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The Welfare Analysis of a Free Trade Zone: Intermediate Goods and the Asian Tigers

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THE WELFARE ANALYSIS OF A FREE TRADE ZONE: INTERMEDIATE GOODS AND THE ASIAN TIGERS*

BY

ANDREW FELTENSTEIN AND FLORENZ PLASSMANN

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Andrew Feltenstein, International Monetary Fund. Email: afeltenstein@imf.org

Florenz Plassmann, State University Of New York, Binghamton. Email: fplass@binghamton.edu

ABSTRACT

We analyse trade reform among the ASEAN countries, which recently began removing all mutual trade barriers. The standard method to avoid complete specialization in traded goods is to distinguish goods both by physical type and place of origin (the so called Armington assumption). This methodology is not suitable for the sort of intermediate goods produced by the ASEAN countries. We develop a computational approach in the context of a non-Armington dynamic general equilibrium model. Analyzing the results of a calibrated version of the model, we find that trade liberalization is generally welfare improving for the ASEAN countries.

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I INTRODUCTION

1.1 How should we analyse the effects of trade reform? More generally, what modeling framework should we adopt if we wish to examine the effects of policy changes upon countries that trade heterogeneous goods? The Armington[1] approach has become quite standard for some time. Here traded goods are distinguished not only by physical type, but also by place of origin. Thus, for example, a Japanese car is different from a Korean car. A main reason for adopting the Armington approach is to avoid complete specialization in trade. If Japanese and Korean cars were identical, then general equilibrium models would generally yield corner solutions.[2] Of course actual trade data do not reflect such specialization.

1.2 The Armington approach is plausible for trade in final goods. That is, it is quite possible to believe that consumers view Japanese and Korean cars differently. On the other hand, the assumption is more difficult to support in the case of intermediate or primary goods. It is unlikely that, for example, computer chips from Thailand and Singapore are imperfect substitutes in production. For perfect substitutes, the standard way to avoid specialization is to introduce transportation costs in trade. Again, this approach seems more acceptable in some cases than in others. It is unlikely that transportation costs for, say, computer chips from Singapore and Malaysia to the United States are significantly different.

1.3 The aim of this paper is to analyse a particular type of trade reform among the five major Association of Southeast Asian Nations (ASEAN) partners; Singapore, Malaysia, Indonesia, Thailand, and the Philippines. All of these countries are major producers of intermediate and final goods and they compete directly with each other. The ASEAN countries started to reduce their mutual trade barriers in 1992. Currently, there are no tariffs of any significance placed upon mutual trade in intermediate goods, although there are tariffs on final goods as well as other trade restrictions. Accordingly, the reforms amount to elimination of tariffs on trade in final goods between the member countries. Their trade policies regarding the exchange of intermediate and final goods with the rest of the world would remain as

[1] See Armington (1969). De Melo (1988) contains a number of relevant references.

[2] The country with the lowest per-unit production cost would produce all output.

before. That is, ASEAN countries would retain their own sets of tariffs for trade from the non-ASEAN world.

1.4 The analysis of this trade reform requires a non-Armington approach in order to accommodate the issue of perfect substitutes in intermediate goods. There is, however, relatively little work on non-Armington trade models that is relevant. There are several possible reasons for this apparent oversight in the literature. Aggregate trade models obviously do not require distinctions between specific goods from different countries. Trade in many primary goods is often determined by non-market factors, such as membership in a cartel that imposes export quotas. Additionally, many models that analyse trade in intermediate goods rely upon input-output matrices for initial trade flows. They then use the trade shares from the input-output matrices for counterfactual policy simulations. This approach of course implies a zero elasticity of substitution in imports of intermediate goods of the same type from different countries. As we argue below, policy simulations using fixed coefficients tend to underestimate changes in trade flows caused by shifts in relative prices.

1.5 Non-Armington type problems often arise in regional models that are used to analyse the effects of policies targeted at specific regions of a country.[3] For example, Feltenstein (1997) analyses the impact of an export tax on gold in Australia in the context of a two-region model of the country. The tax affects only Western Australia, which produces gold for export, but otherwise produces the same goods as the rest of Australia, using a different technology than the rest of the country. Plassmann (2005) develops a 50 state model of the United States in order to analyse the geographic and distributional impact of various tax policies. Although his is a non-Armington model, it describes a closed economy and also assumes that all states have identical technologies.[4]

1.6 Our model represents a group of open economies, all of which have different production technologies and factor endowments. Intermediate goods of the same type that are produced in different countries are perfect substitutes in production. Equilibrium in the model is established by wage

[3] Examples of trade papers that use Armington type assumptions are Bröcker and Schneider (2002), and Giesecke (2002).

[4] Kimball and Harrison (1984), Jones and Whalley (1988), Morgan, Mutti, and Rickman (1996), and Lofgren and Robinson (2002) are examples of regional models based on the Armington assumption.

rates for sector-specific labor types in each country. Trade shares for each type of good are part of the equilibrium outcome, rather than predetermined shares.

1.7 The next section briefly describes the issues of trade reform confronting the ASEAN countries. Section III presents the intuition of the model, which is described in detail in section IV. Section V describes the data and model calibration, while Section VI reports the results of two trade liberalization analyses based on the calibrated simulation model. Section VII provides a summary and conclusion.

II TRADE REFORM IN THE ASEAN COUNTRIES[5]

2.1 Starting in 1992, the ASEAN group of countries embarked upon a program of trade liberalization that aimed at promoting efficiency in production as well as consumer welfare. The key element in this liberalization was the formation of a free trade zone among the member countries.[6] The initial target of the proposed trade reforms was that countries in the zone were to impose tariffs of no more than 5 per cent on most products traded in the region. Other non-tariff barriers were to be eliminated entirely. At the same time, however, member countries could maintain their own trade regimes against the rest of the world. The reforms were to be phased in gradually, with the eventual goals to be achieved by 2008. Currently there are virtually no tariffs on trade in intermediate goods among the ASEAN countries, although there are still tariffs on final goods–the overall average tariff on all traded goods is only 3.8 per cent in the six original countries of the zone. By international standards these rates are quite low, but they nevertheless still differ by country. Accordingly, the ASEAN group is already well on its way to becoming an internal free trade zone.

2.2 The current target is to abolish all tariffs among the six major countries by 2010, while they should be eliminated for the four new members of the zone by 2015.[7] Various extensions to the eventual free trade regime have been proposed. One proposal suggests lowering tariffs uniformly against the rest of the world, in order to avoid problems of importing to a low tariff country, followed by re-exporting to a higher tariff country. Another proposal considers the expansion of the zone to include other countries, in particular, China and the Republic of Korea, although in the somewhat more distant future.

2.3 Trade among the ASEAN countries more than doubled between 1993 and 2000, while trade with the rest of the world increased somewhat less rapidly. Hence there is some evidence of correlation, if not causality, between the reforms and increased trade. Of course, it is difficult to establish causal links. It is also not clear what the effect of the past or future reforms

[5] Much of this section comes from the publication, *Southeast Asia: A Free Trade Area* (2005).

[6] The original members of the zone were Brunei, Indonesia, Malaysia, the Philippines, Singapore, and Thailand.

[7] These are Vietnam, Laos People's Democratic Republic, Myanmar, and Cambodia.

will be on output or consumer welfare. Our model attempts to identify and quantify the causality effects of trade reform on trade volume. It also tries to identify the effects of the reform on growth and welfare, as well as make some predictions about the impact of proposed membership expansion.

III MODEL INTUITION

3.1 Suppose that each country has a number of industries, each of which produces an intermediate and/or final good. Production in each industry requires labor with certain industry-specific skills. Hence, in the short run, labor is immobile between industries. We also assume that there is no labor mobility between countries in either the long or short run. Capital, on the other hand, is perfectly mobile across industries and countries.

3.2 Because we assume that producers view intermediate goods from different countries of origin as perfect substitutes, there is a single equilibrium world price for each intermediate good. Each country's corresponding industry competes for the demand for that product, with industries producing the same good in different countries possibly having different technologies. Given capital mobility, the price of capital is the same across countries. But the immobility of labor permits wage rates to differ across countries and industries. Hence for given wage rates, industries in different countries realize different profits. The assumption of perfect competition ensures that equilibrium profits are zero, so that a good is supplied only by countries that produce it at lowest cost. All countries will supply the good if and only if their unit-production costs are equal. As long as all industries operate under constant returns to scale, this can be achieved if the equilibrium wage in every industry in each country is such that the cost of producing one unit of output with local labor and perfectly mobile capital is equal across countries.

3.3 The ASEAN countries take world prices for all traded goods as given. We determine these world prices as equilibrium prices for the United States.[8] We then solve backwards for wage rates in each country-specific industry so that each country's output prices match these world prices under profit maximization. The equilibrium supply of each traded good is then divided between countries. Thus at equilibrium wage rates for a particular industry, all the sector-specific labor for that industry is utilized. In addition, each country produces positive output from each intermediate industry[9].

[8] We obtained virtually identical simulation results when we determined world prices as equilibrium prices for China. This result indicates that outcomes are robust with respect to the choice of country as price setter.

[9] It is therefore not necessary to either estimate or make assumptions about elasticities of substitutions between identical intermediate inputs from different countries. To implement the model, one only needs estimates of sectoral labor supplies in each country as well as elasticities of the labor/leisure choice that could be identical across sectors.

IV MODEL DESCRIPTION

4.1 Our dynamic model describes the trade flows within and between the 10 countries; Indonesia, Malaysia, Philippines, Singapore, Thailand, China, Taiwan, South Korea, Japan, and the United States.[10] Each country consists of a national government and seven consumers with perfect foresight who supply labor to the seven production sectors (Agriculture, Mining, Manufacturing, Utilities, Construction, Trade and Transport, and Services). Each sector uses intermediate inputs, labor, and capital to produce intermediate and final goods. We assume that capital is perfectly mobile across sectors and countries within and across periods, while labor is country- and sector-specific within periods and of limited mobility within a country across periods. Further details on the model are described in the following sections.

(A) PRODUCTION

4.2 We assume that all sectors operate under perfect competition so that equilibrium profits are zero. The zero profit assumption implies that unit output prices equal unit production costs, or

$$p = B(p)\,p + V(p_L, p_K) \tag{1}$$

where p is the 70×1 ($= 10 \cdot 7 \times 1$) vector of output prices, $B(p)$ is a 70×70 matrix of demand for intermediate inputs, and $V(p_L, p_K)$ is the 70×1 vector of each industry's cost of producing value added from labor L and capital K under their respective prices p_L and p_K. Given p_L and p_K, equation (1) determines the corresponding vector of output prices p. The main difficulty lies in solving equation (1).

4.3 Although there are two standard approaches to incorporate trade in intermediate inputs, one is infeasible and the other is inappropriate for our data and model. One obvious way of introducing trade in intermediate goods is to assume that every industry in every country first determines how much of

[10] The Institute of Developing Economies, Japan, has compiled the joint 1995 Input-Output matrix for these 10 countries with 7 goods and with 24 sectors (see Asian International Input-Output Table 1995). This table provides detailed information on the economic dependencies among these 10 economies. It seemed appropriate to include five of the ASEAN countries' major trading partners into the model rather than including them among the "rest of the world."

each intermediate input is necessary to produce one unit of output, and then determines how much of each intermediate input it acquires from every country (including its own).[11] It is then straightforward to model the demand for intermediate inputs from different countries of origin according to a CES function with an exogenously determined elasticity of interregional substitution. The drawback of this approach is the difficulty of calculating output prices under perfect competition. Because a CES function renders each industry's cost minimizing demand for inputs from different countries a non-linear function of *p*, the elements of the *B* matrix are non-linear functions of *p* as well, which makes it necessary to solve equation (1) numerically. The task of finding repeated numerical solutions to 70 non-linear simultaneous equations is simply too time consuming for large models like ours.[12]

4.4 An alternative approach that circumvents this difficulty is to assume that the elasticity of interregional substitution is zero and to replace the *B(p)* matrix in equation (1) by a 70×70 Leontief matrix with constant country-specific coefficients for different types of intermediate inputs that are differentiated by country of origin. Equation (1) becomes

$$p = Bp + V(p_L, p_K) \tag{1a}$$

which can easily be solved for

$$p = (I - B)^{-1} V(p_L, p_K) \tag{2}$$

[11] The elasticity of substitution between different types of intermediate inputs is likely to be low (because the use of different types of intermediate inputs is determined by technological requirements of the production process) while the elasticity of substitution between intermediate inputs of a given type from different countries is likely to be higher. This difference in elasticity can easily be accommodated through nested CES demand functions and leads to the two-step procedure described in the text.

[12] The solution of the model requires the numerical determination of the market clearing prices of primary inputs (the prices of labor and capital), which is already a time consuming process for large models. The simultaneous solution of the 70 cost functions to determine the output prices for any given set of prices of labor and capital needs to take place at every iteration of the algorithm that searches for the equilibrium vector of prices of labor and capital.

where *I* is the identity matrix.[13]

4.5 This approach has two drawbacks that make it unattractive for our purposes. First, it is fairly common to assume that the elasticity of substitution between different types of intermediate inputs (for example, between manufactured goods and services) is zero. However, the ASEAN countries produce quite similar intermediate inputs, so that their elasticity of interregional substitution is rather high. Assuming fixed import coefficients (that is, an elasticity of interregional substitution of zero) would therefore distort our analysis. A second and more general drawback of this approach is that the actual construction of a matrix of fixed import coefficients is likely to be based on observable import flows. To the extent that these import flows are affected by relative prices, it is not possible to view the elements of such a matrix as technological coefficients that remain constant when relative prices change.[14] If the elements of *B* are functions of *p*, then it is inappropriate to determine output prices with equation (2). Nevertheless, an attractive feature of the second approach is that it eliminates the prices from the *B* matrix

4.6 For our model, we also adopt the standard assumption that intermediate inputs enter the production functions in fixed proportions. In contrast to the second approach, however, we base our solution for incorporating trade in intermediate goods on the assumption that intermediate inputs from different countries are perfect substitutes for each other. That is, we avoid the Armington assumption for trade in intermediate inputs. In the absence of trade restrictions, different countries can simultaneously produce perfectly substitutable goods if and only if they produce these goods at the

[13] Note that it is <u>not</u> possible to incorporate trade in intermediate inputs in this fashion if one has access only to country-specific input-output matrices with coefficients for intermediate inputs that are not differentiated by country of origin (that is, if one has only 10 separate 7×7 input-output matrices instead of a single 70×70 matrix with appropriate import coefficients in the off-diagonal blocks). While it is straightforward to determine 10 separate country-specific 7×1 price vectors from equation (2), these price vectors would be based on the assumption that an industry acquires intermediate inputs only from other industries in the same country. Such a model assumes a zero elasticity of interregional substitution too, but sets the import coefficients equal to zero; it can therefore only accommodate trade in final goods but not trade in intermediate inputs.

[14] It seems much more defensible to construct a fixed coefficients matrix for different types of intermediate inputs by observing an industry's usage of inputs from different sectors than by observing its usage of inputs from the same sector in different countries. For a computer company in Singapore, the degree of substitutability between inputs from, say, the manufacturing and the service sector is likely to be far lower than the degree of substitutability of imported inputs from the manufacturing sectors of, say, Indonesia and South Korea.

same cost and sell them at the same price. As a consequence, producers are indifferent between the countries of origin of their intermediate inputs and they acquire these inputs from any country that has sufficient resources to produce them. The fact that output prices are identical across countries ensures that all countries produce all goods in equilibrium and avoids limit (bang-bang) solutions where every good is produced only by the country with the lowest production cost.[15]

4.7 The key advantage of our approach over a model that does not accommodate any trade in intermediate inputs[16] is that in such a model, an increase in demand for final output of an industry in one country automatically translates into an increase in demand for intermediate goods produced by all other industries in the same country.[17] In contrast, our model permits this industry to satisfy its higher demand for intermediate inputs from the outputs of all countries. As a consequence, our model does not generate increases in demand for output of all industries of a country only because there is higher demand for the output of one industry in that country.

4.8 In contrast to an Armington model with constant import demand coefficients, our non-Armington approach does not require the unrealistic assumption that the elasticities of interregional substitution are zero. It is interesting to examine whether the assumptions of zero versus infinite elasticities actually lead to noticeably different simulation results. The 1995 Input-Output matrix for our 10 countries published by the Japanese *Institute of Developing Economies* permits us to construct the 70×70 B matrix with constant import demand coefficients for intermediate inputs so that we can compare simulations undertaken under the two assumptions. We summarize the results in the Appendix. As could be expected, the effects predicted by the Armington model that rules out interregional substitution are much larger than the effects predicted by our non-Armington model that allows for interregional substitution of intermediate inputs.

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15 The algorithm to implement the assumption of perfect substitutability in conjunction with country-specific IO matrices, production functions, and input prices is described in Plassmann (2005).

16 For example, a model that uses country-specific input-output matrices with coefficients for intermediate inputs that are not differentiated by country of origin (see footnote 13).

17 Consider a model that uses 10 separate 7×7 input-output matrices to determine country-specific price vectors from equation (2). Because these output price vectors differ across countries, such a model assumes that any industry's demand for intermediate inputs is satisfied exclusively by industries in the same country.

(B) CONSUMPTION AND DYNAMICS

4.9 We assume that each consumer receives income from government transfers as well as by supplying his share of the capital stock and part of his endowment of labor. Consumers have rates of time preference that are numerically determined as part of the calibration solution.[18] We assume that, within any period, each consumer supplies labor to only one of the seven industries in his country but that he can relocate part of his labor endowment to other industries within his country in between any two periods. That is, we assume that labor is country- and sector-specific within periods and of limited mobility within a country across periods. To match the observed migration patterns across industries in the base year 2000 when relative wages are exogenously set to one, we calibrate multiplicative constants for the utility of working in each industry. These constants accommodate differences in education requirements and working conditions in the seven industries, and avoid wage equality across industries in steady state.[19]

4.10 We model the consumers' decision problem with the standard set of nested CES and Cobb-Douglas utility functions. Specifically, we assume that each consumer maximizes his lifetime utility function

$$U = \left(\sum_{t=0}^{\infty} a(t) C(t)^{\frac{s-1}{s}} \right)^{\frac{s}{s-1}}, \qquad (3)$$

where $C(t)$ is his consumption at time t, the $a(t)$'s are the CES share parameters that are related to the consumer's pure rate of time preference, and s is the elasticity of intertemporal substitution. First, each consumer allocates his lifetime wealth so as to finance consumption in each period, and then decides how to divide each $C(t)$ among consumption of goods and leisure in that period. He next divides the part of his budget allocated to the consumption of goods among the final goods from the seven sectors.

[18] Our solution algorithm amounts to calibrating each consumer's pure rate of time preference so that his long-run saving rate converges to a stable value, given his observed ratio of marginal utility to price in period zero. The algorithm is described in more detail in Tideman *et al.* (2001). The advantage of this approach is that the periods can be solved sequentially while the assumption of perfect foresight is maintained, which makes it feasible to solve the model for a large number of periods.

[19] The assumption of some degree of labor mobility across sectors in a national economy is equivalent to a migration model in which labor responds to relative wage differentials (see, for example, Ball and Feltenstein, 2001).

Because the 10 countries produce heterogeneous sets of final goods, we assume that consumers care about the origin of production of the commodities that they consume and we employ the standard Armington assumption that final goods produced at different locations are imperfect substitutes for each other. As the final part of his decision problem, the consumer therefore chooses how much of every good to demand from each country.

(C) GOVERNMENTS

4.11 We assume that each government makes direct monetary transfers to consumers, and demands intermediate goods and labor to produce a national public good.[20] Governments finance the production of public goods and transfers to consumers with revenue from import tariffs on imported consumption goods, taxes on capital use, taxes on labor and asset income, taxes on sales, and by issuing public debt. Because our model abstracts from risk, consumers view the holding of government debt and investment in new capital as equivalent so that the interest on public debt equals the equilibrium return of holding existing capital and investment in new capital.

(D) THE REST OF THE WORLD

4.12 We permit the 10 countries to run a trade deficit with the rest of the world, and assume that the rest of the world supplies any quantity of import demand at the world price. Consumers finance the trade deficit by selling a fraction of the capital stock to foreigners. Foreigners use their asset revenue and the proceeds that they obtain from net exports to the 10 countries to finance the countries' budget deficits and to invest in new capital in the region's countries.

[20] We assume that public goods serve neither as substitutes nor complements for private consumption. Because consumers cannot migrate across countries in response to differences in the supply of public goods, we can omit public goods from the consumers' utility functions.

V DATA AND CALIBRATION

5.1 We calibrated the model to replicate the economic situation of the year 2000, using data from the IMF's CEIC Asia Database, statistical abstracts, and through our calculations.[21] We obtained the Leontief coefficients for our split production technology from the *Asian International Input-Output Table* for 1995, published by the Institute of Developing Economies, Japan. This source also provided us with the composition of each government's and each consumer's consumption demand for domestic and foreign goods. We obtained figures for the 2000 Common Effective Preferential Tariff (CEPT) rates from the website of the ASEAN secretariat (www.aseansec.org), and calculated the tariff rates imposed on non-ASEAN imports to match the published tariff revenues. We assumed that each consumer's intertemporal elasticity of substitution is 0.75 and that his elasticity of substitution between the consumption of goods and leisure is 0.8. We calibrated each consumer's pure rate of time preference for his saving rate to smoothly approach a steady growth rate after 75 years.

[21] Spreadsheets that show our calculations and adjustments are available from the authors.

VI SIMULATION RESULTS

6.1 We analyse two scenarios of trade liberalization. The first scenario is the removal of all mutual tariffs between the five ASEAN countries.[22] The second scenario is the admission of China and the Republic of Korea into ASEAN Free Trade Area (AFTA) and the corresponding removal of all mutual tariffs between the seven AFTA countries.

6.2 The ASEAN countries began lowering mutual tariffs in 1993, and there is no indication that any country raised taxes specifically to make up for the lost revenue. We do not consider an analysis of a revenue-neutral policy change to be of much interest in this case. Because the removal of tariffs is likely to change government revenue, the counterfactual simulations depend on our assumption about government expenditure. If government expenditure remains the same as in the base case, then the size of the budget deficit will change. If, on the other hand, the budget deficit is assumed to remain constant, then government expenditure needs to be adjusted. Because the expenditure patterns of consumers and governments differ from each other, the effect of a change in the budget deficit and the corresponding change in consumer spending and investment differs from the effect of leaving the budget deficit unchanged by changing government expenditure. Neither case is inherently more plausible than the other, so we analyse both.

6.3 We assess the economic effects of liberalizing trade by considering changes in (1) the value of output,[23] (2) the value of goods consumption, (3) the value of leisure consumption, (4) the value of imports of final goods, and (5) the equivalent variation. Although (5) is the most inclusive measure of welfare change, the other four illustrate the changes more intuitively. We report only the percentage changes in these variables to simplify the comparison of effects across countries. To provide an idea of the magnitude of the changes, we show the US$ values of selected variables for the year 2000 in Table 1.

[22] The ASEAN countries agreed to reduce mutual tariffs gradually and not to eliminate them completely until 2010. Because most CEPT rates were already fairly low in 2000, we decided to simulate an immediate elimination of tariffs instead.

[23] We choose the value of output rather than GDP because GDP includes the value of tariff revenue.

(A) REMOVAL OF TARIFFS BETWEEN THE ASEAN COUNTRIES

6.4 Table 2 shows the percentage changes of our four key variables in 2000. The percentage changes in future years are very similar to those in 2000, so we omit them in the interest of saving space. Analysis I represents the analysis with unchanged government expenditures and Analysis II the analysis with an unchanged budget deficit.

6.5 The ASEAN countries already reduced their CEPT rates substantially since the establishment of AFTA in 1992, and the average CEPT rate in 2000 was only 3.74%.[24] It is therefore not surprising that the removal of such low tariffs has only a very small effect on the ASEAN economies. The biggest changes are in the volume of imports of final goods; eliminating all tariffs raises the imports of final goods by between 0.28% in Thailand and 0.82% in the Philippines. The percentage changes of all other variables are less than one-tenth of one per cent. The two smallest economies, Malaysia and the Philippines, experience the biggest changes while Singapore experiences the smallest (which is not surprising, given that Singapore's CEPT rates were already zero in 2000).

6.6 It is interesting to note that the value of output in Malaysia and the Philippines *falls* after the removal of tariffs under unchanged government expenditures (Column 1). This result is a direct consequence of being able to use country-specific input-output tables. As imports from other ASEAN countries become relatively cheaper, intra-ASEAN trade increases while imports of final goods from the other five countries decrease. This diversion of trade changes the composition of intermediate inputs that are used to produce the final goods, which happens to lower the total value of output in Malaysia and the Philippines. Although this reduction is very small and does not occur when we assume constant budget deficits, it emphasizes the effect and benefit of using country-specific input-output tables.

6.7 The magnitude of the overall welfare change is fairly modest. The 2000 equivalent variation of the tariff reduction is between US$190 million in Thailand (about 0.02% of the value of output in 2000) and US$799 million in

[24] Malaysia had the lowest average rate with 2.67% and Thailand the highest with 7.40%, while all of Singapore's CEPT rates have been at 0% since the early 1990s.

Malaysia (0.08% of output), while Singapore's is approximately zero.[25] Calculated over the span of 75 years, the equivalent variation is between US$829 million in Thailand and US$4.17 billion in Malaysia. Overall, we conclude that the complete elimination of mutual tariffs between the five ASEAN countries yields the welfare benefits that economic theory predicts, but that these benefits are fairly small.

6.8 An interesting side effect of the small changes is to highlight the consequences of assuming either unchanged government expenditures or unchanged budget deficits. For several variables, these two assumptions about government behavior imply different directions of change. The changes in signs are not consistent across the 10 countries, which can be expected given that these countries differ in their capacities of production (because of differences in industry-specific labor endowments), their government expenditure shares, and their rates of time preference. Nevertheless, the ASEAN countries (with the exception of Singapore) generally experience larger increases in all key variables if their budget deficits rather than their government expenditures remain unchanged.

(B) CHINA AND KOREA JOIN AFTA

6.9 Because China and the Republic of Korea have much higher import demands and tariff rates than the five ASEAN countries, the removal of all tariffs between the seven countries has a fairly sizeable effect. We report the percentage changes of the same key variables as in the earlier analysis for the years 2000 – 2004 and 2010 in Table 3.

6.10 Most notably, the values of Chinese and (South) Korean imports of final goods increase by about 74% and 12.8%, respectively, while the ASEAN countries increase the values of their imports by between 1.1% in Malaysia and 3.7% in the Philippines (Columns 7 and 8). We emphasize that these changes refer only to imports of final goods and do not include imports of intermediate inputs, which explains why the overall changes in the value of 2000 output are much more modest: the value of output increases by between 0.035% (US$364 million) in China and 0.125% (US$91 million) in the Philippines. It is interesting to note that these increases in the value of output do not persist over time in all countries. Only Singapore and the Philippines

[25] We calculated the equivalent variation for a single year *t* as the non-discounted difference between the equivalent variation determined from equation (3) over *t* years minus the equivalent variation determined from equation (3) over *t*-1 years, expressed in year *t* dollars.

experience about the same percentage increase in 2010 output as in 2000 output, while the percentage increase in the value of Malaysia's 2010 output is about half of what it was in 2000. In China and the Republic of Korea, the 2010 output is only marginally higher than it was before trade liberalization. A likely explanation is that Chinese and Korean consumers tend to increase their consumption of leisure by about 0.2% and 0.1%, respectively, while slightly reducing their consumption of goods. While this behavioral change increases consumers' utility, it reduces the demands for—mostly Chinese and (South) Korean—output.

6.11 In contrast to the previous analysis, it is much easier to identify the winners and losers of the elimination of tariffs. Consumers in all seven countries that eliminate their mutual tariffs gain while consumers in Taiwan Province of China, Japan, and the United States are worse off. The countries with the largest reductions in tariffs, China and the Republic of Korea, also experience the largest utility gains, measured in equivalent variation (in absolute values as well in percentage of output—0.56% and 0.37%, respectively), but even the equivalent variations of the ASEAN countries in the year 2000 are noticeably higher than in the previous analysis. It is noteworthy that the differences between the two analyses of constant government expenditures and constant budget deficits are about the same as before—but because most changes are bigger in this experiment, the two analyses almost always yield changes in the same direction.

6.12 The total welfare gain in year 2000 for all 10 countries is about US$7.9 billion under either assumption about government behavior. The sum of the 10 equivalent variations calculated over all 75 years is US$362 billion and US$349 billion, depending on government behavior. We conclude that the overall benefit of China and the Republic of Korea joining AFTA would be fairly sizeable for all seven countries.

VII SUMMARY AND CONCLUSION

7.1 In this paper, we analyse the economics effects of trade liberalization among the ASEAN countries; Indonesia, Malaysia, the Philippines, Singapore, and Thailand. These countries currently levy tariffs on imports of final goods but no tariffs on the imports of intermediate inputs. In addition, these countries produce many intermediate inputs with fairly high degrees of substitutability. The two standard approaches of modeling trade in intermediate inputs are based on the Armington assumption - which assumes that such inputs are distinguishable by place of origin as well as physical type - are not applicable to this situation. We develop an alternative approach that avoids the Armington assumption for intermediate goods and assumes instead that intermediate inputs are perfect substitutes.

7.2 We calibrated our dynamic perfect-foresight model to ASEAN macro data for the year 2000 and undertook two simulations of trade reform—the elimination of mutual import tariffs among the five ASEAN countries and the admission of China and the Republic of Korea into AFTA. We find that complete trade liberalization between the five ASEAN countries leads to only small welfare benefits. This result is plausible because the mutual tariffs among these five countries were already very low in 2000. Our analysis of admitting China and the Republic of Korea into AFTA implies much larger welfare benefits; this is intuitive as well, because the current Chinese and (South) Korean import tariffs are still quite high. Overall, the directions of change are as suggested by economic theory and reinforce arguments for free trade.

Table 1. Historical Values of Selected Economic Variables for year 2000 (in billions of U.S. dollars)

	Value of output	Value of goods consumption	Value of leisure consumption	Value of imports of final goods (net of tariffs)
Indonesia	141.97	99.69	10.99	8.84
Malaysia	84.98	38.25	8.02	11.22
Philippines	72.53	52.22	5.90	3.39
Singapore	82.99	37.77	10.31	4.99
Thailand	110.53	68.65	11.09	7.52
China	1,004.77	518.16	132.98	14.08
Taiwan Province of China	281.65	191.50	45.65	20.31
Korea, Rep. of	458.79	276.28	63.14	8.90
Japan	4,443.58	2,637.53	691.10	98.50
United States	9,412.60	6,739.40	1,590.08	325.03

Sources: IFS (various issues); *Asian International Input-Output Table 1995*; and authors' estimates.

Note: The value of output is GDP minus indirect taxes (which include tariffs).

Table 2. Economic Effects of Eliminating All Mutual Tariffs Among the Five ASEAN Countries 1/

	% change in the value of output		% change in the value of goods consumption		% change in the value of leisure consumption		% change in the imports of final goods		Equivalent variation (US$billion)			
									2000		Over all 75 years	
	I	II	I	II	I	II	I	II	I	II	I	II
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Indonesia	0.000	0.007	-0.003	0.014	0.005	0.023	0.486	0.483	0.035	0.055	1.365	2.091
Malaysia	-0.008	0.028	-0.001	0.034	0.031	0.066	0.555	0.563	0.064	0.080	3.320	4.174
Philippines	-0.004	0.014	0.005	0.017	0.014	0.025	0.823	0.817	0.028	0.036	1.245	1.567
Singapore	0.000	0.004	0.000	-0.015	-0.001	-0.016	0.000	-0.014	0.000	-0.007	0.024	-0.374
Thailand	0.000	0.008	-0.003	0.004	0.004	0.010	0.281	0.277	0.019	0.024	0.829	1.045
China	0.001	0.000	-0.004	0.000	-0.004	-0.001	-0.005	0.000	-0.025	-0.006	-0.759	0.433
Taiwan	-0.001	0.002	0.003	-0.010	0.003	-0.010	0.002	-0.009	0.007	-0.022	0.361	-0.857
South Korea	-0.001	0.006	0.002	-0.021	0.002	-0.021	0.002	-0.021	0.008	-0.070	0.496	-2.891
Japan	0.001	-0.003	-0.003	0.007	-0.003	0.006	-0.003	0.006	-0.105	0.231	-3.739	10.769
United States	0.000	-0.001	-0.001	-0.003	-0.001	-0.003	-0.001	-0.003	-0.047	-0.145	0.894	-9.494

1/ Analysis I represents the case with unchanged government expenditures. Analysis II represents the case with unchanged budget deficits.

Table 3. Economic Effects of Eliminating All Mutual Tariffs Among the Five ASEAN Countries, China and Korea 1/

	% change in the value of output		% change in the value of goods consumption		% change in the value of leisure consumption		% change in the imports of final goods		Equivalent variation (US$billion) Annual		Over all 75 years	
	I	II	I	II	I	II	I	II	I	II	I	II
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Indonesia											$6.3	$5.8
2000	0.076	0.078	0.010	0.000	0.040	0.031	1.514	1.505	$0.134	$0.123		
2001	0.040	0.042	0.015	0.006	0.042	0.033	1.526	1.517	$0.152	$0.141		
2002	0.027	0.029	0.017	0.008	0.043	0.034	1.529	1.521	$0.161	$0.150		
2003	0.022	0.024	0.018	0.008	0.043	0.033	1.532	1.523	$0.166	$0.155		
2004	0.018	0.020	0.018	0.009	0.042	0.033	1.534	1.524	$0.170	$0.159		
2010	0.009	0.012	0.022	0.013	0.046	0.037	1.547	1.538	$0.188	$0.176		
Malaysia											$7.8	$6.7
2000	0.090	0.102	-0.002	-0.045	0.061	0.017	1.099	1.057	$0.129	$0.109		
2001	0.069	0.081	0.007	-0.036	0.069	0.026	1.102	1.060	$0.144	$0.123		
2002	0.062	0.074	0.010	-0.032	0.073	0.030	1.106	1.065	$0.152	$0.131		
2003	0.060	0.073	0.012	-0.031	0.074	0.031	1.110	1.069	$0.159	$0.137		
2004	0.055	0.068	0.013	-0.030	0.075	0.032	1.105	1.064	$0.165	$0.142		
2010	0.053	0.065	0.017	-0.026	0.081	0.039	1.102	1.061	$0.193	$0.167		
Philippines											$5.9	$6.8
2000	0.125	0.113	-0.043	-0.005	0.007	0.044	3.724	3.762	$0.123	$0.145		
2001	0.112	0.100	-0.039	-0.001	0.012	0.048	3.733	3.771	$0.131	$0.153		
2002	0.106	0.095	-0.038	0.000	0.013	0.051	3.723	3.761	$0.134	$0.156		
2003	0.105	0.095	-0.038	0.000	0.013	0.051	3.715	3.753	$0.135	$0.157		
2004	0.107	0.097	-0.038	0.000	0.013	0.051	3.707	3.744	$0.136	$0.158		
2010	0.121	0.114	-0.036	0.002	0.016	0.054	3.660	3.697	$0.140	$0.163		
Singapore											$7.7	$8.7
2000	0.064	0.051	-0.063	-0.021	0.018	0.060	2.401	2.445	$0.137	$0.157		
2001	0.061	0.048	-0.066	-0.024	0.016	0.059	2.398	2.442	$0.145	$0.166		
2002	0.058	0.045	-0.066	-0.025	0.015	0.057	2.397	2.439	$0.152	$0.174		
2003	0.058	0.044	-0.067	-0.025	0.014	0.055	2.397	2.439	$0.159	$0.182		
2004	0.058	0.044	-0.067	-0.025	0.014	0.056	2.396	2.440	$0.165	$0.189		
2010	0.077	0.061	-0.066	-0.024	0.015	0.057	2.400	2.441	$0.200	$0.229		

Table 3 (continued)

	% change in the value of output		% change in the value of goods consumption		% change in the value of leisure consumption		% change in the imports of final goods		Equivalent variation (US$billion) Annual		Over all 75 years	
	I	II	I	II	I	II	I	II	I	II	I	II
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Thailand											$8.2	$9.2
2000	0.055	0.043	0.022	0.058	0.063	0.100	1.800	1.836	$0.178	$0.207		
2001	0.037	0.025	0.025	0.061	0.066	0.103	1.803	1.837	$0.191	$0.221		
2002	0.026	0.014	0.026	0.062	0.066	0.103	1.802	1.839	$0.200	$0.231		
2003	0.021	0.009	0.026	0.063	0.067	0.104	1.802	1.838	$0.206	$0.238		
2004	0.018	0.006	0.027	0.063	0.067	0.103	1.801	1.836	$0.212	$0.244		
2010	0.018	0.006	0.030	0.066	0.071	0.108	1.799	1.834	$0.237	$0.272		
China												
2000	0.036	0.034	-0.031	-0.023	0.183	0.191	73.724	73.736	$5.606	$5.657	$289.2	$290.8
2001	0.024	0.022	-0.022	-0.014	0.192	0.200	74.083	74.094	$6.070	$6.124		
2002	0.016	0.014	-0.019	-0.011	0.195	0.203	74.294	74.308	$6.404	$6.461		
2003	0.012	0.009	-0.019	-0.011	0.195	0.203	74.478	74.491	$6.693	$6.752		
2004	0.009	0.007	-0.018	-0.010	0.196	0.204	74.628	74.643	$6.964	$7.026		
2010	0.007	0.004	-0.014	-0.006	0.200	0.208	75.188	75.200	$8.366	$8.439		
Taiwan Province of China											-$1.4	-$0.2
2000	0.004	-0.001	-0.032	-0.018	-0.032	-0.018	-0.032	-0.018	-$0.071	-$0.037		
2001	-0.002	-0.006	-0.033	-0.019	-0.033	-0.018	-0.032	-0.018	-$0.065	-$0.031		
2002	-0.006	-0.011	-0.033	-0.019	-0.034	-0.019	-0.033	-0.019	-$0.061	-$0.026		
2003	-0.009	-0.013	-0.034	-0.019	-0.034	-0.020	-0.033	-0.019	-$0.060	-$0.024		
2004	-0.011	-0.015	-0.034	-0.019	-0.035	-0.020	-0.034	-0.020	-$0.059	-$0.023		
2010	-0.012	-0.016	-0.031	-0.017	-0.033	-0.018	-0.031	-0.017	-$0.056	-$0.018		
Republic of Korea											$75.5	$70.7
2000	0.041	0.050	-0.018	-0.048	0.104	0.073	12.776	12.742	$1.706	$1.602		
2001	0.031	0.040	-0.017	-0.048	0.104	0.073	12.733	12.700	$1.765	$1.659		
2002	0.025	0.034	-0.017	-0.048	0.104	0.073	12.695	12.661	$1.806	$1.698		
2003	0.021	0.030	-0.017	-0.048	0.103	0.073	12.659	12.625	$1.840	$1.730		
2004	0.017	0.026	-0.017	-0.048	0.103	0.072	12.623	12.590	$1.872	$1.760		
2010	0.005	0.014	-0.015	-0.046	0.105	0.075	12.449	12.417	$2.044	$1.922		

Table 3 (concluded)

	% change in the value of output		% change in the value of goods consumption		% change in the value of leisure consumption		% change in the imports of final goods		Equivalent variation (US$billion) Annual		Over all 75 years	
	I	II	I	II	I	II	I	II	I	II	I	II
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Japan											$7.1	-$3.4
2000	-0.023	-0.022	-0.006	-0.010	-0.007	-0.012	-0.008	-0.012	$0.104	-$0.041		
2001	-0.024	-0.023	-0.009	-0.014	-0.011	-0.015	-0.009	-0.014	$0.040	-$0.108		
2002	-0.028	-0.027	-0.010	-0.015	-0.012	-0.017	-0.011	-0.016	$0.043	-$0.110		
2003	-0.030	-0.029	-0.011	-0.016	-0.013	-0.017	-0.013	-0.017	$0.049	-$0.107		
2004	-0.031	-0.030	-0.012	-0.016	-0.013	-0.018	-0.014	-0.018	$0.048	-$0.113		
2010	-0.033	-0.032	-0.011	-0.015	-0.013	-0.017	-0.013	-0.017	$0.046	-$0.135		
United States											-$44.3	-$45.7
2000	-0.031	-0.031	-0.016	-0.015	-0.020	-0.018	-0.017	-0.016	-$0.148	-$0.034		
2001	-0.026	-0.026	-0.022	-0.021	-0.025	-0.024	-0.023	-0.021	-$0.650	-$0.530		
2002	-0.024	-0.024	-0.025	-0.024	-0.028	-0.026	-0.026	-0.024	-$0.842	-$0.720		
2003	-0.023	-0.023	-0.027	-0.025	-0.029	-0.028	-0.02	-0.026	-$0.951	-$0.826		
2004	-0.022	-0.022	-0.028	-0.027	-0.030	-0.029	-0.028	-0.027	-$1.055	-$0.927		
2010	-0.016	-0.016	-0.029	-0.028	-0.031	-0.030	-0.029	-0.028	-$1.455	-$1.317		

Notes: Japan's equivalent variation in column 9 is positive because Japanese consumers consume more leisure. Column 5 measures the percentage change in the value of leisure, which is negative because the decrease in wages outweighs the corresponding increase in the hours of leisure.

1/ Analysis I represents the case with unchanged governm ent expenditures. Analysis II represents the case with unchanged budget deficits.

APPENDIX 1

COMPARISON OF AN ARMINGTON AND A NON-ARMINGTON MODEL

1 We compare the results of our non-Armington model with those of a traditional 10-country Armington model to evaluate the implications of assuming that intermediate goods from different countries are perfect substitutes. The core of the seven-sector Asian International Input-Output table for 1995 is a 70×84 (= 7·10×7·12) matrix of Leontief shares of intermediate inputs for the 10 countries; Indonesia, Malaysia, the Philippines, Singapore, Thailand, China, Taiwan Province of China, the Republic of Korea, Japan, and the United States, together with information on trade with Hong Kong SAR and the rest of the world. For each industry in each of the 10 countries, the table contains the intermediate input requirements from the 84 (= 7·12) industries in the 12 regions covered by the table. For the non-Armington model, we derived the 10 country-specific IO-tables from the 70×84 matrix by aggregating each country's intermediate input shares in each industry over all 12 regions. For the Armington model of 10 countries, we derived a 70×70 (= 7·10×7·10) intermediate input matrix by adding the sum of the Hong Kong and rest of the world input shares to the input shares from the 10 countries.

2 The Leontief shares represent technological input requirements with zero substitutability that do not depend on relative prices. However, the 70×70 table does not yield values anywhere close to the observed 2000 levels of value added in the seven industries in each country. This suggests that either the technological requirements changed substantially between 1995 and 2000 or that the import coefficients do not represent technological input requirements but rather the actual import shares under the 1995 prices. If the coefficients are functions of the 1995 prices, then it is problematic to use them for analyses that permit relative prices to change and poses a potentially serious problem for an Armington model. This does not pose a problem for our non-Armington model because even if the shares that represent the region of origin of an intermediate input depend on relative prices in 1995, it is nevertheless possible to interpret the sum of these shares as a technological coefficient.

3 Fortunately, it is not necessary to match the observed 2000 data with the Armington model because the main purpose of this exercise is to compare the two models, not to undertake any actual policy analysis. We therefore solved the Armington model using the 70×70 table, accepting each country's industry output of value added as determined by the table, and used

the resulting output in each industry as the base case values. We then used these output shares to calibrate the non-Armington model to yield the identical equilibrium solution. For comparison, we report the actual and imputed total values of output and the actual and imputed total values of imports in each country in Columns 1 and 2 of Tables A1 and A2.

4 The computational requirements of the Armington model made it too time-consuming to place it within a perfect foresight framework, and we decided to compare two static one-period models with fixed saving shares instead.[26] To obtain a somewhat larger effect than in our main analyses, we doubled the tariff rates on imports of final goods of all countries and compared the counterfactual solutions of the two models.[27] We report the results in Tables A1 – A3. Columns 3 and 4 of Table A1 show the values for the two models after doubling all tariff rates, and Columns 5 and 6 show the percentage differences relative to the base case. Doubling all tariffs reduces the value of imports of final goods by between about 6% in the United States and 42% in China (the two countries with the lowest and the highest tariffs). We remind the reader that the two models differ only with respect to the substitutability of intermediate inputs, and that consumers in both models consider final goods from different regions imperfect substitutes. Because the consumption parameters including the Armington elasticities for final goods are identical in both models, it is not surprising that both models imply very similar reductions in imports of final goods.

5 Table A2 shows the changes in levels and percentages of the value of output in each country. Not surprisingly, the Armington model with fixed intermediate input coefficients for imports yields much larger changes than the non-Armington model, and the assumption of fixed import coefficients has a notable impact on the distribution of output changes. The Armington model in Column 4 suggests that the value of output in all countries except Japan and the United States decreases and that the value of output in these two countries—especially in the United States—increases by enough to raise the overall value of output in the 10 countries by US$19.34 billion. The non-

[26] The Armington model with industry-specific labor has over 70 unknown prices whose equilibrium values need to be determined simultaneously, compared to only 9 unknown prices for the non-Armington model (seven prices of labor, one price of capital, and one slack price to circumvent the simultaneity problem that arises from the taxation of factors). Solution time increases exponentially with the number of unknown prices and the solution of a multi-period Armington model required more time than what seemed warranted for our comparative exercise.

[27] As the elasticities of interregional substitution increase, the results of the Armington converge to the results of the non-Armington model. Plassmann (2005) shows a comparison of non-Armington and Armington models with different elasticities of interregional substitution.

Armington model, on the other hand, suggest a much more homogeneous effect with small increases in the value of output in every country except Indonesia and an increase in the total value of output of only US$4.14 billion.

6 Our analysis assumes that the level of government consumption remains constant in the counterfactual analysis and that each government uses the extra tariff revenue to finance the production of additional capital. The change in the value of output therefore does not measure the change in welfare that results from the restriction of trade. Table A3 shows the percentage changes in the value of the consumption of goods and the consumption of leisure units as well as the compensating variation necessary to restore utility to the levels before the tariff change. Both models yield decreases in the value of consumption of goods (as well as decreases in the consumption of physical units), and as before, the range of changes in the Armington model is wider than in the non-Armington model. The pattern differs for the consumption of units of leisure, where the Armington model yields relatively small changes while the non-Armington model suggests more heterogeneous results. However, with respect to changes in the value of leisure (not shown) that take account of wage changes, the pattern and direction of change is identical to the changes in the value of goods consumption. Given the larger changes in the consumption of leisure, it is not surprising that the non-Armington model also implies larger compensating variations for all countries except Japan and the United States. The Armington model yields a larger decrease in the consumption of leisure units for the United States, which explains why its compensating variation for the United States is almost twice the compensating variation implied by the non-Armington model.

7 Overall, we conclude that the results of the two models differ notably. Which sets of results is more compelling depends on one's beliefs about the appropriate structure of trade. Because the import coefficients of the 70×70 IO-table seem to depend at least in part on relative prices in 1995 and because we find it difficult to believe that firms in the five Southeast Asian countries will not change their import patterns in response to changes in relative prices while consumers do change their demands for imports, we consider the non-Armington model a more appropriate framework for our analysis.

Table A1. Value of Imports of Final Goods (in billions of U.S. dollars)

			Change after doubling all tariff rates		% change relative to the base case	
	Actual values	Calibrated base case	Non-Armington	Armington	Non-Armington	Armington
	(1)	(2)	(3)	(4)	(5)	(6)
Indonesia	8.84	29.48	27.38	27.36	-7.13	-7.19
Malaysia	11.22	28.95	26.77	26.65	-7.52	-7.93
Philippines	3.39	4.23	3.28	3.27	-22.41	-22.64
Singapore	4.99	16.23	13.75	13.68	-15.31	-15.74
Thailand	7.52	7.00	5.83	5.79	-16.77	-17.24
China	4.05	3.45	1.98	1.98	-42.51	-42.65
Taiwan Prov. of China	20.31	18.27	16.10	15.97	-11.87	-12.57
Korea, Rep. of	8.90	7.93	6.13	6.10	-22.72	-23.04
Japan	98.50	96.41	90.75	90.78	-5.87	-5.84
United States	325.03	315.19	296.69	297.31	-5.87	-5.67
Total	492.74	527.14	488.66	488.90	-7.13	-7.19
Tariff revenue	53.15	56.15	96.09	96.00	71.13	70.97

Table A2. Value of Output (in billions of U.S. dollars)

			Change after doubling all tariff rates		% change relative to the base case	
	Actual values	Calibrated base case	Non-Armington	Armington	Non-Armington	Armington
	(1)	(2)	(3)	(4)	(5)	(6)
Indonesia	141.98	382.14	382.12	381.13	-0.00	-0.26
Malaysia	84.98	102.13	102.24	100.81	0.10	-1.30
Philippines	72.53	94.96	95.34	93.78	0.40	-1.24
Singapore	82.99	107.78	108.01	106.64	0.21	-1.06
Thailand	110.53	95.94	96.10	94.26	0.17	-1.75
China	1,004.77	645.11	645.33	641.84	0.03	-0.51
Taiwan Prov. of China	281.65	215.55	215.65	212.43	0.05	-1.44
Korea, Rep. of	458.79	336.14	336.38	332.47	0.07	-1.09
Japan	4,443.58	3,938.24	3,938.22	3,939.25	0.00	0.03
United States	9,412.60	10,176.42	10,179.14	10,211.15	0.03	0.34
Total	16,094.40	16,094.40	16,098.54	16,113.74	0.03	0.12

Table A3. Measures of Welfare Loss

	% Change in the value of goods consumption (net of tariffs)		% Change in the consumption of leisure units		Compensating variation (in US$ billion)	
	Non-Armington (1)	Armington (2)	Non-Armington (3)	Armington (4)	Non-Armington (5)	Armington (6)
Indonesia	-0.68	-0.79	-1.10	0.02	$2.58	$2.34
Malaysia	-2.31	-2.76	-2.54	0.16	$2.61	$2.33
Philippines	-2.38	-2.96	-1.33	0.05	$2.41	$2.17
Singapore	-2.34	-2.82	-1.81	-0.10	$3.86	$3.38
Thailand	-2.36	-3.04	0.38	0.17	$1.95	$1.64
China	-0.27	-0.54	-0.90	-0.07	$6.35	$5.41
Taiwan Prov. of China	-1.54	-2.43	0.12	0.04	$3.12	$1.78
Korea, Rep.of	-1.19	-1.83	-0.99	0.03	$4.39	$3.02
Japan	-0.27	-0.25	-0.95	-0.05	$7.93	$9.53
United States	-0.26	-0.06	-0.05	-0.13	$22.78	$41.37
Total	-0.38	-0.31	-0.34	-0.10	$58.98	$72.96

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