ADB Working Paper Series on Regional Economic Integration

Methods for Ex Post Economic Evaluation of Free Trade Agreements

David Cheong

No. 59 | October 2010

ADB

Asian Development Bank

ADB Working Paper Series on Regional Economic Integration

Methods for Ex Post Economic Evaluation of Free Trade Agreements

David Cheong[+]

No. 59 │ October 2010

Asian Development Bank

The ADB Working Paper Series on Regional Economic Integration focuses on topics relating to regional cooperation and integration in the areas of infrastructure and software, trade and investment, money and finance, and regional public goods. The Series is a quick-disseminating, informal publication that seeks to provide information, generate discussion, and elicit comments. Working papers published under this Series may subsequently be published elsewhere.

Contents

Abstract

Evaluating the economic impact of an FTA is an important part of the monitoring and surveying process that should follow the establishment of an FTA. This paper presents methods for evaluating the trade and welfare effects of an FTA. These methods show how to (i) compute indicators for the utilization and value of preferences, (ii) qualitatively assess trade creation and diversion, (iii) quantitatively analyze the FTA's trade effects with trade indicators and the gravity model, and (iv) make inferences about economic welfare. This paper specifies the formulas, computational techniques, and data used for each evaluation method, and describes how to interpret the output from each method with examples taken from countries such as Viet Nam, Indonesia, and Cambodia. The strengths and limitations of each method are also discussed.

1. Introduction

After a free trade agreement (FTA) is established, it is important for policymakers to take stock of its effects. The actual impact of an FTA may be quite different from any prior projection. The purpose of this paper is to present ex post FTA evaluation methods to policymakers as it may not be clear what to assess or how to conduct a retrospective economic assessment. The focus of this paper is on the economic effects of preferences on trade because they are the core of any FTA. There are other aspects of regional integration, such as the financial, political, social, and technological dimensions, but these are beyond the scope of this paper.[1] The methods presented in this paper are mainly quantitative techniques to assess the trade and welfare outcomes of an FTA. These methods assume that there is enough data for statistical analysis from observing the FTA's effects. In general, the methods in this paper try to answer the following three questions:

(i)   Has the FTA affected a member country's trade?
(ii)   Have the FTA's trade effects raised a member country's welfare?
(iii)   Through which channels has FTA-induced trade affected welfare?

The methods are presented in three sections. The first section discusses various ways to measure the extent to which eligible exporters can and do take advantage of preferences under an FTA by showing how to calculate the coverage, utility, and utilization rates. It also shows how to estimate the value of preferences to exporters and the cost of preferences to the countries that offer them. The second section explains how to use trade and production statistics to assess the trade effects and welfare consequences of an FTA. It describes both qualitative and quantitative approaches to evaluating an FTA. The third section contains a description of the gravity model, which is often applied to trade analysis. It discusses how to estimate the gravity model, provides sources for the required data, and explains how to interpret the estimation results. All the methods in this paper are accompanied by examples with real data from countries like Viet Nam, Indonesia, and Cambodia that illustrate how to perform the necessary computations and derive conclusions.

2. FTA Preference Indicators

The discriminatory nature of an FTA consists of granting preferential tariffs to fellow members of the agreement. The preferential tariff is lower than the most favored nation (MFN) tariff—the tariff imposed on imports from non-members. The difference between the MFN tariff and the preferential tariff is known as the preference margin. For example, for the HS 8-digit product Metal Office Furniture (94031000), Viet Nam's MFN tariff has been 32% since 2008, while the Common Effective Preferential Tariff (CEPT) offered to countries in the Association of Southeast Asian Nations (ASEAN) under the ASEAN Free Trade Agreement (AFTA) is 5%. Therefore, the preference margin granted by Viet Nam on imports of this product from ASEAN partners is 27% (i.e., 32% - 5% = 27%).

---

[1]   Readers who are interested in the evaluation of non-economic aspects of regional integration may refer to Park and Estrada (2010).

2.1   Coverage Rate

The first step towards understanding the effects of FTA preferences is to calculate the coverage rate—the proportion of dutiable imports from FTA members that are eligible for preferential treatment. Dutiable imports are those imports on which the MFN tariffs are more than zero. Imports that have a zero MFN duty are disregarded because preferences would be irrelevant for them. To compute the coverage rate, one has to identify (i) all the tariff lines for which imports are dutiable, and (ii) all the dutiable tariff lines that are eligible for preferences. Let D be the set of all tariff lines with dutiable imports from FTA members and P be the set of all dutiable tariff lines that are eligible for preferences under the FTA. Note that P is a subset of D.[2] The formula for the coverage rate is:

$$CoverageRate = \frac{\sum_{i \in P} M_i}{\sum_{i \in D} M_i}$$

where:
 i is a tariff line
M_i is the value of imports in the tariff line i from FTA members
D is the set of all tariff lines with dutiable imports from FTA members
P is the set of all dutiable tariff lines that are eligible for preferences under the FTA

In the formula, the numerator is the sum of imports over all tariff lines that are both dutiable and eligible for preferences, while the denominator is the sum of imports over all dutiable tariff lines.[3] To calculate this fraction, one needs to know the import values from FTA partners for all dutiable tariff lines, and which dutiable tariff lines were eligible for preferences.

The coverage rate shows the official scope of the FTA. The higher the ratio of dutiable imports eligible for preferences to total dutiable imports, the wider the scope of the FTA. The coverage rate does not show the actual utilization of preferences because some imports that were eligible for preferential treatment may have entered under the MFN regime for various reasons to be discussed below. Therefore, the coverage rate is an upper bound to the share of dutiable imports that actually entered with preferences. Note

---

[2]   Often, an FTA will state that a certain tariff line is eligible for preferences even though the tariff line has an MFN tariff of zero. This occurs when preferences are offered on broader categories of imports that include both dutiable and non-dutiable tariff lines. In any case, non-dutiable tariff lines should be excluded because preferential tariffs cannot be lower than zero.

[3]   If it is known beforehand that most dutiable tariff lines have preference margins (i.e., only a few do not have preference margins), then an easier way to calculate the coverage rate would be $CoverageRate = 1 - \frac{\sum_{i \in P^C} M_i}{\sum_{i \in D} M_i}$. That is, one minus the fraction of the sum of imports over all dutiable tariff lines that were not eligible for preferences over the sum of imports over all dutiable tariff lines.

that the coverage rate can be computed for any combination of importers, exporters, products, and periods in the FTA.

For example, consider the trade preferences granted by Viet Nam in 2008 to its ASEAN partners under AFTA. At the 8-digit level, out of 8,300 tariff lines, 8,099 were on the CEPT Included List. The other 201 products were listed under General Exceptions or were covered by another ASEAN scheme. Out of these 8,099 included products, 5,589 were dutiable and therefore had MFN tariffs above zero. Of those, 5,137 dutiable tariff lines (92%) were eligible for preferences. The coverage rate was 86.5%.[4] It is worth reiterating that the coverage rate is an upper bound on the share of dutiable imports that actually utilized preferences, which may be far below the coverage rate if firms choose to ignore the FTA's preferential regime.

Why would firms ignore preferences granted by an FTA? To benefit from these preferences, an exporting firm would have to deal with the administrative issues and technical requirements associated with an FTA's rules of origin. Rules of origin are the criteria for evaluating whether a good can be considered to have originated from a country.[5] In an FTA or any preferential market access scheme, rules of origin are the basis for determining the eligibility of a good for preferences. Without rules of origin, an FTA would be prone to trade deflection, whereby goods enter into the free trade area via the member country with the lowest external tariff and are re-exported to another member country. Complying with rules of origin imposes various costs on firms. These costs stem from additional administrative fees and paperwork, accounting operations for extra information required by the certificate-granting authorities, and constraints on the sourcing of intermediate inputs in order to meet local content requirements.[6] These costs may be so large that they remove any incentive to utilize an FTA's preferential tariffs. For example, in the case of the North American Free Trade Agreement (NAFTA), Anson et al. (2005) found that rules of origin for Mexican exports to the United States (US) imposed an average compliance cost of around 6% in *ad valorem* equivalent, undoing the tariff preference (4% on average) on a large number of tariff lines. Studying the European Union's (EU) preferential market access schemes, Nilsson and Matsson (2009) showed that the coverage rate was 37.3% of the EU's dutiable imports from the world, but the share of dutiable imports that actually entered with preferences was 29.5%. Therefore, 7.8% of the EU's dutiable imports that were eligible for preferences did not utilize them.

---

[4] This estimate is upwardly biased because trade data for Viet Nam is publicly available only at the 6-digit level, and so tariff data had to be aggregated from the 8-digit to the 6-digit level. It was assumed, in the aggregation process, that all FTA imports in a 6-digit tariff line would be considered eligible for preferences if at least one disaggregated tariff line at the 8-digit level was eligible for preferences. This assumption implies a much larger total of preferential trade and therefore an overestimate of the coverage rate.

[5] Rules of origin are usually specified as a local content requirement (e.g., minimum percentage of local value added) or a substantial transformation requirement (e.g., change in tariff classification at the level of the tariff line or at the tariff heading).

[6] The theoretical costs of rules of origin have been studied by Krueger (1992), Krishna and Krueger (1995), Falvey and Reed (1998), Falvey and Reed (2002), Krishna (2005), and Duttagupta and Panagariya (2007).

2.2   Utility Rate

The utility rate measures the effective scope of the FTA as the share of dutiable imports that actually entered with preferences. The formula for the utility rate, as defined by Inama (2003), is:

$$Utility\ Rate = \frac{\sum\limits_{i \in P} M_i^U}{\sum\limits_{i \in D} M_i}$$

where:
i is a tariff line
M_i is the value of imports in the tariff line i from FTA members
M_i^U is the value of imports from FTA members that actually utilized the FTA's preferential rate in the tariff line i
D is the set of all tariff lines with dutiable imports from FTA members
P is the set of all dutiable tariff lines that are eligible for preferences under the FTA

In the formula, the numerator is the sum of all dutiable imports that actually utilized the FTA's preferences, while the denominator is the sum of imports over all dutiable tariff lines. The higher the utility rate, the larger the share of dutiable imports that actually entered under the preferential—rather than the MFN—tariff, indicating a wider effective scope of the FTA. Different from the coverage rate, the utility rate requires knowing the value of imports that actually entered with preferences within each dutiable tariff line that was eligible for preferential treatment.

2.3   Utilization Rate

Besides the scope of the FTA relative to dutiable imports, one may be interested in the attractiveness of a preferential regime relative to MFN treatment. For this, we can compute the utilization rate, which shows the degree to which preference-eligible dutiable imports enter under preferential—rather than MFN—tariffs. The formula for the utilization rate is:

$$Utilization\ Rate = \frac{\sum\limits_{i \in P} M_i^U}{\sum\limits_{i \in P} M_i}$$

where:
i is a tariff line
M_i is the value of imports in the tariff line i from FTA members
M_i^U is the value of imports from FTA members that actually utilized the FTA's preferential rate in the tariff line i
P is the set of all dutiable tariff lines that are eligible for preferences under the FTA

In the formula, the numerator is the sum of all dutiable imports that actually utilized the FTA's preferences, while the denominator is the sum of all dutiable imports that were

eligible for the FTA's preferences. The utilization rate differs from the utility rate in that the denominator of the former considers only dutiable imports that are eligible for preferences while that of the latter considers all dutiable imports. The higher the utilization rate, the more preference-eligible imports actually enter under preferential rather than MFN tariffs. A higher utilization rate also implies that the compliance costs of rules of origin are less of a constraint. To provide a visual summary, **Figure 1** below shows the structure of imports and the different components used in the calculation of the coverage, utility, and utilization rates.

As an example, we consider the EU's Generalized System of Preferences (GSP) scheme, under which certain ASEAN countries benefit from preferential treatment. Preferential imports into the EU from ASEAN comprise mainly mechanical appliances, plastics and rubber, textiles, footwear, and prepared foodstuffs. Nilsson and Matsson (2009) compute a utilization rate of 65.3% for EU preferential imports from ASEAN in 2007, implying that 34.7% of EU preferential imports from ASEAN that could have entered under the GSP actually did not. The authors also calculate the utilization rate on EU preferential imports from the whole world, which is 79%. This is higher than the utilization rate on EU preferential imports from ASEAN. The authors explain ASEAN's lower utilization rate by showing that ASEAN countries face small *ad valorem* preference margins ranging from 0.8% (textiles) to 3.3% (prepared foodstuffs). Therefore, it can be inferred that the compliance costs of the EU's rules of origin for ASEAN countries to benefit from the GSP are at least 0.8% –3.3% of import value for each of the corresponding sectors.

Figure 1: Structure of Imports and Formulas for FTA Preference Indicators

Coverage Rate = B/A*100
Utility Rate = C/A*100
Utilization Rate = C/B*100
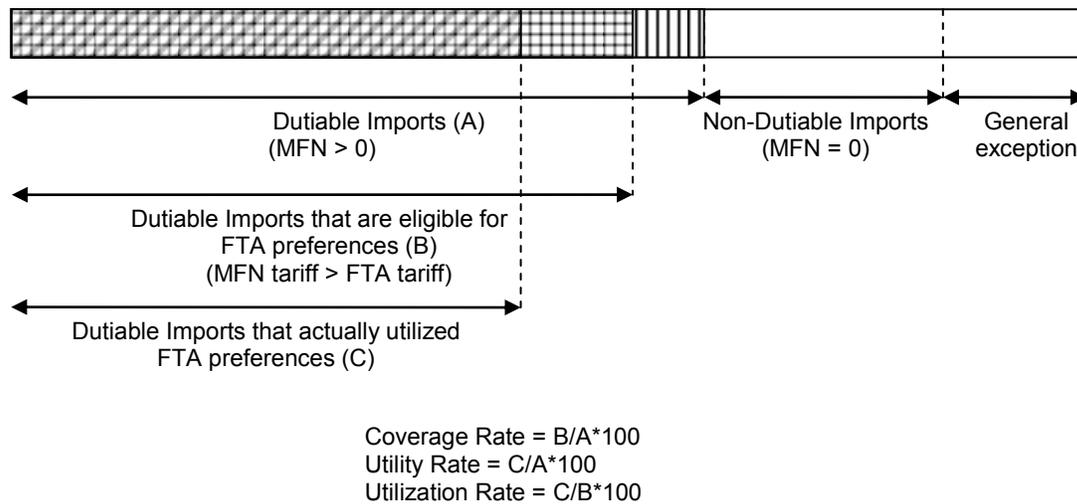
2.4   Value of FTA Preferences

To exporters, the value of trade preferences comes from the rents generated by being subject to lower tariffs than the MFN tariff. For the importing country, these rents are an implicit transfer of tariff revenue from the government to foreign exporters—and, possibly, domestic importers—due to the preference scheme. The size of these rents are proportional to the preference margin, but are inversely related to the costs of complying with rules of origin and the market power of domestic importers in the industry. If the domestic importers of the product are able to affect the price by changing their buying patterns, then they may be able to appropriate some of the rents. This reduces the value of trade preferences to foreign exporters or, equivalently, the transfer from the importing country. For example, Özden and Olarreaga (2003) found that under the African Growth and Opportunity Act (AGOA), a preferential scheme for African exports of clothing to the US, only 1/3 of the available rents actually accrued to African exporters.

As a first step towards measuring the value of trade preferences, we can multiply the preference margin in a certain dutiable tariff line with the tariff line's value of imports from trade partners that are eligible for and actually use preferences. This yields a maximum value of preferences to foreign exporters because compliance costs and the effects of market power among domestic importers could reduce the actual value. Continuing with the example from the previous section, the maximum value of EU preferences to ASEAN exporters in 2007 for textiles was €14 million (= 0.8% * €1780.5 million). For prepared foodstuffs it was €30 million (= 3.3% * €905.9 million). For an aggregate measure of the maximum value of trade preferences, we can simply sum up the computed values over all dutiable tariff lines that were eligible for preferences. The aggregate maximum value of EU preferences to ASEAN exporters in 2007 was €546.8 million.[7] This number is the cost to the EU government of lost tariff revenue from offering preferences under the GSP to ASEAN exporters, but it is only an upper bound on and a rough approximation of the value of GSP preferences to ASEAN exporters. To obtain a more accurate figure of the value of trade preferences to foreign exporters, one has to estimate compliance costs and the effects of importer market power. Methods to do so are technically difficult, and the reader may refer to work by Herin (1986) and Anson et al. (2005) for the former, and Özden and Olarreaga (2009) for the latter.

2.5   Data Sources: Customs Data and Firm Surveys

The main sources of data to calculate the FTA preference indicators described in sections 2.1 to 2.4 are customs declarations and certificates of origin. For any good in a shipment, these documents should provide information on the value of the good, weight, HS code, and the origin criterion used, when preferences are requested. The AFTA certificate of origin is known as Form D (an example of which is shown in this paper's Appendix), while, for the EU, information on the origin of goods is provided in the Single Administrative Document. If the relevant information for a specific FTA can be extracted

---

[7]   The raw numbers for the calculation of the aggregate value of EU preferences to ASEAN countries can be found in Tables 1 and 2 of Nilsson and Matsson (2009).

from these forms and compiled, then the indicators presented in the previous sections should be calculated to measure the utilization and value of preferences.[8]

Alternatively, the necessary information for a specific FTA may be collected via firm surveys to estimate the indicators. The survey should be directed to a random sample of export firms from FTA member countries that sell to other member countries, and it should include the following specific questions:

(a) How much do you export to FTA member countries?
(b) What percentage of your exports to FTA member countries is dutiable?
(c) Out of your dutiable exports to FTA member countries, what percentage is eligible for preferences?
(d) Out of your dutiable exports to FTA member countries, what percentage actually enters under preferential tariffs?
(e) For this FTA, what is the export-weighted average preferential tariff that you pay?
(f) Without this FTA, what would be the export-weighted average MFN tariff that you would pay?
(g) As a percentage of the value of your exports to FTA member countries that actually enter under a preferential tariff, what is the administrative and compliance cost?

If an export firm provides proper responses to the questions above, then we can compute the following statistics for the export firm:

Utility rate = (d)
Utilization rate = (d)/(c)
Export-weighted average preference margin = (f) - (e)
Value of exports that actually enter under preferential tariffs = (a)*(b)*(d)
Maximum value of preferences for the export firm = (a)*(b)*(d)*[(f) - (e)]
Maximum value of preferences net of administrative and compliance costs
= (a)*(b)*(d)*[(f) - (e) - (g)]

For either the utility or utilization rates, an export-weighted average of the export firms' rates can be used as an estimate of the aggregate rate. For an estimate of a country's aggregate maximum value of preferences, we sum up the maximum value of preferences over all export firms in the sample and multiply this sum by the ratio of total intra-FTA exports over the sum of intra-FTA exports by firms in the sample.

A firm-level survey may also be useful in collecting other information about export firms within an FTA.[9] More importantly, firm-level surveys can be used to investigate why the utilization rate of preferences in an FTA is high or low. The firms can be asked to rank

---

[8]   Statistics such as the number of certificates of origin issued or the number of companies that conduct international trade under an FTA may also be indicators of FTA preference utilization, but they are less accurate.

[9]   For example, the Japanese External Trade Organization (JETRO) conducts an annual survey directed at Japanese manufacturing firms' affiliates operating abroad that includes FTA-related questions on the percentage of exports sales out of total sales; the breakdown of export destinations; and whether or not the firm took advantage of FTAs and, if so, which ones.

the importance of certain factors in encouraging or discouraging preference utilization, such as availability of FTA-related information, size of preference margins, procedural efficiency associated with rules of origin, sourcing constraints under rules of origin, overlapping FTAs, reduction of tariffs under investment schemes, and nontariff measures.

2.6   Strengths and Limitations of FTA Preference Indicators

The indicators described in the previous sections are useful summary measures of the extent and effectiveness of preferences in an FTA. They are easily calculated provided that the relevant data is made available. However, these indicators do not identify the reasons for a given level of preference utilization. Firm-level surveys can be used to fill this gap. Furthermore, these indicators focus on measuring the scope, utilization, and value of preferences rather than the size of an FTA's effects on trade or economic welfare.

3.   FTA Trade and Welfare Indicators

This section explains how to use trade statistics to retrospectively analyze the trade effects of an FTA and make inferences about economic welfare. The trade impact of an FTA is of primary interest because the FTA is a commercial arrangement—therefore, intended to affect trade—and the effects on trade are an important indicator of the welfare effects of the FTA. The first part of this section employs a qualitative Vinerian approach to analyzing the trade effects of an FTA in a particular sector. The second part presents two quantitative approaches that focus on trade indicators identified by Lloyd and Maclaren (2004). The methods in this section are easy to implement but yield results that are only indicative of the trade effects of an FTA. As such, they are useful in gaining a first impression before more elaborate methods are deployed. A more formal method is described in section 4.

3.1   Qualitative Analysis of Trade Creation and Trade Diversion

Viner's (1950) analysis of FTAs provides a conceptual framework for studying the trade effects of an FTA. According to Viner's model, a regional trading agreement is beneficial (harmful) if the magnitude of **trade creation**—when preferential tariffs replace inefficient home production by efficient imports from an FTA partner—is larger (smaller) than **trade diversion**—when preferential tariffs replace efficient imports from the rest of the world by inefficient imports from an FTA partner. Therefore, it is important to focus on changes in domestic production and intra- and extra-regional trade.

For a qualitative evaluation of an FTA's trade effects, one can make a comparison of trade and production levels before and after an FTA's implementation using the following criteria:

(i)   an increase in imports from FTA partners accompanied by a drop in domestic production indicates trade creation;

(ii) an increase in imports from FTA partners accompanied by a drop in imports from non-FTA partners indicates trade diversion

(iii) a rise in total imports where imports from non-FTA partners are constant or increasing implies that there is no trade diversion, thus indicating a positive welfare effect;

(iv) a rise in total imports where imports from non-FTA partners and domestic production decrease and

  (a) the fall in imports from non-FTA partners is larger than the fall in domestic production, implying that trade diversion exceeds trade creation, thus indicating a negative welfare effect; or

  (b) the fall in imports from non-FTA partners is smaller than the fall in domestic production, implying that trade creation exceeds trade diversion, thus indicating a positive welfare effect; and

(v) a drop in total imports indicates a negative welfare effect.[10]

Figure 2: Indonesian Food Manufacturing (ISIC 311, rev. 2)—Value-Added and Imports from ASEAN and Non-ASEAN Countries, 1987–1996 (USD million)
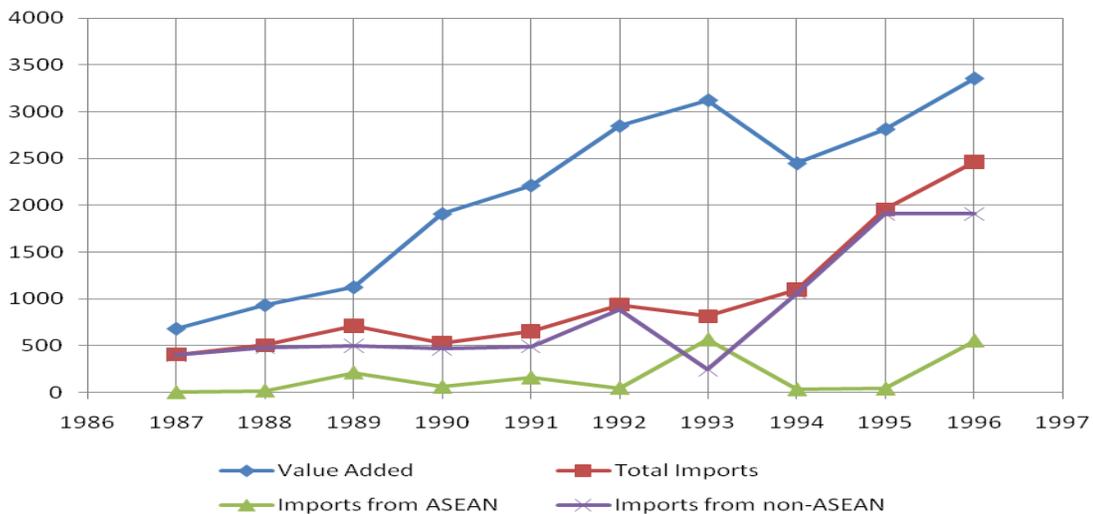
Source: World Bank's Trade, Production, and Protection Database (Nicita and Olarreaga 2006).

To illustrate, consider Indonesia's food manufacturing sector (ISIC 311, Rev.2). **Figure 2** shows the sector's trends from 1987 to 1996 in domestic value-added, total imports, imports from ASEAN, and imports from non-ASEAN countries. Since the original six

---

[10] A drop in total imports may be the result of a (i) fall in imports from both FTA and non-FTA partners, (ii) larger fall in imports from non-FTA partners relative to an increase in imports from FTA partners, and (iii) larger fall in imports from FTA partners relative to an increase in imports from non-FTA partners. In cases (i) and (ii), there is no trade creation and, therefore, the welfare effect is negative. Case (iii) is unlikely because the FTA is supposed to discriminate in favor of FTA partners and against non-FTA partners.

ASEAN countries signed AFTA in January 1992, the reference year chosen was 1991. After 1991, ASEAN imports were relatively stable, except for upward spikes in 1993 and 1996. Non-ASEAN imports after 1991 followed an increasing trend except for a sharp fall in 1993. Therefore, 1993 and 1996 stand out as years when the preferential arrangements in AFTA may have affected Indonesian imports in this sector. In 1993—a year of possible trade diversion—the increase in ASEAN imports was accompanied by a large fall in non-ASEAN imports. The increase in intra-regional imports in 1993 was smaller than the drop in extra-regional imports as shown by the dip in total imports. As such, it is likely that this sector experienced a negative welfare effect in 1993. Further, it is unlikely that intra-regional imports were replacing domestic production (i.e., trade creation) because domestic production reached a peak in 1993. In contrast, 1996 was a year when ASEAN imports increased and non-ASEAN imports had reached a level that was four times that of 1991. The rise in non-ASEAN imports in 1996 suggests that there was no trade diversion and, therefore, Indonesia's food manufacturing sector was experiencing a positive welfare effect.

Although this type of pre-post analysis is relatively easy, there are several limitations to this method. First, the analysis is descriptive and does not quantify the FTA's trade or welfare effects. Having these effects quantified is a pre-requisite for combining results with those from other sectors and conducting a cost-benefit analysis of an FTA. Second, the analysis assumes that any changes in trade and production are caused by the FTA when these could be affected by other factors such as changes in import demand, supply of the import substitute, or technological advances. Not accounting for these non-FTA factors provides a misleading impression of how the FTA affects trade and welfare. In other words, assuming that trade and production would remain at their pre-FTA levels in the absence of the FTA—and, therefore, that all changes in trade and production are caused by the FTA—is unrealistic.

3.2 Quantitative Indicators of Trade and Welfare Effects

One problem with the previous method is that neither the FTA's trade nor welfare effects are quantified, leaving the magnitudes of these effects unknown. To compute these effects, we refer to the general equilibrium model of a regional trading arrangement devised by Lloyd and Maclaren (2004). They show that the economic welfare of a member country depends on changes in three key indicators: (i) trade volume, (ii) intra-union terms of trade, and (iii) extra-union terms of trade. These are all positively related to the member country's welfare, meaning that if, for example, a member country's trade volumes increase or its terms of trade improve as a result of the FTA, then its economic welfare will have risen.

3.2.1 Trade Volumes and Terms of Trade: Observed Values

This section shows how to use observed trade values to compute changes in trade volume, terms of trade, and welfare according to the model developed by Lloyd and Maclaren (2004). The example used here is trade in Indonesia's food manufacturing sector (ISIC 311, Rev.2) in the years 1991 and 1995 with four trading partners—Thailand, Singapore, Australia, and Canada—that comprise two ASEAN and two non-ASEAN countries. Although Indonesia traded manufactured food with other countries,

we will assume for illustrative purposes that the four countries above were Indonesia's only trade partners in manufactured food.

Table 1: Indonesian Trade Values, Quantities, and Unit Values in ISIC 311, Rev. 2 with Selected ASEAN and Non-ASEAN Countries, 1991 and 1995

Reporter	Partner	Year	Import Quantity (thousand US$)	Import Quantity (thousand Kilos)	Import Unit Value (US$ per kilo)	Export Value (thousand US$)	Export Quantity (thousand kilos)	Export Unit Value (US$ per kilo)
Indonesia	Thailand	1991	103,377	292,900	0.35	3,361	10,094	0.33
Indonesia	Thailand	1995	388,923	1,118,000	0.35	10,411	13,149	0.79
Indonesia	Singapore	1991	41,991	132,600	0.32	45,701	108,100	0.42
Indonesia	Singapore	1995	48,269	66,139	0.73	38,576	36,742	1.05
Indonesia	Australia	1991	44,781	52,198	0.86	20,587	47,371	0.43
Indonesia	Australia	1995	107,103	138,200	0.77	23,602	29,646	0.80
Indonesia	Canada	1991	9,853	53,552	0.18	13,167	32,063	0.41
Indonesia	Canada	1995	18,459	54,609	0.34	23,491	33,254	0.71

Note: The unit value is the trade value divided by the trade quantity.
Source: Author's computations with data sourced from the World Bank's Trade, Production, and Protection Database (Nicita and Olarreaga 2006).

Table 1 shows trade data for computing changes in Indonesia's manufactured food trade volumes and terms of trade between 1991 and 1995, which is 3 years after the ASEAN Free Trade Agreement was signed by the original six members in 1992. According to Lloyd and Maclaren's model, the sum of bilateral changes in trade volumes should be weighted by any border taxes or subsidies in a base period.[11] We use 1991 as the base period and 1995 as the new period in our example. We assume that there are no border measures on exports, so the trade volume computation only involves imports. We obtain data on applied import tariffs from the United Nations Conference on Trade and Development's (UNCTAD) TRAINS database via World Integrated Trade Solution (WITS) software. Indonesia's import-weighted applied tariffs in 1990 classified under ISIC 311, Rev. 2 in 1990 were 12.55% (Singapore), 14.95% (Thailand), 17.85% (Australia), and 2.96% (Canada).[12] We weight the import volume changes with the

---

[11] A tax or subsidy on a traded good in their model simply shows up as the difference between the international and domestic prices of a good. For example, an import tariff on a good causes the domestic price to be higher than the international price by the amount of the tariff. As another example, an export subsidy on a good also causes the domestic price to be higher than the international price by the amount of the subsidy.

[12] There are many HS six-digit categories that fall under ISIC 311, Rev.2. WITS provides import and tariff data by HS six-digit categories. Let *HS* be the set of HS six-digit categories that correspond to ISIC 311, Rev. 2 imports from a partner country and *m* be a particular HS six-digit category within that set.

product of these *ad valorem* import-weighted tariffs and the corresponding unit values in the base period. The change in trade volume is therefore calculated as such:

$$Change\ in\ Trade\ Volume = \sum_{p} t_{mp} u_{mp}^0 \left(m_p^1 - m_p^0 \right)$$

where:
the p subscript indicates a partner country
t_{mp} is the import-weighted *ad valorem* tariff on imports from partner country p in the base period
u_{mp}^0 is the unit value of imports from partner country p in the base period
m_p^1 is the quantity of imports from partner country p in the new period
m_p^0 is the quantity of imports from partner country p in the base period

In the example of Indonesian manufactured food imports between 1991 and 1995, the change in trade volume was US$53,423,000. This is positive, indicating that economic welfare in this sector rose in part because of expanded trade volumes.

To complete the analysis, we compute changes in Indonesia's terms of trade with respect to ASEAN and non-ASEAN partners in the sector for manufactured food. According to Lloyd and Maclaren's model, the change in terms of trade should be weighted by base period trade quantities. The change in terms of trade is therefore calculated as such:

$$Change\ in\ Terms\ of\ Trade = \sum_{p} x_p^0 \left(u_{xp}^1 - u_{xp}^0 \right) - \sum_{p} m_p^0 \left(u_{mp}^1 - u_{mp}^0 \right)$$

where:
the p subscript indicates a partner country
x_p^0 is the quantity of exports to partner country p in the base period
u_{xp}^1 is the unit value of exports to partner country p in the new period
u_{xp}^0 is the unit value of exports to partner country p in the base period
m_p^0 is the quantity of imports from partner country p in the base period
u_{mp}^1 is the unit value of imports from partner country p in the new period
u_{mp}^0 is the unit value of imports from partner country p in the base period

---

The import-weighted applied tariff for a trade partner is $t_{mp} = \sum_{m \in HS} \left(\dfrac{M_m t_m}{\sum_{m \in HS} M_m} \right)$, where M_m is the value of base period imports from the partner country in category m and t_m is the base period *ad valorem* applied tariff on imports from the partner country in category m. As information on Indonesia's import measures for 1991 was unavailable, we assume that the import-weighted tariffs in 1991 were the same as in 1990.

The formula is applied to two groups: intra-bloc and extra-bloc partners. In the example, the change in Indonesia's terms of trade for manufactured food with respect to ASEAN countries is US$18,380,000, and for non-ASEAN countries it is US$23,275,650. We conclude that three years after AFTA, Indonesia's food manufacturing sector experienced a gain in economic welfare through increased trade volumes and improved terms of trade with respect to both ASEAN and non-ASEAN partners. The overall gain in welfare was approximately US$95.1 million (i.e., 53.4 + 18.4 + 23.3).

The analysis above was able to quantify the trade and welfare effects of an FTA in a particular sector. The same analysis could be repeated over multiple sectors and the results aggregated to obtain more wide-ranging results. However, like the method in section 3.1, the approach above did not address the problem of whether or not these effects were actually caused by the FTA. Both methods implicitly assumed that the changes in trade and production after the FTA were driven solely by the FTA. If other factors besides the FTA were significant in affecting trade and production patterns, then these two methods would be inappropriate.

3.2.2 Trade Volumes and Terms of Trade: Extrapolated Values with Pre-FTA Growth Rates

In order to isolate the effects of the FTA from the effects of other factors such as changes in income, prices, transportation and communication costs, it is necessary to construct a counterfactual, which is a hypothetical estimate of what trade would have been without the FTA. The FTA's trade effects can then be quantitatively assessed by comparing actual values with the counterfactual. This section constructs a simple but imperfect counterfactual that allows trade in the post-FTA period to evolve according to pre-FTA trends. The underlying assumption is that the impact of other factors besides the FTA on the trend in trade flows would be the same with or without the FTA. More specifically, we compute the geometric mean of annual growth in the pre-FTA period and use this growth rate to obtain numeric estimates of the counterfactual after integration.

Table 2: Indonesian Geometric Mean Annual Growth Rates of Trade Quantities and Unit Values in ISIC 311, Rev. 2 with Selected ASEAN and Non-ASEAN Countries, 1987–1991 (%)

	Import Quantities	Unit Value of Imports	Export Quantities	Unit Value of Exports
Singapore	32.36	–5.50	2.88	17.66
Thailand	65.83	–4.70	118.40	–25.07
Australia	22.19	2.03	144.11	–10.12
Canada	–8.10	–12.80	101.51	–8.34

Note: The geometric mean of, for example, annual import quantity growth over T years is $\left(\prod_{t=1}^{T}(1+g_t)\right)^{\frac{1}{T}}-1$, where g_t is the annual growth rate of imports in year t. We use the geometric and not the arithmetic mean because the latter would overestimate the variables in the post-FTA period.
Source: Author's computations with data sourced from the World Bank's Trade, Production, and Protection Database (Nicita and Olarreaga 2006).

We continue using the case of Indonesian trade in food manufacturing (ISIC 311, rev. 2) with Singapore, Thailand, Australia, and Canada from 1987–1995. As noted previously, AFTA was signed in 1992 and, therefore, import growth rates for Indonesia prior to 1992 are needed in order to estimate a counterfactual for the years 1992 onwards. The pre-AFTA (1987–1991) geometric mean annual growth rates of Indonesia's import quantities and trade unit values with the four selected partners are shown above in **Table 2**.

Table 3: Indonesian Actual and Extrapolated Trade Statistics with Selected ASEAN and Non-ASEAN Countries, 1991–1995

	Partner Country	Singapore		Thailand		Australia		Canada	
	Year	1991	1995	1991	1995	1991	1995	1991	1995
Import Quantity	Actual ('000 kilos)	132,600	66,139	292,900	1,118,000	52,198	138,200	53,552	546,109
	Ext. ('000 kilos)	n.a.	407,013	n.a.	2,215,011	n.a.	116,348	n.a.	38,250
	Imputed AFTA Effect ('000 kilos)	n.a.	-340,874	n.a.	-1,097,011	n.a.	21,852	n.a.	16,359
Import Unit Value	Actual (US$ per kilo)	0.32	0.73	0.35	0.35	0.86	0.77	0.18	0.34
	Ext. (US$ per kilo)	n.a.	0.33	n.a.	0.29	n.a.	0.93	n.a.	0.10
	Imputed AFTA Effect (US$ per kilo)	n.a.	0.40	n.a.	0.06	n.a.	-0.15	n.a.	0.24
Export Unit Quantity	Actual ('000 kilos)	108,100	36,742	10,094	13,149	47,371	29,646	32,063	33,254
	Ext.(000 kilos)	n.a.	1,682,114	n.a.	528,691	n.a.	121,113	n.a.	229,663
	Imputed AFTA Effect ('000 kilos)	n.a.	-1,645,372	n.a.	-515,542	n.a.	-91,467	n.a.	-196,409
Export Unit Value	Actual (US$ per kilo)	0.42	1.05	0.33	0.79	0.43	0.80	0.41	0.71
	Ext. (US$ per kilo)	n.a.	0.78	n.a.	0.16	n.a.	0.28	n.a.	0.29
	Imputed AFTA Effect (US$ per kilo)	n.a.	0.27	n.a.	0.63	n.a.	0.51	n.a.	0.42

Ext.= extrapolated, n.a. = not applicable.
Source: Author's computations with data sourced from the World Bank's Trade, Production, and Protection Database (Nicita and Olarreaga 2006).

To illustrate the extrapolation, consider Indonesia's trade with Singapore in 1991: Indonesia imported 132.6 million kilograms of manufactured food from Singapore at a unit value of US$0.32 per kilogram. To extrapolate Indonesia's import quantities, for example, from 1991 to 1995, the 1991 import quantity is simply multiplied by the corresponding geometric mean growth rate over 4 years: 132.6 million * (1 + 32.36%)[4] = 407 million kilograms. The difference between the actual and extrapolated values of each variable is an estimate of the AFTA effect. **Table 3** shows the calculations of the imputed AFTA effect on Indonesian manufactured food imports. We can see that this effect was negative in 1995 for Indonesia's two ASEAN partners and positive for the two non-ASEAN partners. This is surprising as the preferential agreement should have increased Indonesia's intra-regional imports and reduced extra-regional imports.

However, to quantify the trade volume effect on welfare, we use a slightly adapted version of the Lloyd and Maclaren (2004) measure as described in the previous section. The change in trade volume is now calculated as such:

$$Change\ in\ Trade\ Volume = \sum_{p} t_{mp} u^{E}_{mp} \left(m^{1}_{p} - m^{E}_{p} \right)$$

where:
the p subscript indicates a partner country
t_{mp} is the import-weighted *ad valorem* tariff on imports from partner country p in the base period
u^{E}_{mp} is the extrapolated unit value of imports from partner country p in the new period

m^{1}_{p} is the actual quantity of imports from partner country p in the new period

m^{E}_{p} is the extrapolated quantity of imports from partner country p in the new period[13]

In this example, the change in trade volume is –US\$57,745,000. This negative amount partially indicates that AFTA had a negative welfare impact on the food manufacturing sector in Indonesia because of lower trade volumes.

Table 3 also shows that, as a result of AFTA, Indonesia's manufactured food import prices from Singapore, Thailand, and Canada increased, while imported food from Australia became cheaper. Indonesia's manufactured food export prices to all these four countries rose. To quantify the terms-of-trade effect, we can compute another adapted Lloyd and Maclaren welfare measure. The change in terms of trade is now calculated as such:

$$Change\ in\ Terms\ of\ Trade = \sum_{p} x^{E}_{p} \left(u^{1}_{xp} - u^{E}_{xp} \right) - \sum_{p} m^{E}_{p} \left(u^{1}_{mp} - u^{E}_{mp} \right)$$

where:
the p subscript indicates a partner country
x^{E}_{p} is the extrapolated quantity of exports to partner country p in the new period

u^{1}_{xp} is the unit value of exports to partner country p in the new period

u^{E}_{xp} is the extrapolated unit value of exports to partner country p in the new period

m^{E}_{p} is the extrapolated quantity of imports from partner country p in the new period

u^{1}_{mp} is the unit value of imports from partner country p in the new period

u^{E}_{mp} is the extrapolated unit value of imports from partner country p in the new period

For the Indonesian food manufacturing sector, the change in terms of trade in relation to its two ASEAN partners was –US\$113,145,580, which indicates a loss. On the other hand, Indonesia experienced a positive change in its terms of trade vis-à-vis its two non-

---

[13]   Import-weighted tariffs were used in the base period because these correspond to the tariff regime without the FTA. In this example, the same import-weighted applied tariffs were used as in Section 3.2.1.

ASEAN partners in the amount of US$1,094,173,160. The combined welfare effects of changes in trade volume and terms of trade are overwhelmingly positive at US$923 million (i.e., 1094 –113 – 58), with most of the gains coming from improved extra-regional terms of trade.

To complete the analysis, an explanation is required for the surprising result above that AFTA reduced Indonesia's intra-regional imports. This may be due to several factors that created an upward bias in the estimated counterfactual trend. Firstly, there was already some growth in Indonesian manufactured food imports from ASEAN before 1992 as economic restructuring took place in anticipation of AFTA. Secondly, Indonesia introduced rapid, large-scale economic reforms in the latter half of the 1980s, especially in the trade and finance sectors, and these reforms would have had the most impact on trade and production before 1992. Thirdly, the effects of preferences were not seen in the first half of the 1990s because Indonesia took a longer time to implement its AFTA commitments. These three factors may have contributed to an overestimation of the counterfactual trend and, therefore, generated extrapolated values that were larger than actual values.

3.3   Strengths and Limitations of FTA Trade and Welfare Indicators

The main strengths of the set of indicators described above is that they can offer a quick first impression of an FTA's effects on trade and welfare at any level—tariff line, sectoral, national, or regional—provided that the requisite data is available. The qualitative Vinerian method is limited, however, by its descriptive nature. To measure the size of an FTA's trade and welfare effects, one can use the quantitative methods explained in sections 3.2.1 and 3.2.2. These methods are relatively simple to compute with data on trade and tariffs, and are based on a sound general-equilibrium model. However, these quantitative methods are limited in the way that they account for other factors, besides the FTA, that affect trade. The method in section 3.2.1 does not use a counterfactual and assumes that observed changes in trade after the FTA are entirely due to the FTA. Section 3.2.2 details a method that uses a counterfactual based simply on pre-FTA growth rates in trade. This counterfactual captures the general trends in trade and welfare and—to some extent—how other factors besides the FTA affect these general trends. However, this counterfactual obviously does not account for the variation in trade and welfare levels caused by individual non-FTA factors. These methods, therefore, may not provide reliable estimates of an FTA's trade and welfare impact. For more credible estimates, more elaborate methods, like the formal method described in section 4, need to be deployed.

4.   The Gravity Model

This section describes an econometric method of estimating trade flows known as the gravity model.[14] This model has been used to analyze the impact of not only FTAs, but

---

[14]   The gravity model is attributed to Jan Tinbergen (1962), who compared the size of bilateral trade flows between any two countries to the gravitational force in physics between two objects. Since Tinbergen,

also the effects of General Agreement on Tariffs and Trade–World Trade Organization (GATT–WTO) membership, currency unions, migration flows, foreign direct investment (FDI), and even disasters. The main benefit of the gravity model in evaluating an FTA is that it can control for the effects of as many other trade determinants besides the FTA as necessary and, therefore, isolate the effects of the FTA on trade. The basic gravity model of trade, which is analogous to Newton's Law of Universal Gravitation in physics, relates the imports of country i from country j (M_{ij}) positively to the gross domestic product (GDP) of the importing country (Y_i) and the GDP of the exporting country (Y_j), but negatively to the geographical distance between the importing and exporting countries (D_{ij}):

$$M_{ij} = G \frac{Y_i Y_j}{D_{ij}} \qquad (1)$$

where G is a constant. Expressed in logarithmic form and attaching a random error term (u_{ij}), the basic gravity equation becomes

$$\ln M_{ij} = G + \beta_1 \ln Y_i + \beta_2 \ln Y_j + \beta_3 \ln D_{ij} + u_{ij} \qquad (2)$$

where the β's are coefficients. Given the hypothesized relationships contained in the gravity model, β_1 and β_2 are expected to be positive, while β_3 is expected to be negative. In the gravity equation, geographical distance between the importing and exporting countries is actually a proxy for trade costs, which impede bilateral trade. Other variables that capture trade costs (e.g., adjacency, common language, colonial links, common currency, or whether the importing or exporting countries are islands or landlocked) may be added to this basic equation along with other explanatory variables. Furthermore, recent theoretical work on the gravity equation has emphasized that bilateral trade is not only a function of distance between the two countries, but also the distance of the pair from other countries. Anderson and Wincoop (2003) have coined the term "multilateral trade resistance" to denote the distance between the pair vis-à-vis the rest of the world: the higher the multilateral resistance, the more the pair of countries should trade with each other and *vice-versa*. Multilateral resistance can be easily included in the basic gravity equation as a set of fixed importer (**MTR$_i$**) and exporter effects (**MTR$_j$**).[15] The gravity equation is thus

---

many authors have produced theoretical models that yield the gravity equation for trade (e.g., Anderson 1979 and Bergstrand 1985).

[15] Here, a fixed effect is a binary variable that indicates whether or not an observation is of an individual country. For example, to construct a fixed importer effect for Cambodia, we set a variable equal to one whenever the importing country is Cambodia and zero otherwise. When these fixed effects are included, it is not possible to estimate the effects of time-invariant country specific characteristics such as being an island, or being landlocked. Instead of using fixed effects to control for multilateral trade resistance, one could use a formula that measures the average distance to other trading partners or use iterative methods to construct estimates of the price-raising effects of barriers to multilateral trade (Anderson and van Wincoop 2003).

$$\ln M_{ij} = G + \beta_1 \ln Y_i + \beta_2 \ln Y_j + \beta_3 \ln D_{ij} + \mathbf{MTR_i} + \mathbf{MTR_j} + u_{ij} \qquad (3)$$

At a minimum, the model is estimated with data on bilateral trade, GDP, and distance, using linear regression (ordinary least squares), which is a procedure performed by any statistical software package.[16] The sample should not be restricted only to countries in which the researcher is interested, but it should include as many countries as possible so that the regression is based on the maximum information available. The gravity equation can be estimated with data across pairs of countries from just one year (cross section) or for pairs of countries observed over multiple years (panel data). The latter is preferable because, then, the effects of particular years on global trade can be controlled for. With panel data, the gravity equation is

$$\ln M_{ij}^t = G + \beta_1 \ln Y_i^t + \beta_2 \ln Y_j^t + \beta_3 \ln D_{ij} + \mathbf{MTR_i} + \mathbf{MTR_j} + \mathbf{YEARS} + u_{ij}^t \qquad (4)$$

where the t superscript denotes the year of the observation and **YEARS** is a set of indicator variables for all the years in the sample except the first.[17]

For the analysis of an FTA, we add two variables to the gravity equation. The first is an indicator variable (*TradeCreate*) for observations where both the importing and exporting countries are members of the FTA in year t, while the second is an indicator variable (*TradeDivert*) for observations where the importing country is a member of the FTA in year t, but the exporting country is not. As the variable names suggest, the first variable measures trade creation, which is expected to be positive under the FTA, and the second, trade diversion, which is expected to be negative under the FTA. The gravity model for evaluating an FTA is therefore

$$\ln M_{ij}^t = G + \beta_1 \ln Y_i^t + \beta_2 \ln Y_j^t + \beta_3 \ln D_{ij} + TradeCreate + TradeDivert + $$
$$\mathbf{MTR_i} + \mathbf{MTR_j} + \mathbf{YEARS} + u_{ij}^t \qquad (5)$$

4.1   Gravity Model Data

Estimation of a gravity equation requires data on bilateral trade, GDP, distances, and possibly other determinants of bilateral trade including contiguity (common border), common language, colonial ties, and exchange rates. Bilateral trade flows can be found in the International Monetary Funds' (IMF) Direction of Trade Statistics; the UN's COMTRADE database; or the World Bank's Trade, Production, and Protection database by Nicita and Olarreaga (2006). GDP in current US dollars, converted at current exchange rates, can be found in the IMF's International Financial Statistics or the World Bank's World Development Indicators (WDI). Data on distances—typically the geodesic

---

[16]   Some examples of statistical software are Stata, SAS, and E-Views. Linear regression is also available in the Data Analysis Tool of Excel.

[17]   Suppose the sample contains observations from 2000 to 2003, then the **YEARS** set includes indicator variables for 2001, 2002, and 2003. The 2001 indicator variable, for example, is equal to 1 when the observation is from that year, and zero otherwise.

distances between capitals or the largest cities of each country by population—are available from the *Centre d'Etudes Prospectives et d'Informations Internationales* (CEPII), along with other geographic and trade-related variables.[18]

4.2 Interpretation of Gravity Model Results

To illustrate, a gravity model was estimated with data from 177 importing countries and 193 exporting countries over the period 1988–2007. The trade data is sourced from COMTRADE, GDP from the WDI, and the distance variable from CEPII. The gravity model is estimated first without any FTA-related variables as in equation (4), and then with FTA-related variables as in equation (5). The trade effects of AFTA are evaluated next. AFTA, as mentioned in previous sections, was signed by the original six members in 1992 and joined subsequently by Viet Nam in 1995, Lao People's Democratic Republic (Lao PDR) and Myanmar in 1997, and Cambodia in 1999.

Table 4: Regression Results from Gravity Model Estimation

Linear regression						

Number of obs = 260119
F(382,259736) = 2271.82
Prob > F = 0.0000
R-squared = 0.7312
Root MSE = 2.0943

$\ln M_{ij}$	Coef.	Robust Std. Err.	t	P>| t		[95% Conf. Interval]	
$\ln Y_i$	.8561031	.0259124	33.04	0.000	.8053155	.9068908
$\ln Y_j$	.3612175	.0233257	15.49	0.000	.3154998	.4069352
$\ln D_{ij}$	-1.691341	.0058937	-286.98	0.000	-1.702892	-1.67979

Table 4 shows output from having used the Stata software package to estimate the gravity model as formulated in equation (4). Only the results for GDP and distance are shown as these are the key explanatory variables in the gravity model. The coefficient estimates, since the variables are in logarithmic form, can be interpreted as elasticities. For example, the coefficient estimate on the importing country's GDP is equal to 0.865, which implies that a 1.0% increase in the GDP of the importing country raises its imports by 0.865%.

The coefficient estimates and their standard errors can be used to test certain hypothesized relationships. For example, suppose we state a null hypothesis that bilateral trade is unrelated to the GDP of the importing country (β_1 equals zero). The regression results show that the coefficient estimate on the importing country's GDP ($\hat{\beta}_1$) is 0.865 with a standard error of 0.026. To test the stated null hypothesis, we first choose a level of statistical significance—the maximum probability that the null

---

[18] The CEPII database can be accessed at http://www.cepii.fr/anglaisgraph/bdd/distances.htm.

hypothesis can be mistakenly rejected. This level is often set at 5% (or 1% for a more stringent test). Using 5%, a t-statistic is computed according to the following formula

$$t-statistic = \left|\frac{\hat{\beta}_1}{\hat{\sigma}_{\beta_1}}\right| = \left|\frac{0.865}{0.026}\right| = 33.4$$

This t-statistic is computed automatically by most regression software packages, including Stata as shown in Table 4. Once the value for the t-statistic is determined, it can be compared to the critical value, which is a cutoff value for the t-statistic corresponding to the chosen significance level. The critical value can be found using a table of values from Student's t-distribution. To consult this table, we need to compute the degrees of freedom, which is the number of observations (n) minus the number of explanatory variables (k) minus 1 (n-k-1), or in this example: 260,119 – 382 – 1 = 259,736. This example contains a large number of explanatory variables because of the importer and exporter fixed effects as well as the year indicator variables. The critical value for this test with a significance level of 5% is 1.96.[19] As the computed t-statistic is more than the critical value, the null hypothesis is rejected. Therefore, a statistically significant relationship exists between bilateral trade and the importing country's GDP. Most statistical software packages also produce a p-value, which is the probability of finding, due to random sampling, as large a difference between the estimated and hypothesized values as the difference actually found given that the hypothesized value is true. A smaller p-value implies a smaller probability that random sampling caused as large a difference between the estimated and hypothesized values to be found, therefore a higher likelihood that the values are indeed different, and a firmer basis to reject the null hypothesis. An alternative method of hypothesis testing that yields the same result as using the t-statistic is to check if the p-value is below the chosen significance level, and, if so, then the null hypothesis is rejected. In the regression results above, the p-value for each explanatory variable is an extremely small number, so we can safely reject the null hypothesis that these variables are unrelated to bilateral trade. Moreover, the coefficient estimates have the expected sign.

---

[19] With a very large number of degrees of freedom, one may also consult the Normal Distribution table. In any case, it is necessary to refer to a table on two-tailed tests.

Table 5: Regression Results from Gravity Model Estimation with Trade Creation and Trade Diversion

Linear regression

Number of obs = 260119
F(382,259734) = 2261.09
Prob > F = 0.0000
R-squared = 0.7312
Root MSE = 2.0941

$\ln M_{ij}$	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf. Interval]	
$\ln Y_i$	.8463466	.0260789	32.45	0.000	.7952326	.8974605
$\ln Y_j$	.3625608	.0233251	15.54	0.000	.3168443	.4082774
$\ln D_{ij}$	-1.69801	.006006	--282.72	0.000	-1.709781	-1.686238
TradeCreate	-.3190286	.08031	-3.97	0.000	-.476434	-.1616232
TradeDivert	.2274481	.0531532	.28	0.000	.1232693	.3316269

Table 5 shows Stata output from having estimated the gravity model as formulated in equation (5). This estimation differs from the previous one in that variables for AFTA trade creation and diversion are included. The results for GDP and distance are almost the same as from the previous estimation. However, the estimated coefficients on *TradeCreate* and *TradeDivert* are negative and positive, respectively, which is the opposite of what was expected. Their signs and statistical significance suggest that AFTA actually reduced intra-regional trade and increased extra-regional trade. The percentage reduction in intra-regional trade can be computed as $e^{-0.319}-1=-27\%$, while the percentage increase in extra-regional trade is $e^{0.2275}-1=26\%$.[20] Although the proportions of changes in intra- and extra-regional trade are estimated to be about the same, extra-regional trade of ASEAN countries was about four times that of intra-regional trade during the period, suggesting that the net effect of AFTA was an absolute rise in trade. Nevertheless, the strange results for trade creation and diversion suggest either that preferential AFTA tariffs were ineffective or there were specification problems in the model such as omitted variables.[21]

To investigate if AFTA had a different effect on newer ASEAN members, we run a regression with separate trade creation and diversion indicator variables for two groups: (i) the original six members (*Orig6TradeC* and *OrigTradeDivert*) and (ii) newer members (*CLVTradeC* and *CLVTradeD*).[22] The results are shown in **Table 6** below.

---

[20]   This formula is used to interpret the coefficient on an explanatory variable when the variable is an indicator (or dummy) variable and the dependent variable is in logarithmic form.

[21]   Possible specification problems include the omission of variables to capture the trade effects of the 1997/98 Asian financial crisis or cross-country FDI and platform production in East Asia.

[22]   The group of newer members includes Cambodia, Lao PDR, and Viet Nam. As trade data for Myanmar is unavailable, it is excluded from the regressions.

**Table 6: Regression Results from Gravity Model Estimation with Trade Creation
and Trade Diversion—Original Six ASEAN Members and Cambodia, Lao PDR, and
Viet Nam (CLV)**

Linear regression

Number of obs = 260119
F(382,259734) = 2252.18
Prob > F = 0.0000
R-squared = 0.7313
Root MSE = 2.0939

lnM_{ij}	Coef.	Robust Std. Err.	t	P>| t		[95% Conf. Interval]	
lnY_i	.845397	.0260671	32.43	0.000	.7943063	.8964878
lnY_j	.3632986	.0233275	15.57	0.000	.3175774	.4090198
lnD_{ij}	-1.698416	.0060065	-282.76	0.000	-1.710188	-1.686643
Orig6TradeC	-.7267084	.0986292	-7.37	0.000	-.920019	-.5333978
Orig6TradeD	.0406138	.0672881	0.60	0.546	-.0912691	.1724967
CLVTradeC	.6353428	.118895	5.34	0.000	.4023118	.8683738
CLVTradeD	.585979	.0803296	7.29	0.000	.4285351	.7434229

Again, the results for GDP and distance are almost the same as in previous estimations. However, by breaking down the trade creation and diversion variables by groups of ASEAN countries, we can see that AFTA affected these groups differently. The original six members experienced a reduction of 52% ($e^{-0.7267} - 1$) in intra-regional trade, while extra-regional trade did not change significantly.[23] Interestingly, the intra- and extra-regional trade of newer ASEAN members rose by 89% ($e^{0.6353} - 1$) and 80% ($e^{0.586} - 1$), respectively as a result of AFTA. To gain some perspective on these numbers, consider the case of Cambodian imports. In the third year after becoming an ASEAN member and participating in AFTA (2002), the country's intra-regional imports were US$598 million and extra-regional imports were US$1,067 million. The estimates above suggest that without AFTA Cambodia would have imported only US$316 million (US$598 million/1.89) from other ASEAN countries and US$593 million (US$1,067 million/1.80) from countries outside the region. In other words, Cambodia experienced an increase in trade in that third year of close to US$1 billion due to AFTA.

4.3   Strengths and Limitations of the Gravity Model

The gravity model is used as a workhorse for analyzing trade because data for it is widely available, the model has high explanatory power, and there are established standard practices that facilitate the work of researchers. Its main strengths in evaluating an FTA are that it allows the analyst to control for other trade-related variables and quantify any changes in a country's trade due to the FTA. These quantitative estimates may then be used in welfare calculations. However, the model may yield misleading

---

[23]   Although the sign on *Orig6TradeD* is positive, which would indicate that the original ASEAN six experienced a rise in extra-regional imports, the result is not statistically significant because of the small t-statistic (or high p-value).

results if the data is inaccurate or important variables are omitted from the estimation. Further, although the method of estimating the gravity model presented above addresses most of the basic data and specification issues that arise in implementation, other more complicated problems exist. The analyst should refer to the recent literature for potential solutions to these problems.[24]

5.   Concluding Remarks

This paper has presented ex post economic evaluation methods for policymakers to get a better understanding of how an already-established FTA actually affects trade and welfare. In particular, these methods show how to (i) compute the official versus effective utilization rate of preferences and the value of preferences, (ii) qualitatively assess trade creation and diversion, (iii) quantitatively analyze the FTA's trade effects with trade indicators and the gravity model, and (iv) make inferences about economic welfare. Evaluating the true versus expected economic impact of an FTA is an important part of the monitoring and surveying process that should follow the establishment of an FTA. By noting any discrepancies between the FTA's actual and predicted effects, policymakers can improve their ex ante assessment methods as well as adjust domestic policies and international positions in ongoing FTA negotiations accordingly.

---

[24]   The other problems are, for example, the presence of zero bilateral trade values (Martin and Cong 2008), the bias of ordinary least squares when there is heteroskedasticity in a log-linearized model (Silva and Tenreyro 2006), and the endogeneity of FTAs (Baier and Bergstrand 2007).

References

J. E. Anderson. 1979. A Theoretical Foundation for the Gravity Equation. *American Economic Review.* 69 (1). pp. 106–16.

J. E. Anderson, E. James, and E. van Wincoop. 2003. Gravity with Gravitas: A Solution to the Border Puzzle. *American Economic Review.* 93 (1). pp. 170–192.

J. Anson, O. Cadot, A. Estevadeordal, J. de Melo, A. Suwa-Eisenmann, and B. Tumurchudur. 2005. Rules of Origin in North-South Preferential Trading Arrangements with an Application to NAFTA. *Review of International Economics.* 13 (3). pp. 501–517.

S. L. Baier and J. H. Bergstrand. 2007. Do Free Trade Agreements Actually Increase Members' International Trade? *Journal of International Economics.* 71 (1). pp. 72–95.

J. H. Bergstrand. 1985. The Gravity Equation in International Trade: Some Microeconomic Foundations and Empirical Evidence*. The Review of Economics and Statistics.* 67 (3). pp. 474–481.

P. Brenton and M. Miriam. 2003. Making EU Trade Agreements Work: The Role of Rules of Origin. *The World Economy.* 26 (5). pp. 755–69.

P. Brenton and T. Ikezuki. 2005. The Value of Trade Preferences for Africa. *Trade Note.* 21. Washington: World Bank.

R. Duttagupta and A. Panagariya. 2007. Free Trade Areas And Rules Of Origin: Economics And Politics. *Economics and Politics.* 19 (2). pp. 169–190.

R. Falvey and G. Reed. 1998. Economic Effects of Rules of Origin. *Weltwirtschaftliches Archiv.* 134 (2) pp. 209–229.

———. 2002. Rules of Origin as Commercial Policy Instruments. *International Economic Review.* 43 (2). pp. 393–407.

J. Herin. 1986. Rules of Origin and Differences Between Tariff Levels in EFTA and in the EC. *EFTA Occasional Paper.* 13. Geneva: European Free Trade Association.

S. Inama. 2003 *Trade Preferences for LDCs: An Early Assessment of Benefits and Possible Improvements* (UNCTAD ITCD/TSB/2003/8). New York and Geneva: United Nations Conference on Trade and Development.

K. Krishna. 2005. Understanding Rules of Origin. *NBER Working Paper.* 11150.

K. Krishna and A. Krueger. 1995. Implementing Free Trade Areas: Rules of Origin and Hidden protection. In A. Deardorff, J. Levinsohn and R. Stern, eds. *New directions in Trade Theory.* Ann Arbor, Michigan: University of Michigan Press.

A. Krueger. 1999. Free Trade Agreements as Protectionist Devices: Rules of Origin. In J. R. Melvin, J. Moore, and R. Riezman, eds. *Trade, Theory and Econometrics: Essays in Honor of John S. Chipman.* London: Routledge.

P. J. Lloyd and D. Maclaren. 2004. Gains and Losses from Regional Trading Agreements: A Survey. *The Economic Record.* 80 (251). pp. 445–467.

W. Martin and C. S. Pham. 2008. Estimating the Gravity Model When Zero Trade Flows are Frequent. *Economics Series.* 2008–03. Australia: Faculty of Business and Law, School of Accounting, Economics and Finance, Deakin University.

A. Nicita and O. Marcelo. 2006. Trade, Production and Protection (1976-2004). *World Bank Economic Review.* 21 (1).

L. Nilsson and N. Matsson. 2009. Truths and Myths about the Openness of EU Trade Policy and the Use of EU Trade Preferences. *Working Paper.* Brussels: European Commission Directorate General for Trade.

C. Özden and M. Olarreaga. 2005. AGOA and Apparel: Who Captures the Tariff Rent in the Presence of Preferential Market Access? *World Economy.* 28 (1). pp. 63–77.

D. Park and M. A. R. Estrada. 2010. A New Multi-Dimensional Framework for Analyzing Regional Integration: Regional Integration Evaluation (RIE) Methodology. *ADB Working Paper Series on Regional Economic Integration.* 49. Manila: Asian Development Bank.

J. S. Silva and S. Tenreyro. 2006. The Log of Gravity. *The Review of Economics and Statistics.* 88 (4). pp. 641–658.

J. Tinbergen. 1962. Shaping the World Economy: Suggestions for an International Economic Policy. New York: The Twentieth Century Fund.

J. Viner. 1950. *The Customs Union Issue.* New York: Carnegie Endowment for International Peace.

Appendix 1: AFTA's Form D (Certificate of Origin)

ATTACHMENT 3

Original (Duplicate/Triplicate)

1. Goods consigned from (Exporter's business name, address, country)	Reference No.
	ASEAN COMMON EFFECTIVE PREFERENTIAL TARIFF / ASEAN INDUSTRIAL COOPERATION SCHEME CERTIFICATE OF ORIGIN (Combined Declaration and Certificate)
2. Goods consigned to (Consignee's name, address, country)	FORM D Issued in _____ (Country) See Overleaf Notes

3. Means of transport and route (as far as known) Departure date Vessel's name/Aircraft etc. Port of Discharge	4. For Official Use ☐ Preferential Treatment Given Under ASEAN Common Effective Preferential Tariff Scheme ☐ Preferential Treatment Given Under ASEAN Industrial Cooperation Scheme ☐ Preferential Treatment Not Given (Please state reason/s) .... Signature of Authorised Signatory of the Importing Country

5. Item number	6. Marks and numbers on packages	7. Number and type of packages, description of goods (including quantity where appropriate and HS number of the importing country)	8. Origin criterion (see Notes overleaf)	9. Gross weight or other quantity and value (FOB)	10. Number and date of invoices

11. Declaration by the exporter	12. Certification
The undersigned hereby declares that the above details and statement are correct; that all the goods were produced in .... (Country) and that they comply with the origin requirements specified for these goods in the ASEAN Common Effective Preferential Tariff Scheme for the goods exported to .... (Importing Country) .... Place and date, signature of authorised signatory	It is hereby certified, on the basis of control carried out, that the declaration by the exporter is correct. .... Place and date, signature and stamp of certifying authority

13
☐ Third-Country Invoicing ☐ Exhibition
☐ Accumulation ☐ De Minimis
☐ Back-to-Back CO ☐ Issued Retroactively
☐ Partial Cumulation

ADB Working Paper Series on Regional Economic Integration*

1. "The ASEAN Economic Community and the European Experience" by Michael G. Plummer

2. "Economic Integration in East Asia: Trends, Prospects, and a Possible Roadmap" by Pradumna B. Rana

3. "Central Asia after Fifteen Years of Transition: Growth, Regional Cooperation, and Policy Choices" by Malcolm Dowling and Ganeshan Wignaraja

4. "Global Imbalances and the Asian Economies: Implications for Regional Cooperation" by Barry Eichengreen

5. "Toward Win-Win Regionalism in Asia: Issues and Challenges in Forming Efficient Trade Agreements" by Michael G. Plummer

6. "Liberalizing Cross-Border Capital Flows: How Effective Are Institutional Arrangements against Crisis in Southeast Asia" by Alfred Steinherr, Alessandro Cisotta, Erik Klär, and Kenan Šehović

7. "Managing the Noodle Bowl: The Fragility of East Asian Regionalism" by Richard E. Baldwin

8. "Measuring Regional Market Integration in Developing Asia: a Dynamic Factor Error Correction Model (DF-ECM) Approach" by Duo Qin, Marie Anne Cagas, Geoffrey Ducanes, Nedelyn Magtibay-Ramos, and Pilipinas F. Quising

9. "The Post-Crisis Sequencing of Economic Integration in Asia: Trade as a Complement to a Monetary Future" by Michael G. Plummer and Ganeshan Wignaraja

10. "Trade Intensity and Business Cycle Synchronization: The Case of East Asia" by Pradumna B. Rana

11. "Inequality and Growth Revisited" by Robert J. Barro

12. "Securitization in East Asia" by Paul Lejot, Douglas Arner, and Lotte Schou-Zibell

13. "Patterns and Determinants of Cross-border Financial Asset Holdings in East Asia" by Jong-Wha Lee

14. "Regionalism as an Engine of Multilateralism: A Case for a Single East Asian FTA" by Masahiro Kawai and Ganeshan Wignaraja

15. "The Impact of Capital Inflows on Emerging East Asian Economies: Is Too Much Money Chasing Too Little Good?" by Soyoung Kim and Doo Yong Yang

16. "Emerging East Asian Banking Systems Ten Years after the 1997/98 Crisis" by Charles Adams

17. "Real and Financial Integration in East Asia" by Soyoung Kim and Jong-Wha Lee

18. "Global Financial Turmoil: Impact and Challenges for Asia's Financial Systems" by Jong-Wha Lee and Cyn-Young Park

19. "Cambodia's Persistent Dollarization: Causes and Policy Options" by Jayant Menon

20. "Welfare Implications of International Financial Integration" by Jong-Wha Lee and Kwanho Shin

21. "Is the ASEAN-Korea Free Trade Area (AKFTA) an Optimal Free Trade Area?" by Donghyun Park, Innwon Park, and Gemma Esther B. Estrada

22. "India's Bond Market—Developments and Challenges Ahead" by Stephen Wells and Lotte Schou- Zibell

23. "Commodity Prices and Monetary Policy in Emerging East Asia" by Hsiao Chink Tang

24. "Does Trade Integration Contribute to Peace?" by Jong-Wha Lee and Ju Hyun Pyun

25. "Aging in Asia: Trends, Impacts, and Responses" by Jayant Menon and Anna Melendez-Nakamura

26. "Re-considering Asian Financial Regionalism in the 1990s" by Shintaro Hamanaka

27. "Managing Success in Viet Nam: Macroeconomic Consequences of Large Capital Inflows with Limited Policy Tools" by Jayant Menon

28. "The Building Block versus Stumbling Block Debate of Regionalism: From the Perspective of Service Trade Liberalization in Asia" by Shintaro Hamanaka

29. "East Asian and European Economic Integration: A Comparative Analysis" by Giovanni Capannelli and Carlo Filippini

30. "Promoting Trade and Investment in India's Northeastern Region" by M. Govinda Rao

31. "Emerging Asia: Decoupling or Recoupling" by Soyoung Kim, Jong-Wha Lee, and Cyn-Young Park

32. "India's Role in South Asia Trade and Investment Integration" by Rajiv Kumar and Manjeeta Singh

33. "Developing Indicators for Regional Economic Integration and Cooperation" by Giovanni Capannelli, Jong-Wha Lee, and Peter Petri

34. "Beyond the Crisis: Financial Regulatory Reform in Emerging Asia" by Chee Sung Lee and Cyn-Young Park

35. "Regional Economic Impacts of Cross-Border Infrastructure: A General Equilibrium Application to Thailand and Lao PDR" by Peter Warr, Jayant Menon, and Arief Anshory Yusuf

36. "Exchange Rate Regimes in the Asia-Pacific Region and the Global Financial Crisis" by Warwick J. McKibbin and Waranya Pim Chanthapun

37. "Roads for Asian Integration: Measuring ADB's Contribution to the Asian Highway Network" by Srinivasa Madhur, Ganeshan Wignaraja,and Peter Darjes

38. "The Financial Crisis and Money Markets in Emerging Asia" by Robert Rigg and Lotte Schou-Zibell

39. "Complements or Substitutes? Preferential and Multilateral Trade Liberalization at the Sectoral Level" by Mitsuyo Ando, Antoni Estevadeordal, and Christian Volpe Martincus

40. "Regulatory Reforms for Improving the Business Environment in Selected Asian Economies—How Monitoring and Comparative Benchmarking can Provide Incentive for Reform" by Lotte Schou-Zibell and Srinivasa Madhur

41. "Global Production Sharing, Trade Patterns, and Determinants of Trade Flows in East Asia" by Prema–Chandra Athukorala and Jayant Menon

42. "Regionalism Cycle in Asia (-Pacific): A Game Theory Approach to the Rise and Fall of Asian Regional Institutions" by Shintaro Hamanaka

43. "A Macroprudential Framework for Monitoring and Examining Financial Soundness" by Lotte Schou-Zibell, Jose Ramon Albert, and Lei Lei Song

44. "A Macroprudential Framework for the Early Detection of Banking Problems in Emerging Economies" by Claudio Loser, Miguel Kiguel, and David Mermelstein

45. "The 2008 Financial Crisis and Potential Output in Asia: Impact and Policy Implications" by Cyn-Young Park, Ruperto Majuca, and Josef Yap

46. "Do Hub-and-Spoke Free Trade Agreements Increase Trade? A Panel Data Analysis" by Jung Hur,Joseph Alba,and Donghyun Park

47. "Does a Leapfrogging Growth Strategy Raise Growth Rate? Some International Evidence" by Zhi Wang, Shang-Jin Wei, and Anna Wong

48. "Crises in Asia: Recovery and Policy Responses" by Kiseok Hong and Hsiao Chink Tang

49. "A New Multi-Dimensional Framework for Analyzing Regional Integration: Regional Integration Evaluation (RIE) Methodology" by Donghyun Park and Mario Arturo Ruiz Estrada

50. "Regional Surveillance for East Asia: How Can It Be Designed to Complement Global Surveillance?" by Shinji Takagi

51. "Poverty Impacts of Government Expenditure from Natural Resource Revenues" by Peter Warr, Jayant Menon, and Arief Anshory Yusuf

52. "Methods for Ex Ante Economic Evaluation of Free Trade Agreements" by David Cheong

53. "The Role of Membership Rules in Regional Organizations" by Judith Kelley

54. "The Political Economy of Regional Cooperation in South Asia" by V.V. Desai

55. "Trade Facilitation Measures under Free Trade Agreements: Are They Discriminatory against Non-Members?" by Shintaro Hamanaka, Aiken Tafgar, and Dorothea Lazaro

56. "Production Networks and Trade Patterns in East Asia: Regionalization or Globalization?" by Prema-chandra Athukorala

57. "Global Financial Regulatory Reforms: Implications for Developing Asia" by Douglas W. Arner and Cyn-Young Park

58. "Asia's Contribution to Global Rebalancing" by Charles Adams, Hoe Yun Jeong, and Cyn-Young Park

Methods for Ex Post Economic Evaluation of Free Trade Agreements

Evaluating the economic impact of an FTA is an important part of the post-FTA monitoring and surveying process. This paper presents methods for evaluating the trade and welfare effects of an FTA after its establishment. The paper shows how to assess (i) the utilization and value of preferences, (ii) trade creation and diversion, and (iii) the FTA's welfare effects using trade indicators and the gravity model. Countries such as Viet Nam, Indonesia, and Cambodia feature in the examples.

About the Asian Development Bank

ADB's vision is an Asia and Pacific region free of poverty. Its mission is to help its developing member countries substantially reduce poverty and improve the quality of life of their people. Despite the region's many successes, it remains home to two-thirds of the world's poor: 1.8 billion people who live on less than $2 a day, with 903 million struggling on less than $1.25 a day. ADB is committed to reducing poverty through inclusive economic growth, environmentally sustainable growth, and regional integration.

Based in Manila, ADB is owned by 67 members, including 48 from the region. Its main instruments for helping its developing member countries are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance.