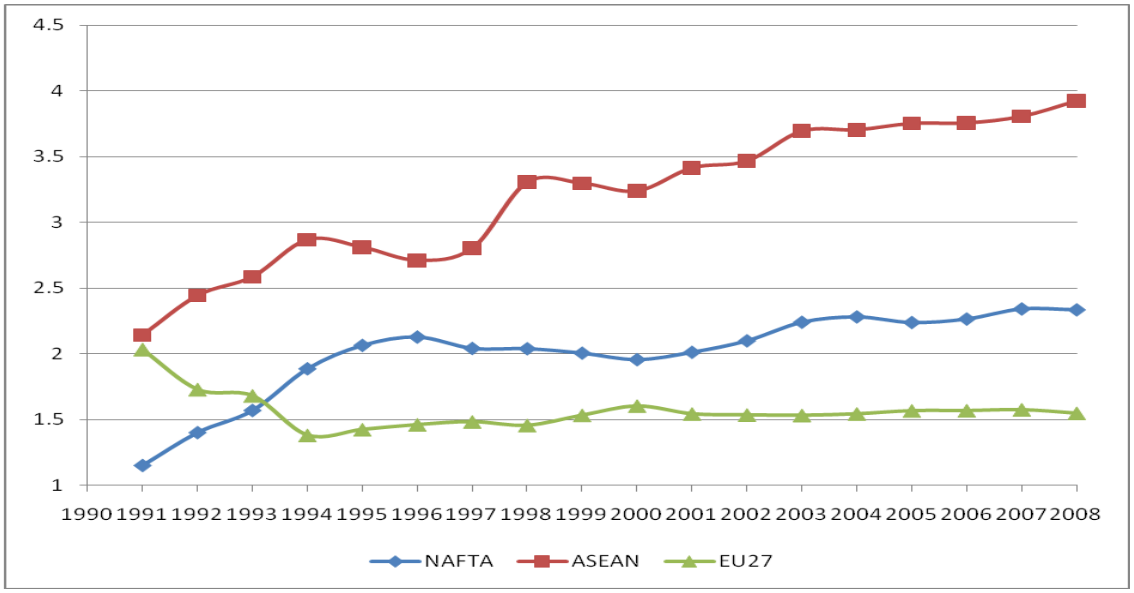
7 Anderson and Norheim (1993) propose a correction to the intra-regional trade intensity formula so that the index is precisely equal to one when regional trade is geographically neutral. To perform this correction, the denominator (T_i / T_W) is replaced by $[(T_i - 1/n^* T_i) / (T_W - 1/n^* T_i)]$, where n is the number of countries in the regional grouping. This correction is most useful if countries in the regional grouping each have a similar value of total trade. If not, the formula provided above is sufficient.

8 The formula for the extra-regional trade intensity index is equivalent to (1 – Intra-Regional Trade Share) / (1 – Region's Share of World Trade).

Figure 2: Intra-Regional Trade Intensity Indices of ASEAN, the EU27, and NAFTA (1990–2008)



Source: Author's computations with data sourced from UN Comtrade.

2.1.3 Regional Trade Introversion Index

Given the problems of the previous two regional trade interdependence indicators, Iapadre (2006) has proposed the regional trade introversion index to measure the relative intensity of regional trading versus trading with outsiders. In this index, intra-regional trade intensity (HI_i) and extra-regional trade intensity (HE_i) are functions of the region's share of outsider's total trade and not of world trade as in the previous trade intensity index. The index's range is [-1,1] and is independent of the size of the region.[9] The index rises (or falls) only if the intensity of intra-regional trade grows more (or less) rapidly than that of extra-regional trade. If the index is equal to zero, then the region's trade is geographically neutral. If it is more than zero, then the region's trade has an intra-regional bias; if it is less than zero, then the region's trade has an extra-regional bias.

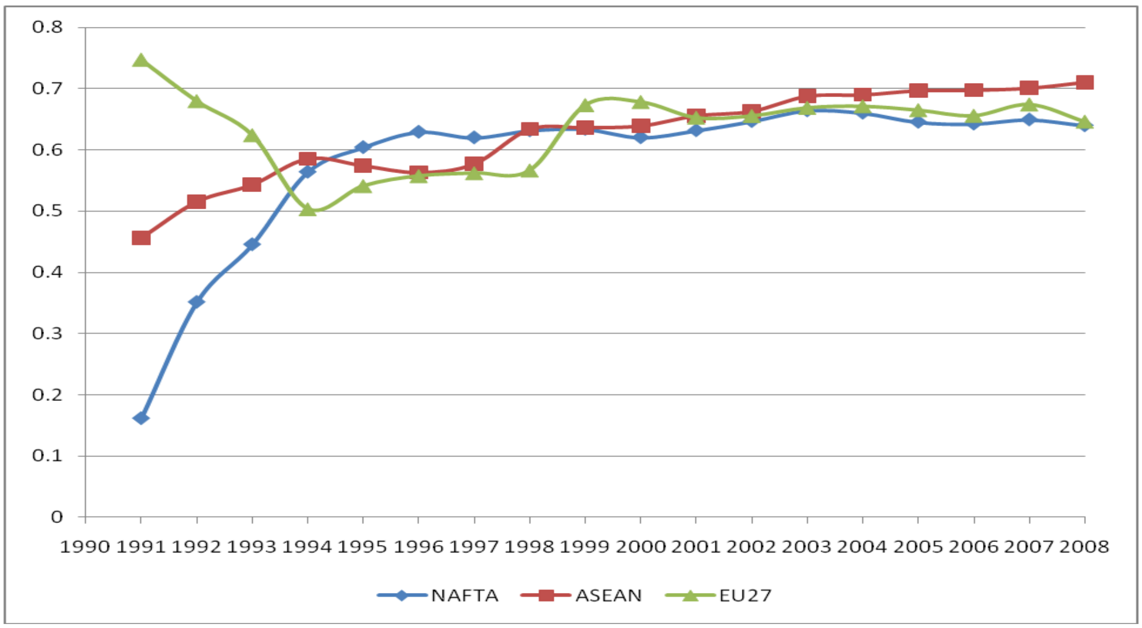
The formula for the regional trade introversion index is the following:

Regional Trade Introversion Index$_i$ = $[HI_i - HE_i] / [HI_i + HE_i]$

[9] The index is made symmetric around zero through a bilinear transformation of the ratio between the intra- and extra-regional trade intensity indices.

where
$HI_i = (T_{ii} / T_i) / (T_{Oi} / T_O)$ and $HE_i = [1 - (T_{ii} / T_i)] / [1 - (T_{Oi} / T_O)]$
T_{ii} = exports of region i to region i plus imports of region i from region i
T_i = total exports of region i to the world plus total imports of region i from the world
T_{Oi} = exports of region i to outsiders plus imports of region i from outsiders
T_O = total exports of outsiders plus total imports of outsiders

Figure 3: Trade Introversion Indices of ASEAN, the EU27, and NAFTA (1990–2008)



Source: Author's computations with data sourced from UNComtrade.

Figure 3 above graphs the regional trade introversion indices for ASEAN, the EU27, and NAFTA in the 1990s and 2000s. The indices for all the three regions hover at 0.65 over most of the period, which points to intra-regional biases in trade. In the early 1990s, the EU27 index fell because the trade of the original EU12 turned inwards due to the Single European Act's mandate to establish a common market by 1992, shifting EU trade away from the countries that would later become EU members. In contrast, trade among the countries that would form the NAFTA and ASEAN blocs intensified in the early 1990s amid the negotiations for and in anticipation of the NAFTA and AFTA agreements signed in 1992. After 1993, as Figure 3 shows, all three regions display similar increasing trends in intra-regional trade.

2.2 Indicators of Comparative Advantage, Regional Orientation, Trade Complementarity, and Export Similarity

If a country plans to join an FTA, it should have an idea of which of its sectors are relatively efficient. These sectors are most likely to have export potential. The sectors that are relatively inefficient are most likely to see increased imports. The country may also be interested in the extent to which the trade of all countries planning to join the FTA is complementary or similar. If trade is complementary (i.e., when one country exports products that another country imports), then the FTA is likely to be beneficial. If trade is similar (i.e., when two or more countries export similar products), then the FTA may not yield much benefit. This section presents indicators to broadly assess the potential effect of an FTA on a particular sector in a country that plans to join an FTA. For illlustrative purposes, we will use trade data provided by the UNComtrade database for ASEAN countries, the People's Republic of China (PRC), and Japan at the aggregate level and the HS85 category (Electrical Machinery & Equipment & Parts, Telecommunication Equipment & Parts, Sound Recorders, Television Recorders) from the year 2000. This 2-digit HS category accounts for the largest share of ASEAN exports in terms of value. In most cases, data was unavailable for Brunei, Lao PDR, Myanmar, and Viet Nam.

2.2.1 Revealed Comparative Advantage

International trade theory states that gains from trade come from specialization in a country's comparative advantage (i.e., sectors in which a country produces relatively more efficiently than in other sectors). The revealed comparative advantage (RCA) index, introduced by Balassa (1965), can be used to discover the products in which a country has a comparative advantage. It is defined as the ratio of a country's share of the commodity in the country's total exports to the share of world exports of the commodity in total world exports. A country is said to have a revealed comparative advantage if the value of the index exceeds one and a revealed comparative disadvantage if the index's value is below one. The larger the difference between countries' RCA indices, the more suitable they are as FTA partners.

The formula for the RCA index is:

Revealed Comparative Advantage$_{cg}$ $= [X_{cg} / X_c] / [X_{Wg} / X_W]$

where
X_{cg} = exports of good g by country c
X_c = total exports of country c
X_{Wg} = world exports of good g
X_W = total world exports

For example, in the HS85 category of goods, the RCA indices of ASEAN countries, the PRC, and Japan in the year 2000 are, in decreasing order, Philippines (3.33), Singapore (2.46), Malaysia (2.37), Japan (1.55), Thailand (1.39), PRC (1.14), Indonesia (0.64), and Cambodia (0). By this index, the Philippines and Singapore are the most efficient in producing goods classified under HS85, while Indonesia and Cambodia are the least efficient. An FTA would benefit the former two countries as they have the largest export potential, while also benefitting the latter two since increased imports would displace inefficient domestic production.

2.2.2 Regional Orientation

The regional orientation index tells us whether a country's exports of a product are more oriented towards a particular region than to other destinations. It is defined as the ratio of two shares. The numerator is the share of the country's exports of the product to the region of interest in the country's total exports to the region. The denominator is the share of the country's exports of the product to other countries in the country's total exports to other countries. If the index has a value greater than 1, this implies that the country has a regional bias in exports of the product. Conversely, if the index is less than 1, then the country has no regional bias. The index can be combined with the RCA index to discover which commodities' markets may experience trade diversion after an FTA. If a country's RCA index is less than 1 and its regional orientation index is more than 1, than an FTA between the country and the region may cause trade diversion. The formula for the regional orientation index is:

Regional Orientation$_{cgr} = [X_{cgr} / X_{cr}] / [X_{cg\text{-}r} / X_{c\text{-}r}]$

where
X_{cgr} = exports of good g by country c to region r
X_{cr} = total exports of country c to region r
$X_{cg\text{-}r}$ = exports of good g by country c to countries outside region
$X_{c\text{-}r}$ = total exports of good g to countries outside region r

Continuing with our example, we measure the ASEAN regional orientation of exports by individual ASEAN countries, the PRC, and Japan in the HS85 category of goods. The computed regional orientation indices for the year 2000 are Cambodia (4.06), Indonesia (2.58), Japan (1.50), PRC (1.31), Philippines (1.24), Singapore (1.21), Malaysia (1.13), and Thailand (1.04). The computed values for all countries are above 1, which shows that all of these countries directed more of their HS85 exports to the ASEAN region than to other countries. The previous section showed that Cambodia and Indonesia did not have a comparative advantage in producing goods from the HS85 category in 2000. The high values for their regional orientation indices in the same year indicate that there may be trade diversion, i.e., Cambodia and Indonesia are replacing non-ASEAN countries as the source of ASEAN imports of HS85 goods.

2.2.3 Complementarity

This index measures the degree to which the export pattern of one country matches the import pattern of a region. It is defined as 1 minus the sum of the absolute value of the difference between the import category shares of the region and the export shares of the country divided in half. The formula for the index is:

Complementarity$_{cgr} = 1 - \{\sum_{g} abs([M_{rg} / M_r] - [X_{cg} / X_c])\}/2$

where
M_{rg} = imports of good g by region r
M_r = total imports of region r
X_{cg} = exports of good g by country c
X_c = total exports by country c

The index takes a value between 0 and 1, with zero indicating no overlap and one indicating a perfect match in the import–export pattern. A high degree of complementarity may indicate more favorable prospects for a successful trade arrangement.

To illustrate, we will individually compute the complementarity between exports from ASEAN countries, the PRC, and Japan with ASEAN imports in the year 2000 at the HS 1-digit level (i.e., HS0 to HS9). The calculated complementarity indices are Malaysia (0.84), Japan (0.80), Singapore (0.79), Thailand (0.79), Philippines (0.73), PRC (0.69), Indonesia (0.55), and Cambodia (0.08). The results show that all these countries, except for Cambodia, have exports that match well with ASEAN's imports. We can infer that trade liberalization between the countries with high index values and ASEAN partners is likely to create gains as their exports match ASEAN's import demand.

2.2.4 Export Similarity

This index captures the degree of similarity between the export profiles of one country and other countries in a region. It is defined as the sum over export categories of the smaller export share, comparing the export share of the country with that of other countries in the region.

The formula for the export similarity index is:

$$\text{Export Similarity}_{cgr} = \sum_{g} min([X_{rg} / X_r], [X_{cg} / X_c])$$

where
X_{rg} = exports of good g by region r
X_r = total exports of region r
X_{cg} = exports of good g by country c
X_c = total exports by country c

The index ranges between 0 and 1. A value of zero indicates no overlap in the export profiles (i.e., the country is not a competitor with other countries in the region) and a value of one indicates perfect overlap. The more similar the export profiles are, then the more likely that there is limited potential for gains from inter-industry trade with a regional trading arrangement. This index does not consider gains from intra-industry trade.

We compute the similarity index for the exports of individual ASEAN countries, Japan, and the PRC in relation to the exports of other ASEAN countries over HS1-digit categories. The export similarity values are Malaysia (0.88), Japan (0.77), Thailand (0.77), Singapore (0.76), Philippines (0.73), PRC (0.70), Indonesia (0.51), and Cambodia (0.12). Except for Indonesia and Cambodia, these countries have similar export structures compared with the ASEAN export structure. As such, gains from inter-industry trade with further ASEAN trade liberalization may arise because of Indonesia's and Cambodia's export dissimilarity to the rest of ASEAN exports.

2.3 Strengths and Limitations of Trade Indicators

The main strengths of using trade indicators is that they are relatively easy to understand, their data requirements are easily satisfied, and their computation is straightforward.[10] However, their main limitation is that, since these indicators are atheoretical, the interpretation of the results may be difficult. In addition, for the indicators presented in section 2.2, the results may be meaningless if the indicators are computed for trade categories that are too aggregated or unsuitably classified. To get more relevant information from these trade indicators, trade data could be reclassified according to a country's production structure and the computations performed at a more disaggregated level. Finally, these trade indicators are able to answer only a limited number of specific questions regarding an FTA.

3. Estimating the Potential Economic Effects of an FTA in an Individual Market

Often, policymakers are interested in how an FTA will affect production, consumption, and trade flows in the domestic market for a single commodity. Policymakers may want to focus on this commodity because, for example, its trade is significant in the country's trade balance, it generates substantial tariff revenue, its production occupies a large share of the country's workers, its output contributes significantly to GDP, or firms in the sector may be important political players. Some of the trade indicators discussed in the previous section may provide partial answers to questions about the economic effects of an FTA in an individual market, but for a more comprehensive analysis we have to turn to a simulation model that is based on standard microeconomic theory and supports trade policy analysis.

We will consider a model that is partial equilibrium, as it focuses on only one market. The main advantage of the partial equilibrium versus the general equilibrium approach, which analyzes all markets simultaneously, is that relatively few data items are necessary. The only required data for a partial equilibrium analysis of an FTA are trade flows, the trade policy (e.g. tariffs), and values for some behavioral parameters (mainly elasticities). Another advantage is that it permits an analysis at a fairly disaggregated level, so the policymaker can focus on a very specific commodity. On the other hand, the partial equilibrium approach may miss important interactions and feedback among various markets. For example, a lower tariff on computer motherboards might also increase the import of power supply units or video cards as these are complements in production.

[10] Some of these trade indicators may be found already computed at the following websites: ITC—http://www.intracen.org/menus/countries.htm; World Bank—http://www.worldbank.org/globaloutlook; UNCTAD—http://stats.unctad.org/handbook/ReportFolders/ReportFolders.aspx; and ARIC—http://aric.adb.org/indicator.php

3.1 The SMART Model

In this section, we describe the framework of a partial equilibrium model known as the SMART model—Software for Market Analysis and Restrictions on Trade—that can be used in assessing the trade, tariff revenue, and welfare effects of an FTA. This model and the simulation tools are part of the World Integrated Trade Solutions (WITS) trade database and software suite provided jointly by the World Bank and the United Nations Conference on Trade and Development (UNCTAD).

The SMART model focuses on the changes in imports into a particular market when there is a change in trade policy. The demand side of the market in SMART is based on the Armington assumption that commodities are differentiated by their country of origin. This assumption implies that, for a particular commodity, imports from one country are an imperfect substitute for imports from another country. Thus, even though an FTA entails preferential trade liberalization, import demand does not completely shift to a source from within the FTA. The SMART model also assumes that consumers' demand is decided in a two-stage optimization process that involves allocating their spending by commodity and by national variety. At the first stage, consumers decide how much to spend on the commodity given changes in the price index of this commodity. The relationship between changes in the price index and the impact on import demand for this commodity is determined by a given import demand elasticity. At the second stage, the chosen level of spending for this commodity is allocated among the different national varieties, depending on the relative price of each variety. The extent of the between-variety response to a change in the relative price is determined by the substitution elasticity.

Different countries compete to supply (export to) the market and the model simulates changes in the composition and volume of imports into that market after a tariff reduction or another change in trade policy. The degree of responsiveness of each foreign exporter's supply to changes in the price is known as the export supply elasticity. The SMART model, by default, assumes that the export supply elasticity of each foreign country is infinite, which implies that each foreign country can export as much of the good as possible at a certain price. This assumption may be appropriate for an importing country whose import quantity is too small to affect the prices of foreign exporters (i.e., the price-taker assumption). If changes in the country's import quantity can have a price effect on the foreign exporter, SMART can operate with a finite export supply elasticity, but the value of this parameter must be found and incorporated into the analysis.

In the SMART model, an FTA will affect both the price index of the commodity and the relative prices of the different national varieties. To illustrate, suppose there are three countries: A, B, and C. A imports a good from B and C, but A is forming an FTA only with B. Reducing the tariff on imports from partner B will lower the domestic price of the variety coming from B and the price index of the commodity. Domestic consumers will therefore want to purchase and import more of the commodity.[11] The cheaper price of imports from B relative to C also causes consumers to switch sourcing their imports from

11 This is called a trade creation effect in SMART, but it is not equivalent to Viner's definition of trade creation.

C to B.[12] This substitution of imports is perfectly balanced in the SMART model so that the substitution does not affect the overall imported quantity, but simply reallocates market shares among foreign partners based on the new relative prices. The FTA does, however, result in an increase in imports from the country or countries benefiting from preferential trade because of lower prices. In sum, the importing country will experience an increase in imports, FTA export partners will have an increase in exports, and outsiders will see their exports of the commodity fall.[13] Besides trade effects, SMART can calculate changes in tariff revenue as well.

SMART requires the following data, which can be extracted from WITS or imported from alternative sources of information, for the simulation of an FTA: (i) the import value from each foreign partner, (ii) the tariff faced by each foreign partner, (iii) the import demand elasticity for the commodity, (iv) the export supply elasticity for the commodity, and (v) the substitution elasticity between varieties of the commodity. Note that SMART accepts just one import demand elasticity for the commodity and not for each national variety. Moreover, the export supply elasticity must be the same for all foreign exporters of the commodity. SMART also expects that the substitution elasticity is the same for any pair of varieties of the commodity.

3.2 Example of Motorcycles Market in Lao PDR

We used the SMART model to capture the economic effects of preferential tariff liberalization in Lao PDR's motorcycles import market (HS871120). We reduced Lao PDR's tariffs to zero for motorcycle imports from ASEAN countries to simulate what would have happened if Lao PDR had liberalized this market for ASEAN partners in the year 2000. We keep the pre-existing Laotian motorcycle tariffs on non-ASEAN countries at the same levels.

Data from WITS show that all of Lao PDR's motorcycle imports in 2000 had a 40% import duty imposed regardless of national origin. Table 1 below shows that Thailand was the largest source of Lao PDR's motorcycle imports (with a 93% market share) followed by the PRC, Japan, Denmark, Republic of Korea (Korea), and France. For the simulation, import tariffs are reduced to zero for Thailand. All other countries continue to face a 40% tariff. We assume that Lao PDR's motorcycle market is too small to affect foreign export prices, so the foreign export supply elasticity is infinite. WITS provides the following values for the behavioral parameters: (i) import demand elasticity for the commodity (1.5) and (ii) substitution elasticity between varieties of the commodity (0.69). As these elasticities were estimated using annual data, any simulated changes can be thought to occur within a year. Table 1 below contains the simulation results. All non-ASEAN exporters suffer a drop in their exports to Lao PDR. The total reduction of Lao PDR's motorcycle imports from non-ASEAN exporters is USD792,000, which results in a tariff revenue loss of USD322,000. However, there is an increase in Lao PDR's

[12] This is called a trade diversion effect in the SMART model, although it does not exactly correspond to Viner's definition of trade diversion.

[13] If the analysis includes finite export supply elasticities, then as the FTA increases the import demand of national varieties that have preferential tariffs, there will be an increase in the prices of these national varieties, which will temper the final quantities of imports demanded of the commodity from these beneficiary countries.

motorcycle imports from Thailand of USD6,156,000 (i.e., USD33,272,000 – USD27,116,000).

Table 1: Exports into Lao PDR's Motorcycle Market (USD Thousand)

Exporter	Tariff Line Code	Exports Year 200	Simulated Exports	Simulated Changes in Tariff Revenue
PRC	871120	1,425	881	-218
Denmark	871120	228	145	-33
France	871120	6	4	-1
Japan	871120	438	277	-65
Korea, Rep. of	871120	38	24	-6
Thailand	871120	27,116	33,272	-10847

Lao PDR = Lao People's Democratic Republic.
Source: WITS.

To approximate the increase in Laotian consumer surplus from additional imported Thai motorcycles, we can use the following formula: ½*Initial Ad Valorem Tariff on Imports*Increase in Imports, which yields ½*0.4*USD6,156,000 = USD1,231,200. If the increase in consumer surplus on additional imports from FTA partners is smaller than the loss in tariff revenue from non-FTA partners, then the net welfare effect of the FTA is negative for the market being studied. In the example, the increase in consumer surplus due to more imports from FTA partners is USD1,231,200, which is larger than the loss in tariff revenue from non-FTA partners of USD322,000. Therefore, we cannot rule out the possibility that the FTA may be beneficial for the Laotian motorcycle market. Note that we cannot say for sure that the FTA is beneficial because we are unable to compute the loss in consumer surplus due to reduced motorcycle imports from non-FTA partners. Furthermore, the SMART calculations do not account for changes in Lao PDR's motorcycle assembly industry, for which imported motorcycle parts enter duty-free already.

3.3 Strengths and Limitations of the SMART Model

The strengths of the SMART model are that it is easily learned and implemented together with the WITS database, it yields important quantitative results on the trade and tariff revenue effects of an FTA, and the analysis can be performed at the most disaggregated level of trade data. However, the main limitation of the SMART model is that it is a partial equilibrium model, which means the results of the model are limited to the direct effects of a trade policy change only in one market. The model, therefore, ignores the indirect effects of trade policy changes in other markets (inter-industry effects) and feedback effects (the effects due to a trade policy change in a particular market that spill over to related markets and return to affect the original market). In addition, SMART does not return results on an FTA's effects on domestic production, which may be of interest to policymakers. Further, SMART does not consider the possibility of new foreign exporting countries serving the domestic market. Finally, SMART's results may be sensitive to the modeling assumptions and parameter values used. Although SMART does not provide a built-in sensitivity analysis, users may perform this manually by changing parameter values over a reasonable range. Table 2 on the next page summarizes the essential characteristics of the SMART model and provides notes on implementing SMART for developing countries.

Table 2: The SMART Model, FTA Analysis, and Developing Countries

	Values/Variables	**Notes on Implementation from a Developing Country Perspective**
Assumptions in the SMART Model	Imports are differentiated by national origin (Armington assumption). Therefore, an FTA does not shift all trade from non-members to members.	This is justified as countries often import different varieties from different countries because of quality differences.
	The default foreign export supply elasticity is infinite, but SMART will accept a finite export supply elasticity.	Most developing countries are price takers in world markets, justifying an infinite foreign export supply elasticity.
	The import demand elasticity is the same for each national variety of the imported commodity. The export supply elasticity is the same for all foreign exporters of the commodity. The substitution elasticity is the same for any pair of varieties of the commodity.	Constraining these elasticities to be the same may not be realistic, but it reduces the number of required parameter values and facilitates the analysis. This is important for developing countries that may lack expertise in this type of analysis.
Data included in the WITS database	Combines COMTRADE, TRAINS, and WTO data on trade and tariff, para-tariff, and non-tariff trade barriers from more than 170 countries; includes parameter values for elasticities.	If a developing country has more timely or reliable data, then it can supplement or replace the WITS trade and trade-barrier data used for the analysis.
Important parameters	(i) Import-demand elasticity (ii) Substitution elasticity	These parameter values in SMART were estimated by the World Bank. They may be less reliable for developing countries. These values may be replaced by more accurate or reasonable ones.
Output of the SMART model	Changes in import value and tariff revenue for a single good by national source.	The changes in import value are measures of trade creation and diversion. (SMART does not consider new sources of imports.)

COMTRADE = United Nations Commodity Trade Statistics Database, TRAINS= Trade Analysis and Information System.

4. Computable General Equilibrium (CGE) Estimation of the Potential Economic Effects of an FTA

The partial equilibrium analysis of an FTA captures, essentially, the effects of a tariff reduction in a single import market. However, FTA negotiations, in practice, encompass the removal of trade barriers across several sectors at the same time. To capture all the effects of multi-sectoral trade liberalization, a general equilibrium approach is necessary. A general equilibrium approach would not only reveal the direct effects of tariff reductions in individual markets, but also any indirect changes in related markets.

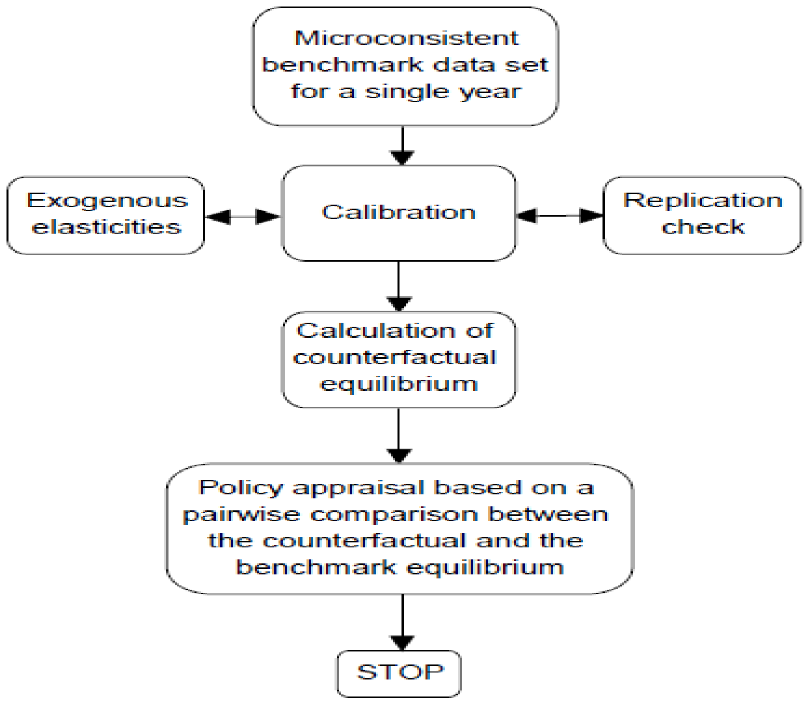
For example, consider a tariff reduction on motor vehicles. A partial equilibrium analysis would simply focus on the direct effects on the motor vehicle market: a reduced import price and increased imports. A general equilibrium analysis would account for any broader effects on the economy. It would trace how a lower tariff on motor vehicles affects the demand for substitutes (e.g., bicycles or train rides) or complementary goods (e.g., petroleum or tires). It would also consider how reducing the tariff on motor vehicles affects input markets that are related to the domestic production of motor vehicles.

Cheaper imported motor vehicles would replace domestic production and, therefore, the demand for workers, machines, and raw materials. Changes in the prices of these inputs would depend on how important the domestic motor vehicle industry was in the employment of these inputs. For example, if the domestic motor vehicle industry was the major purchaser of domestic steel and the main employer of workers, then the price of domestic steel would fall and workers in steel factories would face wage cuts, thus lowering labor income. These workers could reduce their consumption demand for various goods, including demand for motor vehicles, which would be an income effect. The tariff reduction in motor vehicles might also produce a feedback effect. The increase in imports of motor vehicles at the expense of domestically-produced motor vehicles could cause lower demand for domestic inputs and, therefore, a drop in input prices. This could, in turn, motivate domestic producers of motor vehicles to restore some of their output. Finally, the lower tariff would imply lower government revenue and, possibly, lower government spending, some of which might be in the form of sector-specific subsidies.

As shown in the example above, the indirect effects of a single tariff reduction may be quite complex. This complexity increases with the number of trade policies and markets involved. As FTAs cover multiple sectors and various trade reforms, they are often simulated using computable general equilibrium (CGE) modeling. This modeling technique relies on standard microeconomic theory for rigor and consistency as well as computer algorithms for model-solving.

Figure 4 above shows how a typical CGE analysis is conducted. To begin, the analyst needs to organize a dataset about the economy (or economies) concerned from a benchmark year. The data needed for a CGE analysis comes mainly from national input–output tables that are organized into a social accounting matrix (SAM). A SAM extends the sectoral information in national input–output tables to include data on the components of aggregate demand— consumption, investment, government spending, and the external sector including exports and imports. The dataset should be consistent, meaning that the numbers reflect an equilibrium as specified in the CGE model. Equilibrium in a CGE model is defined as the set of values for all variables in the model that equates demand and supply in all markets.

Figure 4: The Process of a CGE Analysis



Source: (Shoven and Whalley, 1992).

Next, the analyst will need to enter values for the parameters of the model. These parameters comprise price, income, and substitution elasticities. These elasticities measure the sensitivity of producers and consumers to relative price and income changes. Their values, therefore, can have an important influence on the outcome of a CGE simulation. Some of these parameters will have values that are derived from statistical studies in the literature, while any parameters whose values remain unknown will have to be calibrated. Calibration involves computing values for the latter set of parameters so that the analyst can reproduce the SAM values from the benchmark year. Once all parameter values in the model are set, the analyst must perform a replication check to verify that the equilibrium solution—the set of prices that clear all markets—reproduces the SAM data from the benchmark year.

Lastly, the analyst changes the values of any exogenous variable(s) to simulate policy changes in the correctly-specified CGE model from the previous step, thus yielding a new equilibrium. This new equilibrium is known as the counterfactual equilibrium. By comparing the simulated changes between the benchmark and counterfactual equilibria, the analyst can make inferences about the potential effects and desirability of the simulated policy changes.[14] In a CGE analysis of trade policy, the analyst would typically study changes in output, exports and imports, factor prices, and welfare.

4.1 The GTAP Model

The Global Trade Analysis Project (GTAP) model, originally formulated by Hertel (1997), is the most widely used CGE model for analyzing trade policy.[15] The model is multi-market, with markets for final goods, intermediate goods, traded goods, and factors of production. It is also multi-regional, with a region representing a country or a group of countries. The quantity of endowments—land, skilled labor, unskilled labor, natural resources, and initial capital—in each region is fixed exogenously within the GTAP model. The main agents in this model are producers, consumers, and the government. These agents are styled according to standard neo-classical axioms, but the GTAP model contains particular production and utility functions.[16] Furthermore, the model assumes perfect competition and that prices will adjust to clear all markets. As the labor supply within each region is fixed and not mobile across regions, market clearing implies that there is no unemployment.

Regions can trade with each other in the GTAP model. International trade in the GTAP model involves the shipping of commodities from a source to its destination region by an international transport sector, which buys inputs of transport from various regions. Importers buy the transport services, and the cost of transport creates the wedge between the free-on-board (FOB) and cost, insurance, and freight (CIF) prices of commodities. Both the transport sector and importers satisfy zero profit conditions in equilibrium because of perfect competition. In addition, international trade is characterized by the Armington (1969) assumption, which implies substitutability, albeit imperfect, between varieties of a good by national origin. As such, GTAP simulations do not result in perfect specialization across countries. Given balance of payments equilibrium, each region's trade balance is equal and opposite to its capital account balance, which is the difference between its domestic savings and investment.[17] Because the basic GTAP model is static (i.e., there is no time dimension and, therefore, no dynamics for variables such as savings or investment), the GTAP model features a "global bank" that collects funds from regions that are net savers and invests them in regions that are net investors until the marginal investment equates the expected rates of return from all regions.

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[14] Studying any changes in the levels of the endogenous variables from one equilibrium to another is known as a comparative static analysis or a counterfactual analysis.

[15] The theory underlying the GTAP model is based on the ORANI model of the Australian economy, which was developed by Dixon et al., (1982).

[16] GTAP uses nested constant elasticity of substitution (CES) and Leontief functions to model the production technology, which implies constant returns to scale. The model uses nested Cobb–Douglas and constant difference in elasticity (CDE) functions to capture the contribution of private, government, and savings demand to regional demand, and the claims of each of these three areas represent a constant share of income (Hertel, 1997, Chapter 2).

[17] The GTAP model ignores unilateral transfers and gifts between countries.

GTAP also houses a database that currently contains SAMs for 113 countries; production, endowment, and bilateral trade data; and values for all parameters in the GTAP model.[18] The ready availability of this information and related software makes implementing the GTAP model easy. For a CGE analysis of trade policies such as import-tariff reductions in an FTA, a combination of user-friendly, menu-driven software such as *AggGTAP* and *RunGTAP* can be used to obtain results. These two software programs were created specifically for use with the GTAP database, and they make CGE analysis convenient. Although the GTAP model and database are suitable for a wide-range of trade policy analyses, the model, data, and/or parameters may have to be modified for the simulation of complex trade (e.g., tariff-rate quotas, export subsidies, service trade barriers, technical trade barriers, overlapping FTAs) or other policies such as investment, migration, or energy policies.[19] To illustrate how simple, yet comprehensive, a CGE analysis can be with the tools provided by GTAP, we will consider the case of the FTA among ASEAN countries, focusing on the effects of preferential trade liberalization on the newest members.

4.2 Example of CGE analysis of an FTA: GTAP simulation of the effects of the ASEAN FTA on Cambodia, Lao PDR, and Viet Nam

To focus attention on certain countries, the data for a CGE analysis is often aggregated by regions, sectors, and factors. In this example, the data on the 113 countries provided in the GTAP database are aggregated into 13 regions: nine ASEAN countries (excluding Brunei Darussalam because it is not in the GTAP database); the PRC; Japan; the rest of East Asia (including Hong Kong, China; Republic of Korea; and Taipei,China); and the rest of the world. The GTAP database contains data on 57 sectors, which have been aggregated into 10 sectors according to the nature of outputs. In the analysis below, we will refer to the first three aggregated sectors as primary, the next four as secondary, and the final three as tertiary.

The five factors included in the GTAP database are: land, natural resources, unskilled labor, skilled labor, and capital. These are left disaggregated in this example. As per the GTAP model, land and natural resources are assumed to be perfectly immobile between sectors but unskilled labor, skilled labor, and capital are perfectly mobile.[20] The benchmark year for this CGE analysis is 2004 as the data from the GTAP database is from this year. We perform a simulation of the ASEAN FTA. Our scenario is simply that the ad valorem tariffs on imports from ASEAN countries into other ASEAN countries are all reduced to zero. For our simulation, the closure (i.e., the treatment of equilibrium in the model) used is the standard GTAP multiregional general equilibrium closure. The solution algorithm used is the Gragg 4 8 12 method with automatic accuracy to get a high level of precision in the results.

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[18] The current version of the GTAP database is version 7. It can be accessed for a fee, although some previous versions are free. More information about the GTAP database and the GTAP model can be found at http://www.gtap.agecon.purdue.edu/

[19] In GTAP, policy measures are modeled as ad valorem price wedges. These price wedges can be between the domestic and world market prices (border measures) or between domestic producer and consumer prices (output taxes or subsidies).

[20] The degree of inter-sectoral mobility of each factor may be adjusted in *GTAPAgg*.

Table 3: Aggregation of GTAP Sectors

	Aggregated Sectors	Disaggregated Sectors
1	Grains and Crops	Paddy rice; Wheat; Cereal grains nec; Vegetables, Fruit, Nuts; Oil seeds; Sugar cane, Sugar beet; Plant-based fibers; Crops nec; Processed rice.
2	Livestock and Meat Products	Cattle, Sheep, Goats, Horses; Animal products nec; Raw milk; Wool, Silk-worm cocoons; Meat; Meat products nec.
3	Mining and Extraction	Forestry; Fishing; Coal; Oil; Gas; Minerals nec.
4	Processed Food	Vegetable oils and fats; Dairy products; Sugar; Food products nec; Beverages and tobacco products.
5	Textiles and Clothing	Textiles; Wearing apparel.
6	Light Manufacturing	Leather products; Wood products; Paper products, publishing; Metal products; Motor vehicles and parts; Transport equipment nec; Manufactures nec.
7	Heavy Manufacturing	Petroleum, coal products; Chemical, rubber, plastic prods; Mineral products nec; Ferrous metals; Metals nec; Electronic equipment; Machinery and equipment nec.
8	Utilities and Construction	Electricity; Gas manufacture, distribution; Water; Construction.
9	Transport and Communication	Trade; Transport nec; Sea transport; Air transport; Communication.
10	Other Services	Financial services nec; Insurance; Business services nec; Recreation and other services; Public Administration/Defense/Health/Education; Dwellings.

Source: GTAP database, (nec = not elsewhere classified).

4.2.1 Simulated Aggregate Effects

Table 4 reports aggregated ad valorem import tariffs used in the simulation. They have been aggregated to get a broad overview of patterns of import protection in ASEAN countries. The most protected sectors are (i) processed food and (ii) grains and crops, while the least protected is mining and extraction. Singapore, being a free entrepôt for goods, does not have any import tariffs. As there is no data in the GTAP database on trade barriers on services, we do not have any tariffs for (i) utilities and construction, (ii) transportation and communications, and (iii) other services.[21]

[21] The GTAP database does, however, have data on trade in services.

Table 4: ASEAN Ad Valorem Import Tariffs (2004)

	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Viet Nam
Grains and Crops	8	5	8	49	3	12	0	25	8
Meat and Livestock	12	2	7	1	4	9	0	5	9
Mining and Extraction	7	1	1	1	1	2	0	2	3
Processed Food	16	9	20	45	8	4	0	30	30
Textile and Clothing	11	4	7	9	7	4	0	14	18
Light Manufacturing	20	5	16	10	4	5	0	10	14
Heavy Manufacturing	14	2	6	2	3	2	0	4	5
Utilities and Construction	-	-	-	-	-	-	-	-	-
Transportation and Communication	-	-	-	-	-	-	-	-	-

Note: (i) The numbers above do not include non-tariff barriers. (ii) The tariff for each country's sector is an aggregation that first takes the trade-weighted average tariff over each sub-sector for each partner and then takes the simple average over all partners. (iii) The GTAP variable used for the ad valorem import tariffs is *rTMS*.

Source: GTAP Database.

Table 5 shows the simulated aggregate effects of the ASEAN FTA. In terms of real GDP, the ASEAN FTA causes an absolute percentage change of no more than 0.2% in all ASEAN countries and almost no change in the PRC, Japan, the rest of East Asia, and the rest of the world. It is interesting to note that, as a result of the ASEAN FTA, there is a contraction of real GDP in the new ASEAN members (particularly in Viet Nam) and Thailand, but an expansion of real GDP in the other ASEAN members (particularly in Lao PDR). As for trade, all ASEAN countries experience an increase in export values and volumes with Singapore's trade expansion being the highest. All ASEAN countries have a larger increase in imports than in exports, worsening their trade balances, but it is important to note that the pre-simulation trade balances in 2004 of all ASEAN countries was in surplus except for Lao PDR, Myanmar, and Viet Nam. For non-ASEAN countries, the results show that exports from the PRC and the rest of East Asia shrink, while Japan's exports increase. This indicates that the ASEAN FTA causes some degree of trade diversion from the PRC and the rest of East Asia. The imports of non-ASEAN countries are also shown to fall. As for the terms of trade, the simulation results in an improvement for six out of the nine ASEAN countries (particularly for Cambodia), but a deterioration for non-ASEAN countries. As a whole, the ASEAN FTA causes an improvement in the ASEAN region's terms of trade.

Table 5: Simulated Aggregate Effects of the ASEAN FTA on GDP and Trade

Aggregate Effects	%Change in Real GDP	Change in Export Value (USD Million)	Change in Import Value (USD Million)	% Change in Export Volume	% Change in Import Volume	% Change in Terms of Trade
Cambodia	-0.1	327.5	377.8	5.92	11.62	1.6
Indonesia	0.03	1321.3	1481.1	1.29	1.84	0.13
Lao PDR	0.18	70.7	104	10.76	10.87	-0.3
Malaysia	0.16	1198.9	1611.4	0.65	1.36	-0.02
Myanmar	-0.01	58.4	73.3	2	2.14	-0.15
Philippines	0.09	562.1	721.9	0.82	1.41	0.21
Singapore	0.05	1865.2	2076.2	0.5	1.26	0.61
Thailand	-0.03	453.8	3601.2	-0.25	3.47	0.59
Viet Nam	-0.2	668.8	1500.6	1.83	4	0.13
PRC	0	-462.2	-551.9	-0.04	-0.12	-0.05
Japan	0	189	-563.8	0.07	-0.13	-0.06
Rest of East Asia	0	-295.3	-332.8	-0.01	-0.08	-0.04
Rest of the World	0	287.2	-3101.4	0.02	-0.04	-0.01

Notes: The GTAP variables used are: (i) *qgdp* for Real GDP, (ii) *VXWD* for export value, (iii) *VIWS* for import value, (iv) *VXWD* for the initial level of exports and *VIWS* for the initial level of imports and *DQXS* for the volume change in exports and imports, and (v) *tot* for the terms of trade.

Source: Author's results from a GTAP simulation.

4.2.2 Simulated Sectoral Effects

To illustrate the sectoral effects of the ASEAN FTA and keep the analysis tractable, we will focus on two countries: Cambodia and Viet Nam. These two countries were selected because they are two of the newer ASEAN members and the simulation results in the most negative percentage reductions in their real GDP, even though they have some of the highest pre-simulation levels of import protection. In the analysis below, we will not consider changes in the tertiary sector because of a lack of data on trade barriers and uncertainty in the quality of data.

The ASEAN FTA produces mixed effects on different sectors in Cambodia as shown in Table 6. The Grains and Crops sector has the largest relative output expansion (14.73%) driven by an increase in export volume. The export price for Cambodia's Grains and Crops increases by 0.47%, which is the largest percentage change for any sector in any country. The export volume of Cambodia's Grains and Crops rises more than four-fold, which is the largest relative increase for any country's sector. In the results, most countries' sectors have absolute percentage changes of less than 0.05% for export prices and less than 0.5% for export volume. In this simulation, the percentage change in export price turns out to be equal to the percentage change in the domestic price in each country's sector. Although the export/domestic price increases by 0.24% in Cambodia's Livestock and Meat Products sector, there is a drop in output and export volumes. This is due to an increase in imports (1.41%), which substitute for and reduce the domestic supply of Livestock and Meat Products in Cambodia's domestic market.

Table 6: Simulated Sectoral Effects of the ASEAN FTA on Cambodia

Cambodia	% Change In Domestic Output	% Change in Export Price	% Change in Export Volume	% Change in Import Price	% Change in Import Volume
Grains and Crops	14.73	0.47	421.22	-0.03	1.15
Livestock and Meat Products	-8.19	0.24	-77.17	-0.11	1.41
Mining and Extraction	-4.17	-0.03	40.99	-0.03	-0.12
Processed Food	-22.31	0.1	5.15	-0.15	0.25
Textiles and Clothing	0.78	0	1.77	-0.04	0.04
Light Manufacturing	-4.85	-0.02	9.32	-0.09	0.15
Heavy Manufacturing	-12.94	0	2.40	-0.08	0.08
Utilities and Construction	7.01	-0.01	2.92	0	0.08
Transport and Communication	-2.84	0.02	-6.25	0	0.02
Other Services	-2.45	0.04	-13.06	0	0.06

Note: The GTAP variables used to calculate percentage changes are (i) *qo* for domestic output, (ii) *pxw* for export price (equal to *pm*, or output price, in this simulation); and (iii) *VXWD* for the initial level of exports and *VIWS* for the initial level of imports and *DQXS* for the volume change in exports and imports.

Source: Author's results from a GTAP simulation.

The only secondary sector that expands is Textiles and Clothing, mainly due to the expansion of exports under ASEAN tariff preferences.[22] All other primary and secondary sectors see their output shrink, with the largest relative fall in Processed Food (–22.31%). Output in this sector is displaced by imports because the sector sees the largest relative fall in import prices (–0.15%) and the largest absolute increase in import volumes at USD82.8 million in 2004 US dollars (not shown in the table), which corresponds to a 0.25% increase across sectors. The contraction in Cambodia's real GDP is due, in order of importance, to Processed Food, Heavy Manufacturing, and Light Manufacturing. Import volumes increase in all sectors except for Mining and Extraction.

[22] Note that this simulation focuses only on the effects of the ASEAN FTA on trade in textiles and clothing. It does not consider the possible effects of the phasing out of the Multi-Fibre Agreement.

The general increase in import volumes can be attributed to tariff reductions and drops in import prices in all the primary and secondary sectors.

Table 7 below shows how Vietnamese sectoral output and trade change due to the simulated ASEAN FTA. Except for the Grains and Crops sector, all primary and secondary sectors experience a contraction in output. The Grains and Crops sector shows the largest relative increase in export price and volume. However, the general contraction in most sectors, especially in the Processed Food and Other Services sectors, explains the negative movement in Viet Nam's real GDP. This is counterbalanced to a limited degree by some growth in the Utilities and Construction sector. The Processed Food sector displays the largest relative drop (–4.02%), which can be traced to an increased import volume of about 16%. The import price of the Processed Food sector drops the most in percentage terms relative to other sectors. All primary and secondary sectors experience an increase in import volumes.

Table 7: Simulated Sectoral Effects of the ASEAN FTA on Viet Nam

Viet Nam	% Change In Domestic Output	% Change in Export Price	% Change in Export Volume	% Change in Import Price	% Change in Import Volume
Grains and Crops	0.98	0.03	6.80	0	4.99
Livestock and Meat Products	-0.66	0.01	-3.25	0	2.91
Mining and Extraction	-0.71	0	-0.63	0	2.01
Processed Food	-4.02	0	3.26	-0.12	15.99
Textiles and Clothing	-0.24	0	0.69	-0.01	1.86
Light Manufacturing	-0.33	0	1.41	-0.02	5.21
Heavy Manufacturing	-0.28	0	6.00	-0.02	3.17
Utilities and Construction	3.47	0	-1.99	0	5.93
Transport and Communication	0.4	-0.01	2.16	0	-0.82
Other Services	-1.36	0.01	-3.46	0	0.83

Notes: The GTAP variables used to calculate percentage changes are: (i) *qo* for domestic output, (ii) *pxw* for export price (equal to *pm*, i.e., output price, in this simulation); and (iii) *VXWD* for the initial level of exports, *VIWS* for the initial level of imports, and DQXS for the volume change in exports and imports.

Source: Author's results from a GTAP simulation.

4.2.3 Simulated Welfare Effects of the ASEAN FTA

The GTAP model also computes a measure of the change in each region's welfare. The change in welfare for each region is the equivalent variation, i.e., the change in money income that would produce the same effect on the region's utility as the policy shock. The GTAP model also conveniently produces a decomposition of the welfare change into five sources: (i) allocative efficiency, (ii) endowment effects, (iii) technical changes, (iv) terms of trade effects, and (v) investment–savings effects. As our simulation of the ASEAN FTA does not include any changes in endowment or technical and productivity parameters, no welfare effects can be attributed to these two sources. The simulation's welfare results are due only to changes in allocative efficiency (the efficiency of resource utilization), terms of trade (the change in the relative price of exports to imports both weighted by benchmark-year quantities), and investment returns on the capital account (the returns on the difference between domestic savings and investment).

Table 8: Simulated Welfare Effects of ASEAN FTA and Decomposition
(USD Million)

WELFARE	Allocative Efficiency	Terms of Trade Effects	Investment-Savings Effects	Total
Cambodia	-4.8	717	22	88.9
Indonesia	85	119.7	-13	191.6
Lao PDR	4.3	-2.9	-2.3	-0.9
Malaysia	186.8	30.7	-12.3	205.1
Myanmar	-0.4	-4.8	-1.2	-6.4
Philippines	72	108.5	-2.8	177.7
Singapore	57.5	1011.2	-28.8	1039.9
Thailand	-54	717.2	-73.8	589.4
Viet Nam	-84.8	37.5	-15.4	62.7
PRC	-3.2	-346.2	45.5	-303.8
Japan	-47.9	-.349.8	60.3	-337.4
Rest of East Asia	-49.5	-253.7	44.3	-259
Rest of the World	-295.6	-1146.7	-22.1	-1465.3
Total	-135.7	-7.5	0.5	-142.8

Note: The GTAP variable containing the decomposed numbers above is WELFARE.

Source: Author's results from a GTAP simulation.

The rightmost column of Table 8 shows the total welfare change for each country or region. There are three observations we can make about the ASEAN countries with a positive total welfare change. First, Singapore receives the largest net welfare gains from the ASEAN FTA followed by Thailand, Malaysia, Indonesia, and the Philippines. Singapore's welfare gains come mainly from large and positive terms of trade effects. Since Singapore began with no import tariffs, there was no change in its import prices but increases in all its export prices due to tariff reductions among its trade partners. Therefore, Singapore's terms of trade improve because it receives a higher price for its exports. Second, the net welfare gainer with the largest change in allocative efficiency is Malaysia. This reflects the fact that Malaysia had the highest levels of tariff protection before the simulation. The removal of tariffs shifted resources from protected but inefficient sectors to more efficient sectors. Third, all the net welfare gainers have a negative effect on their returns to savings and investment. As mentioned earlier, all ASEAN countries had trade surpluses in 2004 except for Lao PDR, Myanmar, and Viet Nam. As the GTAP model is a static general equilibrium model, a trade surplus implies net investment in foreign capital goods. If the domestic return to capital investment increases relative to the foreign return to capital investment, then a country with an initial trade surplus suffers a welfare loss. This is the case of the older ASEAN members, particularly Thailand.

Table 8 shows that the ASEAN FTA does not benefit the new ASEAN members except for Cambodia. It also does not benefit non-ASEAN countries. Cambodia receives a net welfare gain from the ASEAN FTA mainly because of terms of trade and investment-savings effects. The former effect occurs because Cambodia experiences increases in export prices in most sectors and lower import prices in all sectors. The latter effect occurs because Cambodia begins with a trade surplus and experiences a fall in the relative return to domestic investment. Viet Nam is the country that suffers the largest net welfare loss. The loss can be traced primarily to a drop in allocative efficiency. If the change in Viet Nam's allocative efficiency is broken down by sector, the three worst-performing sectors are Light Manufacturing, Textiles and Clothing, and Heavy Manufacturing.[23] In the detailed trade results for Viet Nam (not shown), these sectors undergo trade diversion through large shifts in imports from non-ASEAN countries to ASEAN countries. As such, in these sectors, there is a loss in tariff revenue that outweighs any positive consumption and production reallocation effects.

For the ASEAN region as a whole, there is a net welfare gain of USD2,222.6 million. So, the ASEAN FTA creates a net benefit for the region even though some countries gain and some lose. This comes at the expense of non-ASEAN countries. The PRC, Japan, and the rest of East Asia have a total net welfare loss of USD900.2 million, while the rest of the world suffers a net drop in welfare of USD1,465.3 million. Therefore, the rest of the world bears more of the negative consequences of ASEAN trade preferences than the PRC, Japan, and the rest of East Asia. Table 8 shows that non-ASEAN countries suffer mainly due to negative terms of trade effects.

Finally, we perform a sensitivity analysis by varying the parameter values for the elasticity of substitution between imported and domestic goods around the provided GTAP values by 50%. In the GTAP model, these substitution elasticities are related to the Armington elasticities—substitution parameters between goods of different national origin—in that they have a constant ratio between them. So, a 50% variation in the values of the substitution elasticities implies a 50% variation in those of the Armington elasticities. As both types of elasticities are the crux of any FTA simulation, the results should be influenced by their values.[24] As this is for illustrative purposes, we will only discuss the real GDP and welfare of Cambodia and Viet Nam in the sensitivity results. For percentage changes in real GDP, the estimated standard deviation for Cambodia is

[23] *RunGTAP* includes a tool to decompose each source of welfare changes. Allocative efficiency can be decomposed by commodity and by tax type.

[24] We use the Liu quadrature in the sensitivity analysis to vary the elasticities by 50% under a uniform distribution and obtain standard deviations for the relevant variables.

extremely small so the real GDP contraction following the ASEAN FTA of –0.1% is likely and unaffected by changes in the elasticities. The standard deviation for Viet Nam is estimated at 0.08, so our best guess is that the percentage change in Viet Nam's real GDP lies in the range of –0.04% to –0.36%.[25] In other words, varying the elasticities does not change the sign on the percentage change in Vietnamese real GDP. As for the welfare effects, assuming that the total welfare variable is normally distributed, the results from the sensitivity analysis can be used to calculate the probability of a negative total welfare effect. We find that the probability is 5% for Cambodia and 71% for Viet Nam. Therefore, varying the elasticities creates the possibility of a switch in the sign on the original welfare estimates for these two countries.

4.3 Strengths and Limitations of the GTAP model

The strengths of the GTAP model include: (i) as a general equilibrium model, it accounts for economic changes in all sectors; (ii) it is relatively accessible compared to other CGE models; (iii) it comes with a peer-reviewed and fully-documented database and software suite; and (iv) it is widely-used by trade policy researchers, who can easily try to replicate and verify the results of any GTAP study. On the other hand, the GTAP model faces the same limitations as other CGE models of trade policy: (i) it is constrained by the availability of data, and a lack of data may severely compromise the scope and relevance of a study and the researcher's ability to model certain trade policies; (ii) it involves many parameters, which may be difficult to estimate and validate; and (iii) it contains assumptions or characteristics that may not reflect real-world features. For example, in analyzing FTAs, the GTAP model's use of the Armington assumption creates a bias against findings of trade diversion and, therefore, a bias in favor of FTAs (Lloyd and Maclaren, 2004).

A policymaker can assess the quality of a GTAP analysis by focusing on the following items. First, the model's assumptions and characteristics should be consistent with reality. For example, if the countries being studied are characterized by high rates of unemployment, a market structure in which a few firms operate in each sector with economies of scale in production, then using a model with full employment of labor, perfect competition, and constant returns to scale—as is the case in the standard GTAP model—is inappropriate. The analyst should modify the model so that it represents real world features.[26] In the same vein, if dynamic effects are important, then using the standard GTAP model, which is static, may be misleading.

Second, the data used for simulations should be timely, suitable, and accurate. Researchers using the GTAP model almost always rely on the GTAP database, whose sources may not be complete, precise, or up-to-date. As such, the policymaker should refer to GTAP's documentation to check for the quality of the data used by the GTAP modeler. If the policymaker has access to more reliable or comprehensive data (e.g.

[25] This assumes that the percentage change in the real GDP variable follows a normal distribution. The range shown is the 95% confidence interval.

[26] For an example of modifying the GTAP model to account for unemployment and changes in real wages, see Kitwiwattanachai, Nelson, and Reed (2009). For an example of modeling imperfect competition and increasing returns to scale in a GTAP model of an EU–Morocco FTA, see Elbehri and Hertel (2004).

more accurate records of trade flows, tariff revenue, applied tariffs, or types of trade barriers), then the modeler should be advised to replace or supplement the data from the GTAP database.

Third, the policymaker should be aware that the GTAP model's results hinge on the parameter values used. In the latest GTAP database (version 7), values for the Armington and consumer demand elasticities come from recent econometric work by Hertel, Hummels, Ivanic, and Keeney (2004), and Reimer and Hertel (2004), respectively, but the values for the other parameters (factor substitution and factor transformation elasticities) date back to work on the SALTER model in 1991 (Jomini et al., 1991). Assessing the validity of econometric estimates for these parameters is beyond the scope of this paper, but one can at least check whether the data coverage and time period of these econometric studies are relevant to the countries and goods included in the simulation. Alternatively, if the simulation comes with a sensitivity analysis, one can see whether changes in key parameter values significantly affect the values of important variables such as output, trade, or welfare.

Lastly, a thorough CGE analysis should explain all important results from the simulation. The signs and magnitudes of the main results should be traced to the model's assumptions and structure or patterns in the exogenous variables. Any surprising numbers should also be explained. In the analysis of FTAs, the results should, at a minimum, discern any important developments in the production of regional members, preferably by sector, and the evolution of trade and welfare in both regional members and outsiders. A good CGE analysis of an FTA should present and carefully interpret these results in order to help policymakers make well-founded policy recommendations. Table 9 on the next page summarizes the main characteristics of the GTAP model, its required inputs, and its outputs. The table also includes implementation notes for developing countries.

Table 9: The GTAP model, FTA analysis, and Developing Countries

	Values/Variables	**Notes on Implementation from a Developing Country Perspective**
Assumptions in the GTAP Model	The standard GTAP model is based on full employment, perfect competition, constant returns to scale, differentiation by national origin (the Armington assumption), and no dynamic effects. These characteristics are modeled with specific functional forms and equations.	These characteristics may not prevail in developing countries. For examples of how to change the model to display more appropriate characteristics, see Elbehri and Hertel (2004) and Kitwiwattanachai, Nelson, and Reed (2009).
	The modeler has to decide on which closure to use (i.e., which set of variables to leave as exogenous). The standard GTAP closure leaves factor endowments, technology, and tax and subsidy rates as exogenous variables.	For most FTA scenarios, the GTAP standard closure is appropriate. Exceptions are scenarios with technological changes, endogenous taxes and subsidies, or dynamic effects associated with investment and capital accumulation.

	Values/Variables	Notes on Implementation from a Developing Country Perspective
Data included in the GTAP database	Version 7 includes trade, trade protection, and input–output data for 113 countries and 57 sectors from the reference year 2004.	If a developing country has more timely or reliable data, then it can supplement or replace the GTAP trade and trade barrier data used for the analysis.
Important parameters	Goods substitution elasticities, factor substitution elasticities, factor transformation elasticities, investment parameters, and consumer demand elasticities	Chapter 14 of the GTAP 7 database documentation explains how these parameter values were estimated. Modelers may replace them with other more suitable values.
Output of the GTAP model	Aggregate level: real GDP, trade, terms of trade, and welfare (with sources of welfare changes). Sectoral level: output, trade, and prices	These results should be subjected to a sensitivity analysis. The RunGTAP program provides this facility.

5. Concluding Remarks

Countries, particularly developing ones, are increasingly turning to regional trade agreements in their efforts to benefit from world markets and overcome the failure of multilateral trade negotiations. In this context, it is crucial that policymakers have the right tools to evaluate these regional trade agreements and know how to make use of these tools. This paper has presented various methods—trade indicators, SMART, and GTAP—to evaluate the economic effects of FTAs. Each method is explained as concisely as possible and accompanied by examples mainly from ASEAN and, in particular, the newer ASEAN members: Cambodia, Lao PDR, and Viet Nam. It is hoped that the explanations will prove sufficiently useful for gaining a quick understanding of the logical foundations of each method, and, given the wide variety of FTA-related questions that policymakers have, the examples will illustrate which methods are relevant to which questions. Further, given that policymakers work under time, organizational, and financial constraints, the descriptions of each method's requirements should be helpful to policymakers when judging the feasibility of using any one method and the expected quality of results. Lastly, it is worth mentioning that the same methods would be applicable with some modification in the case of customs unions or other types of regional trade agreements.

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Methods for Ex Ante Economic Evaluation of Free Trade Agreements

In this paper, David Cheong discusses three methods—trade indicators, Software for Market Analysis and Restrictions on Trade (SMART) in World Integrated Trade Solutions (WITS), and the Global Trade Analysis Project (GTAP) model—for evaluating the potential economic effects of free trade agreements (FTA). For each method, the author identifies aspects of a FTA that can be evaluated, describes the data sources and software requirements, interprets the output results, and discusses the strengths and limitations. As illustrations, the methods are applied to Cambodia, Lao PDR, and Viet Nam.

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Printed in the Philippines