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December 2007

The Impact of CAFTA on Poverty, Distribution, and Growth in El Salvador

Samuel Morley
Eduardo Nakasone
and
Valeria Piñeiro, Independent Consultant

Development Strategy and Governance Division
and
Markets, Trade and Institutions Division

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ABSTRACT

In this paper we develop a dynamic CGE model to examine the impact of CAFTA on production, employment and poverty in El Salvador. We model four aspects of the agreement: tariff reductions, quotas, changes in the rules of origin for maquila and more generous treatment of foreign investment. The model shows that CAFTA has a small positive effect on growth, employment and poverty. Tariff reduction under CAFTA adds about .2% to the growth rate of output up to 2020. Liberalizing the rules of origin for maquila has a bigger positive effect on growth and poverty mainly because it raises the demand for exportables produced by unskilled labor. We model the foreign investment effect by assuming that capital inflows go directly to capital formation. This raises the growth rate of output by over 1% per year and lowers poverty incidence in 2020 by over 25% relative to what it would be in the baseline scenario.

These simulations say something important about the growth process in a country like El Salvador in which it seems reasonable to assume that there is idle unskilled labor willing and able to work at a fixed real wage. In such an economy, growth can be increased in one of three ways. First, already employed resources can be moved to sectors where they are more productive. That is what the tariff reductions under CAFTA do, and the result is positive but small. Second, the structure of demand can be changed in such a way as to increase the demand for previously unemployed unskilled labor. That is what the maquila simulation does, because maquila uses a lot of unskilled labor relative to skilled labor and capital. Finally the supply of capital can be increased by increasing the rate of capital formation. That is what happens in the FDI simulation.

Key words: CAFTA, El Salvador, growth, poverty, CGE model

1. INTRODUCTION

The Central America Free Trade Agreement (CAFTA–DR) was negotiated in 2004 between the United States and five countries of Central America: Costa Rica, El Salvador, Guatemala, Honduras, and Nicaragua. The treaty was later expanded to include the Dominican Republic (DR). It promises greater access to the U.S. market for Central American and Dominican exporters and liberalized treatment on rules of origin for the maquila industry It includes all sorts of assembly, but about 90% are textile and clothing firms., in exchange for reduced barriers to imports, guarantees for foreign direct investment, and greater protection for intellectual property by each of the signatories. For El Salvador, CAFTA is a logical further step in a process of trade liberalization and reform that has made its economy one of the most open in the region. Its policy is devoted to attracting foreign investment and expanding exports, particularly to the United States. In effect, by tying itself more firmly to the global economy in general and to the United States in particular,[1] El Salvador is gambling that its development prospects will be enhanced.

Even though El Salvador was the first country in Central America to ratify CAFTA (in December 2004), the agreement has been controversial. Some feel that lowering tariffs on the products they grow will hurt El Salvador's poor farmers. Others feel that the treatment of foreign investment and intellectual property rights is too generous, and the protection of the environment is too lax. In addition, the prior commitment to trade liberalization and reform does not seem to have done much for the Salvadorian economy. While the economy did grow quite rapidly in the early 1990s, as tariffs were reduced, there has essentially been no growth in the last 10 years, partly because El Salvador has suffered a series of natural disasters since the late 1990s. Whatever the reason for this poor performance, it has increased skepticism about the supposed benefits of CAFTA.

The purpose of this paper is to identify and quantify the effects that adherence to the Agreement will have in the years ahead. First, we summarize the changes in the level of protection that El Salvador and the United States have agreed to in the CAFTA Agreement. Second, we use a Computable General Equilibrium (CGE) model to simulate the effects of these changes on domestic production, employment, prices, and factor incomes. Because the changes in tariffs and quotas in the Agreement are gradual, our model is dynamic. With it we hope to be able to show how the economy will react over time to these policy changes. Finally, we use the results of the CGE simulations to determine the effects of the various CAFTA scenarios on poverty and the distribution of income.

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[1] In addition, El Salvador dollarized its economy in January, 2001.

2. TRENDS IN INCOME, TRADE, AND PROTECTION PRIOR TO CAFTA

Even before CAFTA, El Salvador had already significantly reduced barriers to imports. During the 1990s the average tariff rate was cut by almost two-thirds, so that by 1999 the country had the second lowest tariff levels and the smallest tariff dispersion in Central America (Table 1). That means that CAFTA does not represent a significant change in direction in general tariff policy. Averages, of course can hide significant differences in protection across sectors. But the negotiators of CAFTA were quite careful to maintain protection for politically sensitive products such as foodcrops, at least in the short and medium run.

To get a sense of the economic environment in which CAFTA was passed, we present several key sectoral and macro time series since 1990 in Table 1. The first thing that stands out in the table is the deterioration in El Salvador's growth performance beginning in about 1995. Whereas per capita income grew at 4 percent per year in the first five years of the 1990s, growth slowed to 1 percent per year from 1995–2000 and did not grow at all in the next four years. Critics of trade liberalization could be pardoned for questioning the benefits of a growth strategy based on trade liberalization. Agriculture has been particularly hard hit by trade liberalization; its share of gross domestic product (GDP) fell by almost 50 percent after 1990. That was offset to some extent by the rise of a vibrant fishing sector. As the table shows, industry has maintained its share of GDP since 1990. This is entirely due to the rise of the maquila component, which by 2002 comprised 11 percent of GDP (Morley 2006). Since virtually all of the expansion of maquila happened after 1990, the data suggest that nonmaquila manufacturing must have shrunk by at least 4 percent of GDP. Two points follow from this. First, maquila plays a significant role in the story of the potential impact of CAFTA. Second, other than maquila and fishing, the rest of the traded goods sector has not benefited from trade liberalization to date. This is partly due to the succession of natural disasters and partly to the effects of an increasingly overvalued exchange rate resulting from the success of maquila and the large quantity of remittances flowing into El Salvador from migrants in the United States.

Table 1. Patterns of growth and tariffs in El Salvador

Year	GDP per capita	INV/Y	EXP/Y	IMP/Y	AG/Y	Min + Fish/Y	IND/Y	SVC/Y	Tariff data Average	Tariff data Dispersion
					shares (current prices)					
1990	939.4799	0.139	0.186	0.312	0.171	0.018	0.267	0.543	0.160	0.086
1991	954.9056	0.154	0.172	0.305	0.171	0.023	0.067	0.539		
1992	1006.261	0.185	0.161	0.324	0.142	0.023	0.296	0.539		
1993	1057.613	0.186	0.194	0.341	0.140	0.064	0.282	0.514		
1994	1097.564	0.197	0.200	0.352	0.140	0.067	0.280	0.513		
1995	1142.901	0.200	0.216	0.378	0.134	0.076	0.274	0.516	0.102	0.076
1996	1138.013	0.152	0.211	0.339	0.130	0.074	0.274	0.522		
1997	1161.788	0.151	0.259	0.376	0.134	0.067	0.273	0.526	0.102	0.057
1998	1180.847	0.176	0.248	0.371	0.120	0.066	0.282	0.531		
1999	1197.218	0.164	0.249	0.373	0.105	0.065	0.293	0.537	0.057	0.034
2000	1199.116	0.169	0.274	0.424	0.098	0.066	0.295	0.541		
2001	1196.377	0.167	0.258	0.416	0.094	0.069	0.299	0.538		
2002	1200.383	0.162	0.264	0.411	0.085	0.068	0.302	0.544		
2003	1200.076	0.167	0.267	0.430	0.085	0.072	0.300	0.543		
2004	1197.116	0.156	0.272	0.442	0.088	0.071	0.287	0.554		

Source: World Development Indicators. For tariff data, see Lederman, Perry, and Suescun (2002).
*Percentages of GDP at current prices

3. TRADE LIBERALIZATION UNDER CAFTA

The CAFTA treaty specifies precisely how tariffs on all commodities are going to be eliminated or reduced over time. For each country, the agreement contains a long and detailed list of commodities, with both the current most-favored nation (MFN) tariff and a tariff category to which the commodity has been assigned. These categories determine how quickly tariffs will be reduced over time. Table 2 shows the categories that are relevant to El Salvador.

Table 2. Tariff Categories under CAFTA

Category	
A	Immediate tariff reduction to 0
B	Linear reduction of tariffs to 0 over 5 years
C	Linear reduction of tariffs over 10 years
D	Linear reduction of tariffs over 15 years
E	Six-year grace period, then reduction of 33% over next 4 years, then full liberalization from 12^{th} to 15^{th} year
F	Ten-year grace period, then linear reduction to 0 over the next 10 years
G	Goods in this category already have a 0 tariff rate
H	Goods in this category are excluded from tariff reductions under CAFTA, with tariffs remaining at the rates agreed to by the World Trade Organization (WTO)
M	Nonlinear reduction in tariffs to 0: 2% in 1^{st} year, 8% per year from 3^{rd} to 6^{th} year, and 16% per year from 7^{th} to 10^{th} year
N	Elimination of tariffs in 12 equal annual steps
O	Six-year grace period and then elimination in 9 nonlinear steps: 40% from 7^{th} to 11^{th} year, and 60% from 12^{th} to 15^{th} year
P	Ten-year grace period, then elimination over 7 years: 33% from the 11^{th} to the 14^{th} year and 67% from the 15^{th} to the 18^{th} year
Q	Elimination over 15 years: 15% in 1^{st} year, 33% from the 4^{th} to the 8^{th} year, and 67% from the 9^{th} to the 15^{th} year

Source: CAFTA-DR Treaty

For a subset of sensitive agricultural products, CAFTA also expands a system of tariff rate quotas (TRQs), originally set up under the World Trade Organization (WTO), which define the amounts of certain commodities that can be imported free of tariffs.[2] In addition, for many products, safeguard provisions permit a country to apply the MFN tariff level if imports from the United States or imports from Central America to the United States exceed the safeguard level. Safeguards are provisions permitted under WTO (and the General Agreement on Tariff and Trade [GATT]) regulations, by which imports beyond the safeguard level can be temporarily restricted if the affected industry can show that it will suffer serious injury from that level of imports. In most cases, the tariffs at the safeguard level fall over time.

[2] These are products that are politically sensitive or produced or consumed by the poor.

We now turn our attention to changes in the level of protection of agricultural commodities under CAFTA (Table 3). As is pointed out above, commodities under CAFTA are divided into various categories, according to the time profile of programmed tariff reductions under the agreement. Table 3 shows the amount of trade in each of the tariff categories for all agricultural and processed agricultural products, and the level and changes in the average tariff in each of the categories.[3]

For example, in category A, tariffs are eliminated immediately, while in B they are reduced to zero in five equal installments over the first 5 years and in C over the first 10 years. Note that these are all weighted averages of individual tariff rates, where the weights are determined by the commodity's share in total imports. As is well known, under this method, the average level of protection can be seriously underestimated when tariffs are so high that they choke off imports.

Certain commodities like beans, corn, and rice are of particular importance to the poor, from both the income and consumption viewpoint. We have used the information on tariff categories and initial tariffs (in the column called pre-CAFTA, table 3) to calculate the time path of tariff reductions for a number of these "sensitive" commodities; the results are presented in the lower portion of Table 3. Note that the table shows only the tariff level, not the impact of quotas, which we will discuss later.

A high level of protection is clearly afforded to domestic producers of sensitive products, particularly yellow corn, poultry, pork, beans, and rice.[4] This pattern may, at least to some extent reflect the desire by the Central American governments to protect their producers from subsidized exports from the United States. A recent study estimated that subsidies in the United States amounted to 41 percent of the value of production of rice, 50 percent for milk, and 32 percent for corn (Monge, Sagot, and Gonzalez 2004). With the exception of white corn, tariff protection for all of these sensitive products will disappear over 20 years. But for most, liberalization will be very gradual, much of it occurring at least 10 years after the treaty goes into effect. This is important. In Central America, many have protested that CAFTA will hurt small farmers by reducing protection of commodities of particular importance to smallholders and the poor. The evidence in the table makes it quite clear that this will not be the case, at least for the first 5 to 10 years. It seems that the Salvadoran negotiators of CAFTA were not willing to impose a shock treatment on the producers of these sensitive commodities. But it is also clear that over the long run, the reductions in tariffs for these commodities are considerable. Domestic producers are given a fairly long time to adopt new crops or new and more efficient production techniques. But in the long run, they will have to adjust to a far lower level of protection.

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[3] Note that formally CAFTA only reduces Salvadoran tariffs on goods imported from the United States. For simplicity, in this paper, the CAFTA tariff reductions are treated as if they apply to all imported commodities. This implies that the estimates of the impact of tariff reduction will be overstated. The reason for this simplifying assumption is that the tariff rates are so low that the differences between the true effect and the estimates are necessarily small.

[4] This pattern is observed not only in El Salvador but also in the other Central American countries (Morley 2006).

Tariffs in categories A and B are either eliminated immediately or over the first five years of the agreement. These categories include products such as prime cuts of beef, fish, flowers, various fresh fruits and vegetables, potatoes, and inputs to processed foods such as soups and dog food. For the most part, these are not products in which U.S. imports compete with local producers. For fish, fruits, and vegetables, it is unlikely that U.S. prices would compete with the local products even at a zero tariff. The picture for beef is more complicated. Central American cattle growers do not now produce prime cuts of beef, so the increase in tariff-free imports should have little effect on local producers. In fact, because CAFTA grants beef import quotas to the United States, the treaty is on balance likely to be favorable to them.

Category C commodities are those with a 10-year linear tariff reduction schedule. This group primarily comprises processed foods. Commodities in the D and F categories will see a gradual reduction of tariff protection over 15 or 20 years, respectively. Thus whatever impact CAFTA has on producers in these two categories will necessarily be quite drawn out. The bulk of D category products are dairy products, processed foods, chocolate, malts, and products made from vegetable oil or animal fat.

The treatment of different agricultural commodities under CAFTA was anything but uniform (Table 3). Over half of imports either had no protection prior to CAFTA (category G) or had tariff rates set to zero upon ratification of the agreement. A second group of commodities will have their tariffs lowered, but the process will be quite gradual. Finally, for several sensitive commodities such as white corn, rice, poultry, and dairy, tariffs are either not lowered at all or not lowered significantly until at least 10 years after ratification.

Table 3. Tariff reductions under CAFTA

Tariff Category	Imports	Exports	Number of products	Average tariff rates: Pre CAFTA	First year	5th year	10th year	15th year
A	18836	1055	398	13.39%	0.00%	0.00%	0.00%	0.00%
B	9376	898	141	12.85%	10.28%	0.00%	0.00%	0.00%
C	17553	7614	153	15.33%	13.80%	7.68%	0.00%	0.00%
D	6249	34825	89	18.24%	16.96%	12.17%	6.07%	0.00%
G	146154	576	245	0.00%	0.00%	0.00%	0.00%	0.00%
N	2135	335	17	21.18%	19.49%	12.36%	3.53%	0.00%
Yellow corn	48854	0	1	15.00%	15.00%	15.00%	9.00%	0.00%
White corn	644	0	1	20.00%	20.00%	20.00%	20.00%	20.00%
Quota	19276	42	42	38.58%	38.50%	38.50%	38.50%	25.68%
Total	268433			8.53%	6.43%	6.43%	4.62%	1.89%

Table 3. Continued

Tariff on sensitive commodities								
	Yellow corn	White corn	Rice	Beans	Beef	Pork	Poultry	Diary
Initial	0.150	0.2	0.400	0.15	0.15	0.400	0.370	0.002
Year 1	0.150	0.2	0.400	0.12	0	0.400	0.306	0.002
Year 5	0.150	0.2	0.400	0	0	0.400	0.253	0.002
Year 10	0.102	0.2	0.400	0	0	0.272	0.228	0.002
Year 15	0	0.2	0.213	0	0	0	0.121	0.001
Year 20	0	0.2	0	0	0	0	0	0

Source: Morley (2006)

When the tariff reductions are allocated across the sectors used in the CGE-based simulations (Table 4), the average tariffs shown are the weighted averages of individual commodity tariffs where the weights are the import shares of the commodities in question. Table 4 gives a good idea of which sectors still had high levels of protection prior to CAFTA and how that protection is slated to change over the next 20 years. Trade liberalization in the 1990s reduced protection in all manufacturing sectors other than clothing, tobacco, and processed foods. Most of the sectors with high tariffs were either agricultural or in sectors closely tied to agriculture such as dairy, meat, and tobacco. This means that for the most part, further trade liberalization under CAFTA will primarily affect agriculture either directly or indirectly. Tariffs go to zero in all sectors by year 20, but the process is not uniform. As we already saw in Table 3, liberalization for subsistence commodities does not begin until almost 10 years after ratification. Protection does drop rapidly for textiles and bananas, but since these are both export sectors it is not clear how important this change in protection really is.

Table 4: Tariff changes under CAFTA by sector and year

		Year					
		Base year	**1**	**5**	**10**	**15**	**20**
1	Coffee	14.83	13.84	9.89	4.94	0.00	0.00
2	Cotton	0.00	0.00	0.00	0.00	0.00	0.00
3	Grains	12.73	12.21	12.20	10.01	2.74	0.00
4	Sugarcane	40.00	37.33	26.67	13.33	0.00	0.00
5	Other agricultural activities	14.37	7.12	2.93	0.55	0.00	0.00
6	Livestock and poultry	7.28	0.00	0.00	0.00	0.00	0.00
7	Forestry	1.77	0.00	0.00	0.00	0.00	0.00
8	Fisheries	13.31	2.57	0.00	0.00	0.00	0.00
9	Mining	0.66	0.00	0.00	0.00	0.00	0.00
10	Meat products	18.88	18.91	15.39	8.50	0.51	0.00
11	Diary products	19.90	20.71	20.53	20.33	10.16	0.00
12	Wheat manufacturing	10.00	9.16	5.82	1.66	0.00	0.00
13	Sugar	14.78	13.71	9.73	4.75	0.00	0.00
14	Other processed foods	8.92	5.92	3.66	0.91	0.00	0.00
15	Beverages	21.49	15.39	8.58	1.66	0.00	0.00
16	Tobacco products	28.71	27.50	19.64	9.82	0.00	0.00
17	Textiles	9.52	0.04	0.02	0.00	0.00	0.00
18	Wearing apparel	21.00	1.32	0.62	0.00	0.00	0.00
19	Leather products	11.28	1.06	0.16	0.00	0.00	0.00
20	Wood products	3.32	0.36	0.20	0.00	0.00	0.00
21	Paper products	5.44	4.28	1.82	0.00	0.00	0.00
22	Printing and publishing						
23	Chemicals	3.16	1.67	0.62	0.00	0.00	0.00
24	Petroleum products	5.44	1.17	0.65	0.00	0.00	0.00
25	Rubber and plastic products	3.59	1.43	0.63	0.00	0.00	0.00
26	Mineral products	7.06	3.58	1.51	0.00	0.00	0.00
27	Metal products	3.33	2.46	1.34	0.00	0.00	0.00
28	Machinery and equipment	4.35	1.40	0.61	0.00	0.00	0.00
29	Transport equipment	8.69	17.20	12.63	0.00	0.00	0.00
30	Electricity	5.00	0.00	0.00	0.00	0.00	0.00
31	Construction	1.50	3.33	0.98	0.00	0.00	0.00

Source: Authors' calculations

4. MODELING THE IMPACT OF CAFTA

To predict the impact of CAFTA on the Salvadorian economy,[5] we use a recursive dynamic general equilibrium model, which identifies the effects of the changes introduced by CAFTA on prices, output, and employment across different sectors of the economy. Since changes in trade liberalization under CAFTA are mainly limited to tariff reductions in various agricultural commodities, they will obviously affect prices, output, and employment in agriculture. But they will also have indirect effects on urban consumers, government revenue, prices, the balance of payments, and the exchange rate, which well may be larger than the direct effects of the tariff reductions in agriculture, as well as second-round effects. In this section we will give a short overview of the model, with a complete mathematical and technical discussion relegated to Appendix 1.

The Recursive Dynamic CGE Model

Recursive dynamic CGE models have been used in Chenery, Robinson, and Syrquin (1999); El-Said, Lofgren, and Robinson (2001) to analyze different development strategies in Korea and Egypt; in Lofgren, Harris, and Robinson (2001) as a tool to model changes in poverty resulting from various policy alternatives; and finally in Thurlow (2003), who developed a recursive dynamic model for South Africa.[6]

These models are solved in two stages. The first stage aims to find a solution for a one-year equilibrium using a static CGE model. In the second stage, a model between periods is used to handle the dynamic linkages that update the variables that drive growth. The intertemporal equations provide values for all exogenous variables needed for the next period by the static CGE model, which is then solved for a new equilibrium. The model is solved forward in a dynamically recursive fashion, with each static solution depending only on current and past variables. The model does not incorporate future expectations; instead the behavior of its agents is based on adaptive expectations, as the model is solved one period at a time. The variables and parameters used as linkages between periods are the aggregate capital stock (which is updated endogenously, given previous investment and depreciation), the population, the domestic labor force, factor productivity, export and import prices, export demand, tariff rates and transfers to and from the rest of the world (all of which are modified exogenously). The dynamic model used in this research follows the models developed by the International Food Policy Research Institute (IFPRI) (see Lofgren, Harris, and Robinson 2001; Thurlow 2003.

[5] This paper is one of a pair of CGE analyses of the impact of CAFTA at the country level done by the authors, the other being on Honduras. A full mathematical statement of the model used for the two papers can be found in Appendix 3 of the Honduras paper (Morley and Piñeiro 2007).

[6] This section of the paper is taken from Piñeiro 2006.

This model for El Salvador is solved for 2000 (the base year for the data) and then solved recursively year by year until the year 2020. This allows us to compare growth trajectories under different policy scenarios, as well as tracking changes in policies such as tariff levels, which change slowly over time. Most CGE trade models are solved for just the final comparative static equilibrium changes resulting from a change in tariffs. Under CAFTA, however, the tariffs change gradually to give affected sectors the time to make adjustments, so tracking the timing of impacts of the changes is an important part of the analysis.

First Step: The Single Period Solution

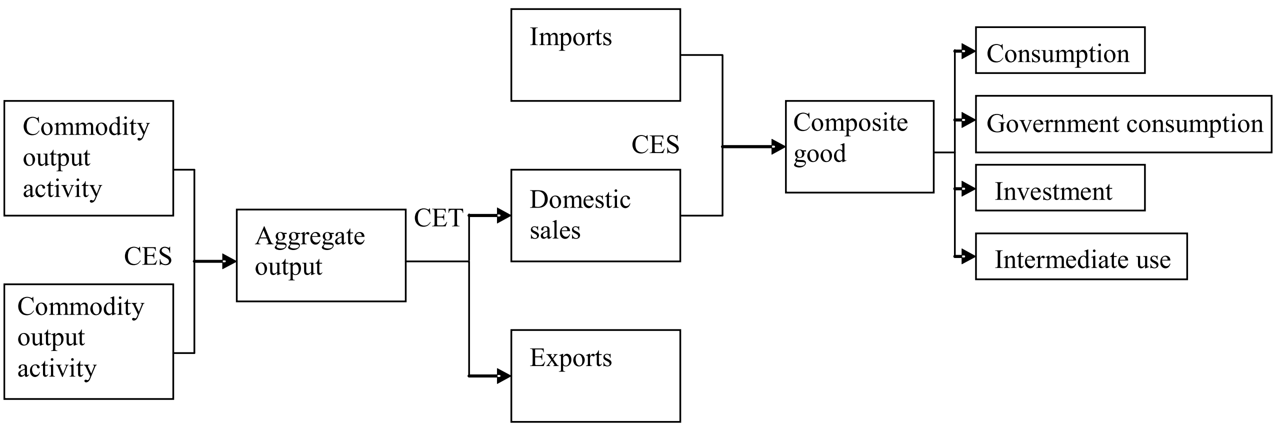
Basic data for the CGE models is obtained from a Social Accounting Matrix (SAM). A SAM is a comprehensive, economy-wide data framework, typically representing the economy of a country. The SAM used in this paper is for 2000 and is based on the SAM developed by Carlos Acevedo and reported in Acevedo (2004).

The CGE model has three components. The first shows the payments that are registered in the SAM, following the same disaggregation of factors, activities, commodities, and institutions shown in the matrix. The second is the equations that represent the behavior of the different institutions. The third is the system of constraints that have to be satisfied by the whole system covering the factor and goods markets, the balances for savings–investment, the government, and the current account of the rest of the world.

Each producer maximizes profits under constant returns to scale and perfect competition. There are two factors of production: labor (differentiated by skill) and capital. Production is related to factor inputs through a constant elasticity of substitution (CES) production function, which allows the producers to substitute these two inputs until they reach the point where the marginal revenue of each factor equals the factor price (wage or rent). The producers must also decide on the amount of intermediate inputs they will use, assuming fixed shares that specify the appropriate amount of intermediate inputs per unit of output and labor/capital (value added). Finally, output prices depend on the value added (cost of labor and capital), intermediate inputs, and any relevant taxes and subsidies.

Figure 1 shows the flow of a single commodity from producers to final demand. First, goods from all producers are aggregated into commodity outputs using a CES product demand system. The aggregate output is sold domestically or internationally. The producers' allocation between domestic sales and exports is specified via a constant elasticity of transformation (CET) function, assuming imperfect transformability between exports and domestic sales. The producers sell their products to the market with the highest profitability. The domestic price is the international price times the exchange rate plus any possible export taxes or export subsidies. The domestic good is combined with imports to produce the composite commodity. For this the Armington[7] specification is used, which means that the domestically produced and imported goods are imperfect substitutes.

Figure 1. Flow of goods from producers to the national composite commodity



Notes: CES is constant elasticity of substitution; CET is constant elasticity of transformation.

In this model there are four institutions—households, enterprises, government, and the rest of the world, which do three things: (1) produce, (2) consume, and (3) accumulate capital. Households save a constant coefficient of their disposable income and buy consumption goods. They own the enterprises and work in those enterprises. As a result, household income is the sum of salaries, profits, government, and rest-of-the-world transfers. Household consumption of goods and services is determined by a linear expenditure system. Firms buy intermediate goods, hire factors of production, produce commodities and services, and sell them in the market. Government receives taxes, consumes goods and services, and makes transfers to households. The capital account collects the savings from the households, firms, government, and rest of the world and buys capital goods (investment).

Closures and Assumptions on Factor Supplies

The closures are the mechanisms that determine how various macro constraints are satisfied. (1) El Salvador has a fixed exchange rate, which means that foreign savings are flexible or endogenous to the model[8] for all the simulations except the one for foreign direct investment (FDI), for which a change in closure was necessary. For this last experiment, the exchange rate is flexible or endogenous and foreign savings are fixed, in order to capture the increases in FDI for the simulation. (2) For the government, the level of consumption and income taxes are fixed across simulations. (3) In equilibrium, total saving must

[7] Armington (1969).
[8] El Salvador started its dollarization process in 2001.

equal total investment. There are various ways to guarantee this. In all but one of our simulations, we fix the saving rates of households and government, which makes total saving and investment positively related to the level of income. (4) In the labor markets, we assume that there is an excess supply of unskilled labor and a fixed real wage rate. We also assume that within each period labor is mobile across sectors, which means that real wages are equal across sectors for each type of labor. For skilled labor, a supply curve is added, making wages as well as quantities endogenous to the model. (5) Capital is fully employed and sector specific, which means that profit rates are free to vary across sectors.

Second Step: Between Periods

In the second step of the recursive model, the linkages between periods are introduced. To do this, the static model is solved for one specific year and then the capital stock, population, domestic labor force, factor productivity, export and import prices, and export demand parameters are updated. The updated model is then solved again for the following year and so on.

Total capital accumulation is endogenous (in all but the FDI scenario) since it is equal to total saving, which is endogenous. By definition the capital stock at the beginning of the current period is equal to the last period's capital stock plus net investment last period.[9] The allocation of new capital across sectors is done by adjusting the proportion of each sector's share in aggregate investment as a function of the relative profit rate of each sector compared to the average profit rate of the economy as a whole. Sectors with higher (lower) average profit rates will get higher (lower) shares of the available investment. Over time sector profit rates should converge.

The reader should note that our version of dynamic behavior may well understate or overstate the full reaction of an economy to changes in policies or conditions. In the model, total investment is determined by total saving and is therefore endogenous. But neither the saving nor the investment decision is modeled directly. Thus we do not incorporate the possible effect on total capital formation of a rise in the overall profit rate in response to CAFTA, for example, or a rise in total saving in response to a rise in the interest rate. This limited characteristic of our version of the dynamic reaction to changes in CAFTA should be kept in mind in interpreting the results presented.

Turning to the supply of labor by skill, the model determines only the amount of employment. It does not distinguish between those who are unemployed and those of working age who are not in the labor force. This is an important distinction for skilled labor. For unskilled labor, we assume that up to

[9] To estimate the base-period capital stock in 2000, we assume a lifetime of 12 years for capital, where all the depreciation occurs in the final year. The estimate of the capital stock in 2000 is assumed to be completely independent of the initial capital output ratio and depends only on the level of investment observed between 1987 and 1999. Under these assumptions, the initial level of capital turns out to be 1.75 times the level of GDP at market prices. In the dynamic simulations, we set depreciation in year t at 8 percent of the capital stock so that the transition equations at time t would depend only on the solution at time t–1.

2020 there is an excess supply of labor, which is equivalent to assuming that the rate of growth of employment does not exhaust the available stock of either unemployed or inactive unskilled labor.

For skilled labor, we assume an upward sloping supply curve shifting rightward by 2 percent per year and with an elasticity of +5 with respect to the real wage. In addition to unemployment, El Salvador has a large pool of well- educated but inactive labor, especially women. We assume that by 2020 this group will have grown large enough to supply the amount of skilled labor called for in our sequence of short-run solutions. This assumption may be unrealistic in the FDI scenario because of the rapid growth rate of employment it requires. Finally, productivity growth, real government consumption and transfers, world price of exports, and current account balances are set exogenously based on observed trends.

For investment we have two different treatments depending on the simulation. For the CAFTA simulations related to reduction in tariffs, changes in the maquila scheme, and import quotas, we use a saving-driven closure in the single-period solution. In the FDI simulation, we impose the constraint that the addition to FDI all be devoted to fixed investment. Therefore, in this simulation, total saving is investment driven.

To summarize, the dynamic accumulation process is updated in three ways:

1. by exogenous trends (labor force growth, productivity changes, capital stock growth, and population growth);
2. by economic behavior (distribution of investment by sector and distribution of labor force by sector and category); and
3. by implemented policies (changes in tariffs, import quotas, and FDI as a result of CAFTA).

For the dynamic model, we first do a forward simulation to 2020 to create a base run—one in which there are no CAFTA-related changes in exogenous variables. We then run the model with various CAFTA policy alternatives and compare those results with the base run. Because we may not have completely captured important aspects of dynamic behavior, or because of misspecifications in the model itself, we put less weight on the absolute values of our projects than we do in the comparison of the base run with the various CAFTA alternatives. In other words, we are less confident in the growth or employment forecasts of our base run or CAFTA alternatives than we are in the difference between that base run and the CAFTA alternatives.

5. SIMULATING THE IMPACT OF CAFTA

The dynamic model we have described in the previous section is recursive. It solves the system of equations for all the endogenous variables for each period and then updates those variables (such as the capital stock, labor force, and tariff rates) that change over time, either because they are endogenous in the model, or because they are policy variables that are subject to change. In each of the simulations, we run the model from its 2000 base, using the observed values for all exogenous variables up to 2005, and then insert the changes introduced by CAFTA after 2005, running each simulation out to 2020. We present the results in the form of growth rates of all the endogenous variables of interest from the 2000 initial values. Each table displays the initial values for each variable and the annual average growth rate from 2000 to 2020. There are five simulations.

Base. This is the projection of the economy without CAFTA. It is our best estimate of how the economy would grow in the absence of CAFTA, and therefore it is the counterfactual with which each of the CAFTA simulations should be compared.

CAFTA. In this simulation, we change all the sectoral tariffs according to the time patterns shown in Table 4Since these tariff changes vary across both time and sector, it will be useful to show explicitly the time path of the response to the changes, in addition to the 23-year average rate of growth .

Maquila. Textiles are an area of potentially large benefits but equally large and uncertain risks because of the expiration of the Multifiber Agreement in January 2005. In the past (before 2000) in Central America, maquila was almost entirely limited to the assembly of clothing from imported inputs. From 1984, with the passage of the Caribbean Basin Economic Recovery Act, the maquila industry was exempted from the worldwide quota system then in force. But its products were not exempt from U.S. tariffs until the U.S. Congress passed the Caribbean Basin Economic Recovery Expansion Act in 1990. With the passage of the North American Foreign Trade Agreement (NAFTA) in 1994, this advantage was partially offset by the more generous treatment of Mexican producers with regard to rules of origin. The Caribbean Trade Promotion Act (CBTPA), passed in 2000, extended to the Central American countries the market access conditions for maquila granted to Mexico under NAFTA, with similar liberalized restrictions on rules of origin. Imports of knitted or shaped apparel were permitted free of tariffs, provided that the intermediate inputs from the yarn up to the finished good were produced in a CAFTA country.[10] This has had a major impact on production in Central America. But the CBTPA has a sunset provision. It will expire in 2008 unless CAFTA is implemented. What CAFTA does for textiles is to make permanent the liberalized rules of origin for inputs to the maquila industry granted temporarily under the CBTPA. To model the impact of these provisions of the CAFTA agreement, we keep the level

[10] Tee shirts and socks were subject to a maximum tariff-free import ceiling.

of intermediate imports to the textile industry at the level observed in 2000, prior to the passage of the CBTPA. Then, starting in 2005, we reduce these intermediate imports to the very low levels observed after the implementation of the CBTPA. This simulation then shows the positive effect to the booming maquila industry of domestically producing the intermediate inputs.

ALLCAFTA. In this simulation, we combine the effects of the tariff reductions plus maquila plus tariff-free quotas granted by the United States and El Salvador on particularly sensitive commodities. For imports into El Salvador, certain commodities of particular importance to the poor, either as consumers or producers, were given special treatment under CAFTA. Tariffs for these commodities were typically quite high prior to CAFTA, and the rate of tariff reduction under CAFTA in most cases will be slow, as shown in Table 3 But CAFTA also established tariff-rate quotas (TRQs) in many of these commodities, making liberalization faster than seems likely from the tariff category in which these commodities were placed. These are the commodities in which CAFTA could have a significant effect in the short run, since it permits tariff-free imports up to a certain quantitative limit, as soon as the treaty is implemented. In addition, the United States granted tariff-free importation for quantities of certain commodities from El Salvador. We now look at the most important of these commodities and ask what the impact of the TRQs is likely to be in practice.

For import quotas into El Salvador, what effect will the quota have on domestic prices and producers? It is easy to show that quotas only have an effect on domestic prices and output levels if they are larger than the amount previously imported (Morley 2006) If they are smaller, they effectively transfer tariff revenue to the importer. In all cases where there are quotas, the amounts relative to either domestic production or to the average level of imports suggest that we can safely ignore any effect of the quotas on equilibrium prices. Yellow corn has a big quota, about equal to the level of imports. But there is no domestic production. In the case of rice, there is a fairly large quota, but it is less than the current level of imports, which means that the marginal rice import will pay the tariff. That in turn means that changes in the equilibrium solution will be caused by changes in the tariff over time, not the quota. For white corn, the quota is quite large relative to imports, but it amounts to less than 5 percent of the level of domestic production, so price effects of the quota are likely to be small. Pork is the only commodity for which the quota is likely to have a price effect, since it is larger than the current level of imports and amounts to about 15 percent of total production.

FDI. It is relatively straightforward to model the impact of trade liberalization under CAFTA. But there are many additional items and agreements in the CAFTA treaty that have to do with the treatment of FDI. All are aimed at defining and protecting the rights of foreign investors with respect to the protection of intellectual property and expropriation. For many observers these conditions are seen as excessively generous to foreign investors. It is beyond the scope of this paper to make a complete analysis of the net benefits or costs of these FDI provisions on the Salvadorian economy. Since no one has a clear idea of just how much additional FDI El Salvador can expect to receive under the new CAFTA legal conditions, as a first approximation we simply increased by 25 percent the observed level of FDI that came into El Salvador between 2000 and 2004. This gives rise to two effects. The first and less important one is the simple balance-of-payments effect of an increased inflow of foreign resources. The second and more important effect is on total capital formation. These inflows go to capital formation. Therefore in this simulation we change our saving–investment closure to ensure that these inflows directly increase investment.

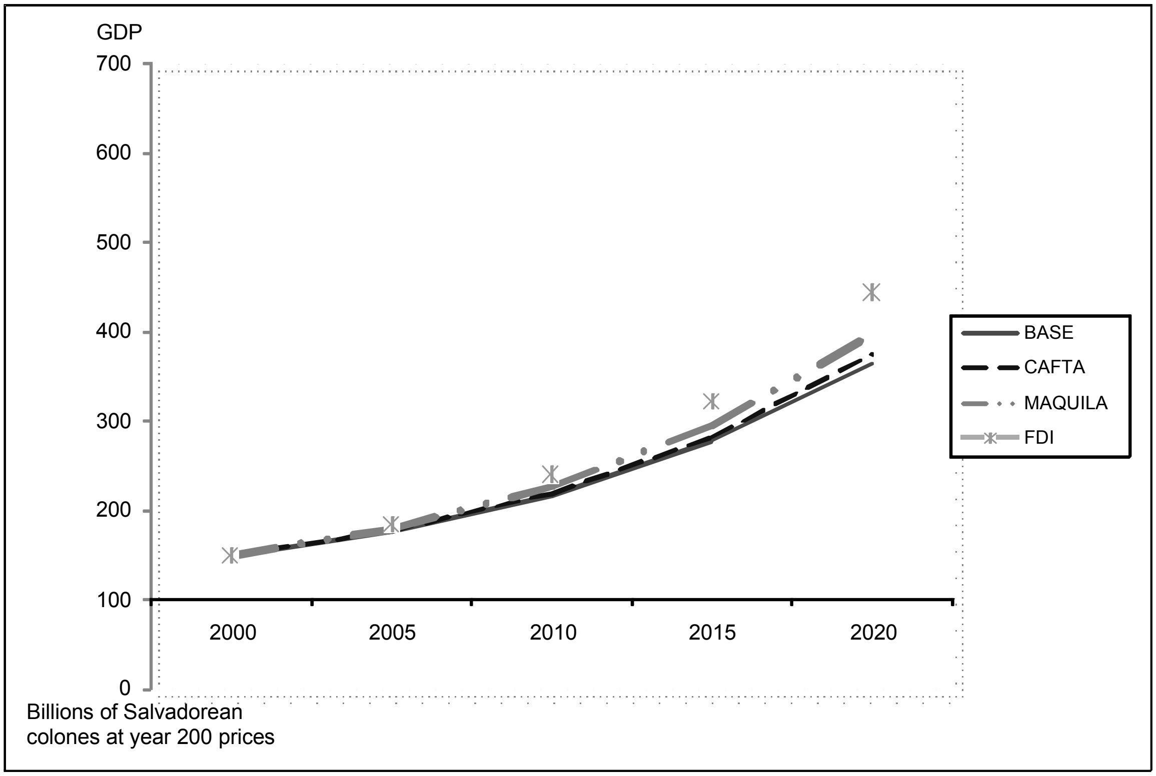
6. RESULTS OF THE CGE SIMULATIONS

Figure 2 shows the trajectory of the Salvadorian economy up to 2020 under the various simulations. The solid line at the bottom labeled base is the trajectory, assuming that there are no changes in either external conditions or domestic policy except that the temporary import liberalization for maquila under the CBTPA is assumed to expire.[11] The remaining lines show the impact on the growth rate of three different scenarios: (1) CAFTA, which is tariff reductions alone; (2) MAQUILA, the permanent liberalization of rules of origin for inputs to the maquila industry; and (3) FDI, the effect on domestic investment and growth of the more generous treatment of foreign direct investment.

The dynamic model makes the fairly optimistic prediction that El Salvador will be able to reach an average annual growth rate of 4.5 percent over the period 2000–20, even with the expiration of the temporary maquila benefits. That is far higher than the actual growth rates observed over the last 10 years, which is partly because we do not include financial crises or natural disasters in our estimation. One of the reasons for the relatively high growth rate is the low capital requirement per unit of output that is implied by previous rates of capital formation in the country. Another reason is the assumed continuation of remittances equal to roughly 3 percent of GDP in the base year 2000. This helps maintain demand. Also the reader should remember that the model we have developed does not endogenize the saving–investment process. Therefore, one should not put too much emphasis on its growth estimates but should instead use its forecasts mainly as a benchmark against which to examine the effect on the growth rate of the changes in policy under CAFTA. Assuming the basic saving–investment processes are unaffected by CAFTA, the model will do a good job of estimating the changes in the growth rate due to CAFTA. In other words, the reader should mainly pay attention to the growth differentials under the CAFTA scenarios, rather than the predicted growth rates.

[11]Maquila turns out to be far less important to the Salvadorian economy than it is to Honduras.

Figure 2. Growth in GDP in different CAFTA scenarios



As the reader can see, trade liberalization under CAFTA has a positive effect on the growth rate of the economy, but the effect is small, with the growth rate rising by only 0.20 percent per year over the base scenario. Maquila raises the growth rate by an additional 0.25 percent. What does increase the growth rate is FDI. If the CAFTA regulations, which are intended to make the host country more hospitable to FDI, actually succeed in attracting foreign investment, the results will be immediate and large. Investment rates rise, and by 2020 the capital stock has grown by 25 percent relative to the base run. That causes a big increase in the growth rate of the economy and of employment, as we shall see. All of this demonstrates the sensitivity of the Salvadorian economy to the rate of capital formation.

To help shed light on the differential impacts of the changes under CAFTA, the growth rates of the main macro aggregates are shown under the four different scenarios in Table 5 over the 20-year period (2000–20). Each column corresponds to one of the simulations described in the previous section. The first column displays the levels of each of the variables in base year 2000. Note that the columns labeled CAFTA and MAQUILA show the effects of these two scenarios considered in isolation. The next column (ALLCAFTA) shows the combined effect of all the changes including quotas under CAFTA other than FDI, whose separate effect is shown in the last column.

Table 5. Annual rates of growth of macro aggregates 2000-2020

	Initial value 2000*	Base	CAFTA	Maquila	All CAFTA	FDI**
		(Annual percentage growth rate 2000-2020)				
Absorption	163.34	4.21	4.49	4.59	4.87	5.50
Private consumption	123.34	4.21	4.49	4.52	4.80	5.44
Fixed Investment	26.43	4.35	4.67	4.96	5.29	5.91
Government consumption	12.92	4.07	4.30	4.58	4.82	5.41
Exports	47.31	5.01	5.01	5.60	5.69	5.48
Imports	52.12	4.18	4.18	4.58	5.00	5.54
GDP (market price)	158.53	4.48	4.48	4.91	5.09	5.49

Source: Authors' worksheets
* In 2000 billion Salvadorean colones
** Foreign direct investment

The overall growth rates are as described. Relative to the growth rates in the base, trade liberalization by itself increases the rate of growth of both exports and imports and permits a slight overall increase in the growth rate of production, investment, and internal demand.

MAQUILA has a larger positive effect on growth than CAFTA. Trade liberalization by itself does raise the growth rate, but the effect of MAQUILA on growth is bigger. It increases the rate of growth of exports and imports of nonmaquila commodities, which shifts more of the country's production to unskilled, labor-intensive commodities such as maquila. Note that the overall economy becomes less capital-intensive than in the baseline and uses more unskilled labor, which we have assumed is in excess supply. That is what permits aggregate growth to jump by about 0.5 percent per year.

When trade liberalization, maquila, and quotas are combined in the simulation ALLCAFTA, the aggregate growth rate is only slightly higher than that for MAQUILA alone. However, the composition of output changes with the reduction in tariffs, permitting an increase in the rate of growth of imports, consumption, and absorption.

Of all the simulations, the one that has the largest impact on the growth rate is FDI. Recall that in this simulation we hypothesize that in El Salvador, measures to make FDI more attractive to foreign investors result in an increase in FDI of 25% above. The average level of FDI between 2000 and 2004. In this simulation the key is not just the increase in foreign saving but the assumption that, being FDI, all of it goes into capital formation. As a result, the level of investment increases by about 2.5 percent of GDP and the growth rate of investment in the economy rises by almost 25 percent. By 2020, the capital stock of the economy is 25 percent higher than its level in the base run. Those additional supplies of capital have a large impact on the growth rate of GDP and all of its components.

This simulation is in no way a forecast of what the aggregate growth rate will be under CAFTA, since we do not know whether CAFTA will induce that much additional FDI. But the simulation does make clear the critical role of capital formation in getting higher growth rates. We should note in passing that our recursive dynamic CGE model does not really endogenize the saving–investment process, and so may understate the full impact of the changes brought about by CAFTA. Our model takes a given amount of investment and allocates it to the most profitable sectors. That is surely part—but only part—of the full dynamic story. If CAFTA makes production more profitable, it could well increase the overall rate of saving and capital formation. That would increase the growth rate of the economy by more than we show in our simulations.

Changes in Sectoral Growth Rates of Trade and Production

Turning to simulation results by sector for the various scenarios, trade liberalization under CAFTA increases production, imports, and exports in all the sectors shown in Table 6. The differences in growth rates between the base run and CAFTA are all positive but small. One might have thought that unilaterally reducing tariff barriers might increase imports and crowd out domestic production. While that may happen in particular sectors, it does not happen in the aggregate, and in particular it does not happen in agriculture. Instead resources move into areas where they are more productive. Overall, output increases and the economy become somewhat more open. As expected, maquila increases the growth rate of exports and production in manufacturing. Somewhat surprisingly, that increase does not come at the expense of agriculture, which also has higher growth rates in the MAQUILA simulation than in trade liberalization alone, partly because the rate of growth of capital is faster in this scenario (see Table 5). But it is also due to our assumption that there is excess unskilled labor, where the positive stimulus of added demand for maquila permits the economy to employ more people, grow faster, and increase the rate of growth of capital stock.

Table 6. National production and trade

Sector	Initial Share 2000*	Base	CAFTA	Maquila	All CAFTA	FDI**
			(Annual percentage growth rate 2000-2020)			
Exports						
Agricultural sector	5.71	4.63	4.77	5.03	5.17	5.76
Primary sector	5.74	4.64	4.77	5.03	5.18	5.76
Mining	0.03	4.93	4.89	5.32	5.29	6.28
Secondary sector	77.06	5.35	5.43	6.19	6.27	6.47
Manufacturing sector	76.82	5.36	5.43	6.20	6.28	6.48
Food industry	7.57	4.18	4.31	4.52	4.65	5.48
Tertiary sector	17.21	4.26	4.43	4.62	4.80	5.40

Table 6. Continued

Sector	Initial Share 2000*	Base	CAFTA	Maquila	All CAFTA	FDI**
			(Annual percentage growth rate 2000-2020)			
Imports						
Agricultural sector	5.30	4.32	4.75	4.59	5.02	5.13
Primary sector	12.53	4.09	4.39	4.43	4.75	5.06
Mining	7.23	3.91	4.12	4.32	4.53	5.01
Secondary sector	74.47	4.25	4.72	4.65	5.13	5.20
Manufacturing sector	73.38	4.23	4.71	4.63	5.12	5.19
Food industry	8.64	4.35	4.82	4.65	5.13	5.16
Tertiary sector	13.00	4.58	4.94	5.02	5.38	5.07
Production						
Agricultural sector	6.15	4.60	4.77	4.97	5.15	5.75
Primary sector	6.49	4.61	4.78	4.98	5.16	5.76
Mining	0.33	4.82	4.91	5.24	5.34	5.93
Secondary sector	38.90	4.87	5.01	5.50	5.64	5.91
Manufacturing sector	32.46	4.93	5.03	5.57	5.68	5.94
Food industry	8.45	4.32	4.51	4.64	4.84	5.39
Tertiary sector	54.61	4.37	4.58	4.76	4.98	5.47

Source: Authors' worksheets
* Initial share of total exports, imports, and production
** FDI is foreign direct investment.

The effects of the various policy scenarios on production in all the sectors of the CGE model are shown in Table 7. The growth rates of exports and imports disaggregated in the same way are presented in Appendix 1. For most of the sectors, both CAFTA and MAQUILA slightly increase the growth rate. When these two effects are combined in the ALLCAFTA simulation, what really stands out is how small is the total impact of CAFTA. Changes in sectoral growth rates, plus or minus, are small. This is an important result. If the CGE model accurately represents the Salvadorian economy, these results predict that the impacts of CAFTA—either positive or negative—on the sectoral growth rates or structure of the economy will be quite limited.

There are two exceptions to this general picture. The first is maquila itself (see the last row in Table 7). Not surprisingly, its growth rate sharply increases in the MAQUILA scenario. The second area where there are significant effects is in the FDI simulation. If CAFTA really does increase direct investment in El Salvador, the results on sectoral growth rates will be fairly dramatic. Note that the response would be equally large if domestic savers and investors responded to the expanded profit opportunities made possible by CAFTA.

Table 7. Sectoral growth rates, 2000-2020

	Sectoral growth rates					
	Initial share 2000*	**Base**	**CAFTA**	**Maquila**	**All CAFTA**	**FDI****
		(Annual percentage growth rate, 2000-2020)				
Production						
Coffee	1.20	4.57	4.72	4.95	5.10	5.60
Grain	1.71	4.61	4.78	4.98	5.15	5.77
Sugar	0.32	4.08	4.27	4.40	4.60	5.16
Other crops	0.01	5.56	5.05	5.86	5.34	6.56
Livestock	1.98	4.56	4.76	4.91	5.12	5.73
Forestry	0.64	5.01	5.16	5.42	5.58	6.29
Fishing	0.30	4.53	4.68	4.90	5.06	5.68
Mining	0.33	4.82	4.91	5.24	5.34	5.93
Processed meat	0.61	4.64	4.83	5.02	5.21	5.85
Dairy	0.74	4.55	4.77	4.87	5.10	5.63
Flour	2.17	4.42	4.65	4.71	4.95	5.42
Sugar products	0.58	4.22	4.42	4.55	4.75	5.33
Other processed foods	2.61	4.24	4.41	4.58	4.76	5.36
Beverages and tobacco	1.75	4.12	4.30	4.42	4.60	5.16
Textiles	2.34	4.68	4.76	4.92	5.01	5.77
Clothing	0.69	4.34	4.54	4.60	4.81	5.33
Leather	0.79	4.38	4.54	4.69	4.86	5.44
Lumber	0.39	4.58	4.70	4.94	5.07	5.70
Paper	0.62	4.48	4.61	4.84	4.98	5.53
Publishing	1.33	4.23	4.39	4.54	4.70	5.31
Chemicals	1.34	4.27	4.40	4.61	4.74	5.31
Petroleum	2.40	4.03	4.20	4.41	4.59	5.10
Plastics	0.60	4.27	4.25	4.59	4.57	5.42
Nonmetallic minerals	1.06	4.38	4.48	4.86	4.96	5.60
Metals	1.65	4.97	4.99	5.33	5.36	6.11
Machinery	1.08	4.68	4.78	5.08	5.19	5.85
Transportation equipment	1.56	4.60	4.57	4.96	4.94	5.80
Electricity	1.72	4.74	4.91	5.25	5.42	5.72
Water	0.20	4.42	4.64	4.80	5.02	5.41
Construction	4.52	4.53	4.85	5.14	5.47	5.77
Commerce	16.08	4.44	4.69	4.80	5.06	5.51
Hotels and restaurants	5.86	4.26	4.46	4.60	4.80	5.35
Transportation	8.50	4.36	4.55	4.76	4.96	5.42
Communication	1.36	4.18	4.39	4.48	4.70	5.20
Financial services	2.11	4.39	4.58	4.71	4.91	5.44
Real estate	9.37	4.59	4.77	5.03	5.22	5.76
Domestic services	5.24	4.22	4.41	4.60	4.79	5.43
Government	6.09	4.13	4.37	4.63	4.88	5.22
Maquila	8.14	6.24	6.29	7.60	7.65	7.19

Source: Authors' worksheets
*Initial share of total exports, imports, and production
** FDI is foreign direct investment.

The Impact of CAFTA on Factor Markets

The impact of the CAFTA simulations on the growth rates of capital and employment is then broken down by skill level, gender, and place of residence, (rural or urban)(Table 8). Recall that our definition of skill is based on the level of education: all workers with a high school education or more are classified as skilled. The first thing to note is that employment is higher for all types of labor in the CAFTA simulation (tariff reduction). CAFTA increases employment, both rural and urban, for both males and females. MAQUILA has a very different effect. It dramatically increases the demand for female unskilled labor. When the maquila and tariff reduction effects are combined in the ALLCAFTA simulation, the general patterns are somewhat damped but still survive. Because of maquila, the growth rate of employment under ALLCAFTA is especially favorable to the unskilled.

What about rural versus urban labor? Obviously the rate of growth of rural employment is slower than urban, particularly for unskilled labor. But comparing the base with the CAFTA simulations, we see that in the base rural unskilled employment increases by a bit less than 5 percent per year. But what is of more interest here is that, in the ALLCAFTA simulation, the growth rate of employment of unskilled labor in the rural sector is about 0.7 percentage points faster than in the base, and almost 0.1 percentage point higher in the urban sector, thanks largely to the increase of employment of women in the maquila industry. By 2020 those differences in growth rates translate into an increase of more than 15 percent in rural and more than 19 percent in urban unskilled employment. We conclude that CAFTA will be beneficial to the unskilled. It has an urban bias to be sure, but that is primarily because of the maquila effect on employment of unskilled female labor. Rural labor will also share in the benefits of CAFTA—how much depends on the extent of the rural or urban bias of the CAFTA agreement. Our results say that while more job opportunities will open up in the urban area than the rural under CAFTA, both areas gain. Employment of skilled labor also grows faster under CAFTA, but as we shall see in a moment, most of the gains for skilled labor come in the form of wage increases rather than job creation.

Table 8. Growth rates of capital and labor by gender and skill

	Base	CAFTA	Maquila	All CAFTA	FDI*
	(Annual percentage growth rate 2000-2020)				
USKLM	2.844	2.997	3.157	3.314	3.599
USKLF	3.019	3.152	3.426	3.560	3.704
RSKLF	2.876	3.016	3.231	3.375	3.625
RSKLF	2.924	3.047	3.272	3.398	3.580
UUSKLM	5.035	5.283	5.594	5.846	6.179
UUSKLF	5.850	5.999	6.666	6.812	6.482
RUSKLM	4.528	4.760	5.016	5.255	5.657
RUSKLF	5.241	5.453	5.738	5.952	6.214
CAP	3.140	3.299	3.552	3.717	4.239

Source: Authors' worksheets
*FDI is foreign direct investment.
Notes: USKLM is urban male skilled labor.
USKLF is urban female skilled labor.
UUSKLM is urban unskilled male labor.
UUSKLF is urban unskilled female labor.
RSKLM is rural skilled male labor.
RSKLF is rural skilled female labor.
RUSKLM is rural unskilled male labor.
RUSKLF is rural unskilled female.
CAP is capital stock.

The Impact of CAFTA on Capital Formation

In a dynamic simulation, what happens to investment and the capital stock is a key part of the explanation of the impact of any policy or exogenous change in conditions. We saw earlier that tariff cuts by themselves increase the growth rate of investment (Table 5). That is reflected in a terminal-year capital stock 3.3 percent higher than the base run. Maquila increases the rate of growth of capital formation and leads to a terminal-year capital stock that is 8.5 percent higher than the base run.

The really big impact here is seen in the FDI simulation. Under FDI, the initial investment share rises by about 2.5 percent of GDP. More important, the rate of growth of investment rises by 35 percent (from 4.35 to 5.91 percent (Table 5). Those two changes raise the investment share from 17 percent in the base year 2000 to 22 percent in 2020, and they increase the quantity of capital available to the economy in year 2020 by about one-third. We have already seen the effect of that on the overall growth rate. Here the table shows the impact of all that investment on employment. It helps labor in every category. For unskilled labor, the increased demand is reflected in a big increase in the growth rate of employment. For skilled labor, assuming a positively sloped supply curve, some of the impact of increased demand comes in the form of more employment and some comes in higher wages. In either case, the FDI simulation underlines the critical role of capital formation in any growth scenario. We do not have a behavioral explanation for investment, so this simulation should be interpreted as a warning that the success or failure of CAFTA is likely to depend on whether or not it helps governments to create conditions that encourage both foreign and domestic investment.

Labor Earnings Inequality

Our results suggest that there will be a significant rise in earnings inequality, with or without CAFTA (Table 9). That is at least partly because we are assuming that there is an excess supply of unskilled labor or equivalently that the real wage for both rural and urban unskilled labor is fixed over the entire 20-year simulation. We assume that the supply curve of skilled labor, for both rural and urban and both sexes, rises by 2 percent per year, which is less than the increase in the demand for skilled labor. As a result, real wages for the skilled rise in all of the simulations, including the baseline. Since wages for the unskilled are fixed by the assumption of an excess supply of labor, the relative wage of the unskilled declines. In the baseline projection, by 2020 the relative wage of unskilled males in the urban sector falls about 37 percent relative to the wage of the skilled, and the relative wage of unskilled females falls by 36 percent. Both of those differentials widen a bit in favor of the skilled in all the alternative CAFTA scenarios. The faster the economy grows, the wider the skill differential becomes, which is what one would expect from the assumptions about the supply curves of the two types of labor. As for the urban–rural wage differentials, it is assumed to be constant for unskilled labor of both sexes, and therefore it is not shown in Table 9. The last rows of the table show the urban–rural differential for skilled males, which narrows slightly in all the scenarios.

What can we conclude from all of this? Even without CAFTA, the table tells us that the wage pyramid will become more unequal. Growth in whatever form will drive up the wages of the skilled. CAFTA slightly exaggerates that trend because it increases the growth rate. That does not mean necessarily that CAFTA favors the skilled. Rather it increases the growth rate of employment of the unskilled and the wages of the skilled. CAFTA increases the earnings of both the skilled and the unskilled, but for the latter the improvements come in the form of more jobs at the same wage, while for the former the improvement comes from both higher wages and more jobs.

Table 9. Relative wages

	Initial	2005	2010	2015	2020
USKLM/UUKLM					
BASE	1.09	1.15	1.23	1.33	1.45
TARCUT1	1.09	1.16	1.24	1.34	1.47
MAQUILA	1.09	1.16	1.25	1.36	1.49
ALLCAFTA	1.09	1.17	1.26	1.37	1.52
FDI	1.09	1.18	1.28	1.41	1.56
USKLF/UUKLF					
BASE	1.11	1.19	1.27	1.38	1.51
TARCUT1	1.11	1.19	1.28	1.39	1.53
MAQUILA	1.11	1.20	1.30	1.42	1.57
ALL CAFTA	1.11	1.20	1.31	1.43	1.59
FDI	1.11	1.20	1.31	1.45	1.62
RSKLM/RUKLM					
BASE	1.10	1.16	1.25	1.35	1.47
TARCUT1	1.10	1.17	1.25	1.36	1.49
MAQUILA	1.10	1.18	1.27	1.38	1.52
ALLCAFTA	1.10	1.18	1.28	1.40	1.54
FDI	1.10	1.19	1.30	1.43	1.58
RSKLF/RUKLF					
BASE	1.12	1.18	1.27	1.37	1.49
TARCUT1	1.12	1.18	1.27	1.38	1.51
MAQUILA	1.11	1.19	1.29	1.41	1.55
ALLCAFTA	1.11	1.20	1.29	1.42	1.57
FDI	1.11	1.20	1.31	1.44	1.59
USKLM/USKLF					
BASE	0.98	0.97	0.97	0.96	0.96
TARCUT1	0.98	0.97	0.97	0.97	0.96
MAQUILA	0.98	0.97	0.96	0.96	0.96
ALLCAFTA	0.98	0.97	0.96	0.96	0.95
FDI	0.99	0.98	0.98	0.97	0.97
USKLM/RSKLM					
BASE	0.990	0.990	0.990	0.988	0.987
TARCUT1	0.990	0.990	0.990	0.990	0.988
MAQUILA	0.991	0.987	0.986	0.985	0.983
ALLCAFTA	0.991	0.988	0.987	0.985	0.984
FDI	0.993	0.992	0.990	0.989	0.987

Source: Authors' worksheets
Note: TARCUT1 stands for tariff cut.

Factor Shares

One important implication of the evidence shown so far is that CAFTA appears to be favorable to unskilled labor despite the widening of the skill differential. This is confirmed in the changes in factor shares displayed in Table 10. The share of unskilled labor rises in every scenario and the capital share falls in every scenario. In the MAQUILA and FDI scenarios, increases are large in the capital stock, output, and the employment of unskilled labor. The latter two increases are so large that the shares of both capital and unskilled labor rise, at the expense of skilled labor. Note that this happens even though the increase in the skill differential in both of these scenarios is large.

Table 10. Factor shares (%of GDP at factor cost)

	2000	2005	2010	2015	2020
Unskilled labor					
BASE	0.168	0.173	0.179	0.185	0.191
CAFTA	0.168	0.173	0.179	0.185	0.191
MAQUILA	0.167	0.176	0.182	0.189	0.197
ALLCAFTA	0.167	0.176	0.182	0.189	0.196
FDI	0.164	0.171	0.177	0.183	0.190
Skilled labor					
BASE	0.187	0.186	0.186	0.184	0.182
CAFTA	0.187	0.187	0.185	0.184	0.182
MAQUILA	0.187	0.189	0.188	0.186	0.184
ALLCAFTA	0.187	0.189	0.188	0.186	0.184
FDI	0.187	0.190	0.188	0.186	0.184
Capital					
BASE	0.645	0.641	0.636	0.631	0.627
CAFTA	0.645	0.640	0.636	0.632	0.627
MAQUILA	0.647	0.635	0.630	0.625	0.620
ALLCAFTA	0.647	0.634	0.629	0.625	0.620
FDI	0.648	0.639	0.635	0.631	0.627
Total	1.00	1.00	1.00	1.00	1.00

Source: Authors' worksheets

7. THE IMPACT OF CAFTA ON POVERTY AND THE DISTRIBUTION OF INCOME

The dynamic CGE model estimates CAFTA's effects on employment, production, and income. What are the implications of those changes for poverty and the distribution of income? To answer this question, we have to find a way to translate labor market outcomes of the CGE into distribution of income across households. This is difficult because the CGE tells us about employment creation and wages for individuals, but for distributional and poverty purposes, those individuals must be treated as members of households. Thus, if a certain number of additional jobs have been created, we need a way of deciding which formerly unemployed individuals will get those jobs, and which families they come from. Exactly the same type of question arises when we consider the effect of a change in the skill composition of the labor force. For example, the CGE may tell us that the skilled labor force has increased. We then need some way of deciding which members of which families are upgraded.

Here we will follow a microsimulation methodology developed by Vos, Taylor, and Paes de Barros (2002). In the procedure, a household survey as close as possible to the base year of the CGE is used to get a base-period distribution of the labor force across the households represented in the survey[12]. In the first step, the labor force is divided among the various skills represented in the CGE model, and rates of unemployment for each are calculated. Then random numbers are assigned to the group that will shrink in size, and that group is ranked according to the random numbers. Thus, for example, if the model calls for an increase in employment, random numbers are assigned to the unemployed. Then the procedure moves down the ranked list of the unemployed until a sufficient number have been found to reach the amount of employment given by the CGE solution. Then, working with the newly simulated labor force by type, one repeats the procedure to change the skill or sectoral composition of that labor force. At a final stage, the wage of the new labor force with the composition determined by the CGE solution is changed in accordance with it. At this point, the new labor force with the new wage structure is reassembled into the households from the base-period survey and new levels of household income per capita as well as poverty and income distribution statistics are calculated.

Two things should be noted about this procedure. First, the selection of individuals to move from one labor category to another is entirely random, not based on any behavioral model. This is not very satisfactory from a theoretical point of view. To remedy that defect, the procedure is replicated 50 or 100 times and the statistical results tabulated. This is intended to test the validity or sensitivity of the results to the particular choice of individuals who are moved from a contracting to an expanding group. We can then report not only the mean of the various trials, but also the standard errors and confidence intervals. In the El Salvador case, we repeated these simulations 100 times. The second thing to note is that the

[12] We used the household survey of 2005.

solution we are proposing is sequential. That is, we start with unemployment and adjust it to get the new labor force determined by the CGE model, and then change the sector and skill level of that new labor force and finally the wage. This seems like the right order, but it is possible that the solution would be different if we had chosen a different sequence of changes.

An overview of the results of our microsimulations shows various poverty and distribution statistics and standard errors for the baseline and each of the four alternate scenarios reported in previous sections of this paper (Table 11). For the base, we started from a 2005 household survey from that year, and then did the microsimulations for the year 2020, based on changes in employment, participation rates, unemployment, and changes in relative wages determined by the results of the CGE simulation. The table reports average labor and per capita income, distribution statistics, and poverty incidence, the poverty gap and poverty severity for both extreme and moderate poverty, where the poverty lines for each measure were calculated by Fundación Salvadoreña para el Desarrollo Económico y Social in El Salvador.

Table 11. Changes in poverty and distribution under CAFTA, 2020

	2005	Baseline		Tariff Cut		Maquila		All CAFTA		FDI	
	(Base year)	Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.
National											
Labor income	**222.3**	**222.3**	0.0	**221.7**	0.1	**222.2**	0.1	**222.4**	0.1	**224.1**	0.1
Theil – labor income	**0.69**	**0.70**	0.00	**0.70**	0.00	**0.70**	0.00	**0.70**	0.00	**0.70**	0.00
Gini – labor income	**0.56**	**0.56**	0.00	**0.56**	0.00	**0.56**	0.00	**0.57**	0.00	**0.57**	0.00
Per capita household income	**104.7**	**140.9**	0.0	**146.0**	0.0	**151.3**	0.1	**155.4**	0.1	**159.6**	0.1
Poverty incidence	**40.2%**	**23.6%**	0.4%	**21.5%**	0.3%	**19.9%**	0.4%	**18.5%**	0.4%	**17.7%**	0.3%
Poverty gap	**17.4%**	**8.8%**	0.1%	**7.9%**	0.2%	**7.1%**	0.1%	**6.6%**	0.1%	**6.2%**	0.1%
Poverty severity	**10.5%**	**4.9%**	0.1%	**4.4%**	0.1%	**3.9%**	0.1%	**3.6%**	0.1%	**3.3%**	0.1%
External poverty incidence	**15.5%**	**7.1%**	0.2%	**6.3%**	0.3%	**5.6%**	0.2%	**5.1%**	0.2%	**4.8%**	0.2%
External poverty gap	**6.9%**	**3.0%**	0.1%	**2.6%**	0.1%	**2.3%**	0.1%	**2.1%**	0.1%	**1.9%**	0.1%
External poverty severity	**4.5%**	**1.9%**	0.1%	**1.6%**	0.1%	**1.4%**	0.1%	**1.3%**	0.1%	**1.2%**	0.1%
Theil – per capita household income	**0.49**	**0.40**	0.00	**0.39**	0.00	**0.38**	0.00	**0.37**	0.00	**0.37**	0.00
Gini – per capita household income	**0.50**	**0.46**	0.00	**0.45**	0.00	**0.45**	0.00	**0.45**	0.00	**0.45**	0.00
Rural											
Labor income	**137.2**	**153.3**	0.9	**154.8**	0.9	**156.1**	1.1	**157.4**	1.1	**158.4**	1.0
Theil – labor income	**0.72**	**0.67**	0.00	**0.67**	0.01	**0.66**	0.01	**0.66**	0.00	**0.66**	0.01
Gini – labor income	**0.55**	**0.55**	0.00	**0.55**	0.00	**0.55**	0.00	**0.55**	0.00	**0.55**	0.00
Per capita household income	**61.6**	**93.3**	0.6	**98.0**	0.6	**102.3**	0.8	**105.7**	0.7	**108.4**	0.7
Poverty incidence	**44.4%**	**23.3%**	0.6%	**20.8%**	0.6%	**18.9%**	0.7%	**17.4%**	0.6%	**16.5%**	0.6%
Poverty gap	**20.0%**	**9.2%**	0.3%	**8.1%**	0.3%	**7.2%**	0.2%	**6.5%**	0.2%	**6.1%**	0.2%
Poverty severity	**12.4%**	**5.3%**	0.2%	**4.6%**	0.2%	**4.1%**	0.2%	**3.7%**	0.2%	**3.5%**	0.2%
External poverty incidence	**18.6%**	**7.8%**	0.3%	**6.8%**	0.4%	**5.9%**	0.3%	**5.4%**	0.3%	**5.0%**	0.3%
External poverty gap	**8.4%**	**3.3%**	0.2%	**2.9%**	0.2%	**2.5%**	0.1%	**2.3%**	0.1%	**2.1%**	0.1%
External poverty severity	**5.4%**	**2.1%**	0.1%	**1.8%**	0.1%	**1.6%**	0.1%	**1.4%**	0.1%	**1.3%**	0.1%
Theil – per capita household income	**0.43**	**0.33**	0.00	**0.32**	0.01	**0.31**	0.01	**0.30**	0.00	**0.30**	0.01
Gini – per capita household income	**0.47**	**0.43**	0.00	**0.42**	0.00	**0.41**	0.00	**0.41**	0.00	**0.41**	0.00

Table 11. Continued

	2005 (Base year)	**Baseline** Mean	S.E.	**Tariff Cut** Mean	S.E.	**Maquila** Mean	S.E.	**All CAFTA** Mean	S.E.	**FDI** Mean	S.E.
Urban											
Labor income	**272.1**	**265.3**	0.6	**263.6**	0.6	**263.7**	0.7	**263.3**	0.7	**265.4**	0.7
Theil – labor income	**0.61**	**0.66**	0.00	**0.66**	0.00	**0.66**	0.00	**0.67**	0.00	**0.67**	0.00
Gini – labor income	**0.53**	**0.55**	0.00	**0.55**	0.00	**0.56**	0.00	**0.56**	0.00	**0.56**	0.00
Per capita household income	**133.6**	**172.7**	0.4	**178.1**	0.4	**184.1**	0.5	**188.7**	0.5	**193.8**	0.5
Poverty incidence	**37.5%**	**23.8%**	0.5%	**22.0%**	0.4%	**20.5%**	0.4%	**19.3%**	0.4%	**18.5%**	0.4%
Poverty gap	**15.6%**	**8.6%**	0.2%	**7.8%**	0.2%	**7.1%**	0.2%	**6.6%**	0.2%	**6.2%**	0.2%
Poverty severity	**9.2%**	**4.7%**	0.1%	**4.2%**	0.1%	**3.8%**	0.1%	**3.5%**	0.1%	**3.3%**	0.1%
External poverty incidence	**13.5%**	**6.7%**	0.3%	**5.9%**	0.3%	**5.4%**	0.3%	**4.9%**	0.2%	**4.6%**	0.3%
External poverty gap	**5.9%**	**2.7%**	0.1%	**2.4%**	0.1%	**2.1%**	0.1%	**1.9%**	0.1%	**1.8%**	0.1%
External poverty severity	**3.8%**	**1.7%**	0.1%	**1.5%**	0.1%	**1.4%**	0.1%	**1.2%**	0.1%	**1.1%**	0.1%
Theil – per capita household income	**0.43**	**0.37**	0.00	**0.36**	0.00	**0.35**	0.00	**0.35**	0.00	**0.35**	0.00
Gini – per capita household income	**0.47**	**0.44**	0.00	**0.44**	0.00	**0.44**	0.00	**0.43**	0.00	**0.43**	0.00

Source: Authors' worksheets

Note: SE is standard error.

As we have already seen, the CGE model predicts a fairly optimistic and significant increase of 34 percent in per capita income between 2005 and 2020 in El Salvador, even without CAFTA. The impact is large and favorable for both urban and rural poverty, but especially rural. At the national level, the 34 percent increase in per capita income causes poverty to fall by 41 percent, which implies an income–poverty elasticity of –1.20. The impact of growth on rural and extreme poverty is even larger. Rural household income rises faster than urban (52 percen, compared with 29 percent) and that causes rural poverty to fall at an even faster rate than urban poverty. These results all come from the rapid rate of growth of rural employment generated by our macro model. Agricultural production rises faster than urban services, and since we have assumed no increase in productivity, this translates into rapid increases in rural employment. With the number of jobs in the countryside growing about 4.7 percent per year, and the rural population only growing by 2.5 percent per year, the increase in participation rates and earning opportunities for rural families is large, thus moving a substantial number above the poverty line.

Because of the rapid increase in employment of the unskilled forecast in all the alternative scenarios, including the baseline, the model predicts a significant reduction in income inequality. At the national level, inequality in the baseline falls because of the narrowing of rural–urban income differentials. But it also falls within both the rural and the urban sectors, considered separately.

One may well question the accuracy of these predictions, but what is of greater importance to us here, is the impact of CAFTA on the projections. Whatever error may be in the baseline projections, there is no reason to think that there will be a relationship between the CAFTA projections and an unknown error in the baseline. Therefore, the difference between the CAFTA forecasts and the baseline should be a robust estimate of the impact of CAFTA.

Consider now what the changes in poverty and distribution estimates across the simulations tell us about the impact of CAFTA, first comparing tariffcut to the baseline. The tariffcut column shows the impact of the tariff reductions alone, separate from all the other components of the treaty. The tariff reductions are favorable both to rural and to urban families. Employment and per capita income rise in both rural and urban areas, while poverty and extreme poverty fall. Contrary to the expectations of some observers, CAFTA’s impact is particularly favorable in the rural area. According to these estimates, per capita household income increases about 5 percent, compared to 3 percent in the urban area.

This result may seem surprising because of the reduction of tariffs on some agricultural commodities, but that ignores three things. First, the average level of tariffs prior to CAFTA was already quite low (see Table 1). Second, tariffs on sensitive products were reduced slowly and carefully (see Table 3). Third, increases in income cause indirect increases in household demand for agricultural commodities, which (according to the simulations) offsets the unfavorable direct impact of reduced protection.

Not only does the tariff reduction under CAFTA help the poor, it also slightly improves the distribution of income. Compare the Gini coefficients for per capita household income in the CAFTA column with those in the baseline. Both the rural and the national Theils and Ginis fall by one percentage point, and all these changes are statistically significant. This is an important and somewhat surprising result. Recall that in the CAFTA scenario the rate of growth of skilled employment increases slightly over the baseline and so does the relative wage of the skilled (Table 9). Those changes are small, which is why the distribution of labor income is the same in both the baseline and tariff cut scenarios. At the household level, the additional wages from increased employment adds of formerly unemployed unskilled workers increases household income enough at the bottom of the income pyramid to more than offset the absolute gains in employment and wages for the skilled.

Maquila is even more favorable to the poor than trade liberalization, particularly for the urban sector. Because the increase in the demand for female unskilled labor is very large as are demand-side linkages, the boom in this sector spreads, increasing demand and employment throughout the economy. Rural and urban poverty both fall, the former by an even greater amount than the latter. This merely underlines two features of poverty reduction in El Salvador. The first is the critical sensitivity of poverty to employment growth, particularly for the unskilled. Any development strategy that successfully creates employment for this group will have a large and favorable impact on poverty. The second feature is the linkage between the rural and the urban sectors. If the economy creates urban employment that pulls unemployed or inactive workers out of the countryside at the same time that the rise in urban employment and income increases the demand for agricultural production by urban households, the impact on rural poverty will be favorable.

Maquila not only has a favorable impact on poverty rates, both rural and urban, it also reduces inequality. At the national level, the Gini falls from 0.46 in the baseline to 0.45. One reason for this is that under maquila the difference between urban and rural households' average income narrows. This happens in spite of the fact that maquila itself is an urban activity. This is just one more reminder of the importance of the linkage between the urban and rural labor markets for the unskilled. Rapid employment growth for the urban unskilled lifts incomes throughout the economy. For the unskilled the gains come in the form of more jobs at the same wage. For the skilled, the rise in labor demand is satisfied partially by an increase in employment but also by an increase in relative wages. That is why the urban Gini for labor income rises relative to the baseline. This also explains why poverty can be reduced at the same time labor income inequality rises, particularly in the urban sector.

In the next scenario, ALLCAFTA combines the tariff cuts with access to the maquila market. As we have seen, both trade liberalization and maquila reduce poverty. When we measure their joint impact, the results are roughly equal to the sum of the effects considered separately. In the ALLCAFTA simulation, poverty at the national level falls by 5 percentage points relative to the baseline. The bulk comes from maquila and the rest from trade liberalization. If we look at the rural and urban impacts separately, we find that in relative terms trade liberalization is more helpful to the rural poor, while maquila has a bigger impact on the urban poor. Altogether urban poverty falls by 4.5 percentage points, of which 3.3 percentage points or more than two-thirds comes from maquila. But even so, because of the spread effects of faster employment growth for the unskilled, rural poverty falls further (5.9 percentage points) than urban, so that the reduction in rural poverty due to maquila is actually larger than the reduction in urban poverty.

The changes in poverty and distribution presented in Table 11 for the different scenarios are the result of changes in employment, in the skill composition of the employed labor force, and in relative wages. We use microsimulation methodology to get an idea of how important each of these changes is to the final observed changes in Table 11.

The microsimulation procedure is a way of estimating the poverty and distributional impact of the changes in the labor market determined by a CGE equilibrium solution, including changes in unemployment, labor force structure or skill composition, and relative wages. Since these changes are made sequentially, we can make a quasi- decomposition of the overall changes in poverty or distribution, according to poverty and distribution statistics calculated separately at each stage of the microsimulation. In other words, we can ask what the poverty or distribution level would have been if the overall employment growth had been as it was in the CGE solution but with labor force structure and relative wages held constant. We can repeat this same procedure at each step of the microsimulation and calculate the changes in poverty and distribution resulting from the particular change in the labor market solution (Table 12). We are calling this a "quasi-decomposition" because one cannot build up to the final CGE solution in this way. The CGE was not asked to determine the rate of growth of total employment, holding labor force structure constant. If it had been, almost certainly the overall rate of growth of employment would have been lower than the one determined by the CGE. We can ask what the effect on poverty is of a change in total employment, holding the labor force structure constant, but that is not a CGE solution nor is it a part of the CGE solution. Indeed the whole point of the CGE is that overall growth will almost certainly involve changes in labor force structure and relative wages. Having said this, it is still instructive to make this quasi-decomposition to get an idea of which of the various changes in the labor market seem to have had the biggest impact on poverty and its distribution.

In Table 12, there are three columns for each of the scenarios for the year 2020. The first, labeled E, gives the results coming from employment growth alone, holding both the skill composition and relative wages at their 2005 levels. It applies the rate of growth of total employment in each scenario to each category of labor. For example, in the baseline scenario, total employment grows at 4.9 percent per year between 2005 and 2020. The E column shows what would happen to poverty and the distribution of income if that rate had been applied to all categories of employment. The microsimulation adjusts the participation rate and the unemployment rate for each type of labor until the overall average rate of growth of employment is reached. It then applies the base-period wage rate to each class of workers and calculates the poverty and distribution statistics.

The second column, labeled S, changes the skill composition of the employed labor force so that in 2020 the rate of growth by skill category and gender of the labor force is consistent with the CGE model solution for 2020. In this case the microsimulation brings enough workers out of unemployment or inactivity to reach the rate of growth of employment for each skill class generated by the CGE model for 2020. It assigns to each new worker the average wage by skill observed in the base year. Finally, the column labeled W shows the effect of changing relative wages by giving each of the workers in the S or skill level solution the wage shown in the CGE solution for 2020, rather than the one from the base year. The W columns for each scenario are identical to the columns for 2020 in Table 11.

The first point to be gleaned from Table 12 is the key role employment growth plays for the unskilled in alleviating poverty. Look first at the tariff cut column. It shows the effect of trade liberalization alone. Trade liberalization increased the average employment growth rate from 4.9 percent in the base line to 5.1 percent. The small increase is enough to reduce the national poverty rate from 24.5 percent in the base line to 23.2 percent. In all of the simulations, employment growth for the unskilled is higher than for the skilled. That means that in the columns marked S, the growth rate of employment of unskilled labor is higher than the growth rate under column E. The effect of that differential growth rate can be seen in the columns labeled S, where we permit differential growth rates of employment by skill. Not surprisingly, in almost every case, the poverty rates in the S column are lower than they are in the corresponding E columns, reflecting the close connection between poverty and employment growth for the unskilled.[13] In the tariff cut simulation, the difference in poverty rates between the S and E columns is particularly large. That says that trade liberalization by itself favors the unskilled. Faster-than-average growth in jobs for this group reduces the national poverty rate by 1.4 percentage points relative to what it would have been if all skill categories had grown at the same rate.

Overall employment growth plays an even greater role in the total poverty reduction in all the other scenarios simply because they all have higher rates of growth than trade liberalization alone. That is particularly clear in the maquila scenario. From the E column in that scenario, we find that employment growth by itself reduces the national poverty rate by 3.8 percentage points relative to what it is expected to be in 2020 in the baseline. In all the scenarios, changes in skill structure and wage differentials do

[13] The exception is ALLCAFTA where the poverty rates are approximately equal.

reduce the poverty rates a bit more than employment growth alone, but still the latter comprises at least 90 percent of the total amount of poverty reduction from each of those simulations.

If we now look at the effect of permitting the rise in wage differentials generated by the CGE model to feed through into household incomes, we find that in every case the impact is positive. Rising wage differentials actually reduce poverty relative to what it would have been with the simulated employment growth rates differentiated by skill. This is true in every scenario. Since the model assumes a constant real wage for the unskilled, this pattern has to mean that there are either significant numbers of skilled workers in poor households, or that poor households earn some of their income from either family farms or informal urban activities part of which are returns to capital, the quantity of which rises in each of our scenarios.

Table 12. Decomposition of CAFTA Effects, 2020

		Baseline			Tariff Cut			Maquila			AllCAFTA			FDI		
	2005		Mean			Mean			Mean			Mean			Mean	
National		E	S	W	E	S	W	E	S	W	E	S	W	E	S	W
Labor income	222.3	215.2	210.1	222.3	214.9	209.3	221.7	214.7	209.0	222.2	213.7	208.7	222.4	212.3	209.2	224.1
Theil- labor income	0.69	0.66	0.65	0.70	0.66	0.65	0.70	0.65	0.65	0.70	0.65	0.64	0.70	0.65	0.64	0.70
Gini- labor income	0.56	0.55	0.55	0.56	0.55	0.55	0.56	0.55	0.55	0.56	0.55	0.55	0.57	0.55	0.55	0.57
Per capita household income	104.7	135.8	133.8	140.9	139.1	138.4	146.0	146.0	143.0	151.3	150.6	146.5	155.4	150.2	149.6	159.6
Poverty incidence	40.2%	24.5%	23.9%	23.6%	23.2%	21.8%	21.5%	20.7%	20.1%	19.9%	18.7%	18.8%	18.5%	18.5%	17.9%	17.7%
Poverty gap	17.4%	9.2%	8.9%	8.8%	8.6%	7.9%	7.9%	7.5%	7.2%	7.1%	6.6%	6.6%	6.6%	6.5%	6.3%	6.2%
Poverty severity	10.5%	5.2%	5.0%	4.9%	4.8%	4.4%	4.4%	4.1%	3.9%	3.9%	3.6%	3.6%	3.6%	3.5%	3.4%	3.3%
External poverty incidence	15.5%	7.5%	7.2%	7.1%	6.9%	6.3%	6.3%	5.9%	5.6%	5.6%	5.1%	5.1%	5.1%	5.0%	4.8%	4.8%
External poverty gap	6.9%	3.1%	3.0%	3.0%	2.9%	2.6%	2.6%	2.5%	2.3%	2.3%	2.1%	2.1%	2.1%	2.0%	2.0%	1.9%
External poverty severity	4.5%	2.0%	1.9%	1.9%	1.8%	1.7%	1.6%	1.6%	1.5%	1.4%	1.3%	1.3%	1.3%	1.3%	1.2%	1.2%
Theil- per capita household income	0.49	0.38	0.36	0.40	0.37	0.35	0.39	0.36	0.34	0.38	0.35	0.33	0.37	0.34	0.33	0.37
Gini- per capita household income	0.50	0.45	0.44	0.46	0.45	0.44	0.45	0.44	0.43	0.45	0.44	0.43	0.45	0.43	0.42	0.45
Rural																
Labor income	137.2	151.8	151.4	153.3	153.1	152.8	154.8	155.2	154.0	156.1	156.1	155.2	157.4	155.9	155.9	158.4
Theil- labor income	0.72	0.66	0.66	0.67	0.66	0.65	0.67	0.65	0.65	0.66	0.65	0.64	0.66	0.65	0.64	0.66
Gini- labor income	0.55	0.55	0.54	0.55	0.55	0.54	0.55	0.54	0.54	0.55	0.54	0.54	0.55	0.54	0.54	0.55
Per capita household income	61.6	90.7	92.1	93.3	93.9	96.6	98.0	99.9	100.7	102.3	104.2	104.1	105.7	104.7	106.5	108.4
Poverty incidence	44.4%	24.6%	23.4%	23.3%	22.9%	20.9%	20.8%	20.0%	19.0%	18.9%	17.8%	17.5%	17.4%	17.5%	16.6%	16.5%
Poverty gap	20.0%	9.8%	9.2%	9.2%	9.0%	8.1%	8.1%	7.7%	7.2%	7.2%	6.7%	6.6%	6.5%	6.6%	6.2%	6.1%
Poverty severity	12.4%	5.7%	5.3%	5.3%	5.2%	4.7%	4.6%	4.4%	4.1%	4.1%	3.8%	3.7%	3.7%	3.7%	3.5%	3.5%
External poverty incidence	18.6%	8.3%	7.8%	7.8%	7.6%	6.8%	6.8%	6.4%	6.0%	5.9%	5.5%	5.5%	5.4%	5.4%	5.1%	5.0%
External poverty gap	8.4%	3.6%	3.4%	3.3%	3.3%	2.9%	2.9%	2.7%	2.5%	2.5%	2.3%	2.3%	2.3%	2.3%	2.1%	2.1%
External poverty severity	5.4%	2.3%	2.1%	2.1%	2.1%	1.8%	1.8%	1.7%	1.6%	1.6%	1.5%	1.4%	1.4%	1.4%	1.3%	1.3%
Theil- per capita household income	0.43	0.26	0.24	0.33	0.26	0.24	0.32	0.26	0.24	0.31	0.26	0.24	0.30	0.25	0.24	0.30
Gini – per capita household income	0.47	0.43	0.42	0.43	0.42	0.41	0.42	0.42	0.41	0.41	0.41	0.40	0.41	0.41	0.40	0.41

Table 12. Continued

	2005	Baseline			Tariff Cut			Maquila			AllCAFTA			FDI		
			Mean			Mean			Mean			Mean			Mean	
Urban																
Labor income	272.1	253.9	246.8	265.3	252.7	244.6	263.6	251.3	243.6	263.7	249.2	242.4	263.3	247.2	242.7	265.4
Theil- labor income	0.61	0.61	0.61	0.66	0.61	0.61	0.66	0.61	0.61	0.66	0.61	0.61	0.67	0.61	0.61	0.67
Gini- labor income	0.53	0.53	0.53	0.55	0.53	0.53	0.55	0.54	0.53	0.56	0.53	0.53	0.56	0.54	0.53	0.56
Per capita household income	133.6	165.9	161.8	172.7	169.3	166.4	178.1	176.8	171.3	184.1	181.7	174.9	188.7	180.6	178.4	193.8
Poverty incidence	37.5%	24.5%	24.2%	23.8%	23.4%	22.4%	22.0%	21.2%	20.9%	20.5%	19.3%	19.6%	19.3%	19.1%	18.8%	18.5%
Poverty gap	15.6%	8.8%	8.7%	8.6%	8.3%	7.8%	7.8%	7.4%	7.2%	7.1%	6.5%	6.7%	6.6%	6.4%	6.3%	6.2%
Poverty severity	9.2%	4.8%	4.7%	4.7%	4.5%	4.2%	4.2%	4.0%	3.8%	3.8%	3.4%	3.5%	3.5%	3.4%	3.3%	3.3%
External poverty incidence	13.5%	6.9%	6.7%	6.7%	6.5%	5.9%	5.9%	5.7%	5.4%	5.4%	4.9%	4.9%	4.9%	4.7%	4.6%	4.6%
External poverty gap	5.9%	2.8%	2.7%	2.7%	2.6%	2.4%	2.4%	2.3%	2.2%	2.1%	1.9%	2.0%	1.9%	1.9%	1.8%	1.8%
External poverty severity	3.8%	1.8%	1.7%	1.7%	1.6%	1.5%	1.5%	1.4%	1.4%	1.4%	1.2%	1.2%	1.2%	1.2%	1.2%	1.1%
Theil- per capita household income	0.43	0.35	0.33	0.37	0.34	0.32	0.36	0.33	0.31	0.35	0.32	0.31	0.35	0.31	0.30	0.35
Gini- per capita household income	**0.47**	**0.43**	**0.42**	**0.44**	**0.43**	**0.42**	**0.44**	**0.43**	**0.41**	**0.44**	**0.42**	**0.41**	**0.43**	**0.41**	**0.41**	**0.43**

Source: Author's worksheets
Notes: E is employment, S is skill, W is wage. FDI is foreign direct investment.

As we have already seen, the model forecasts a reduction in inequality. That is mainly due to the underlying employment trends of the baseline, slightly amplified by CAFTA itself. Table 12 allows us to separate the effects of the changes in employment from the changes in relative wages forecast by the model. The message from the table is clear. Trade liberalization by itself has a relatively small impact on employment and growth. But that impact is progressive. At both the national and rural levels, the Gini falls by one percentage point, and urban–rural household income differentials narrow.

In all the other simulations, the growth of the economy is higher than in the baseline and so is employment for the unskilled. No change in relative wages would have resulted in a further reduction in inequality. But faster growth, coupled with supply constraints for skilled labor, led to rising wage differentials in favor of skilled labor. That raised the Ginis and Theils in both subsectors and at the national level relative to the levels they would have reached with employment growth alone. But those regressive increases in relative earnings do not completely offset the favorable effects of rising employment for the unskilled, except for urban households in the maquila and tariff cut scenarios.

The message here is that the positive effect of job creation on the distribution of income is greater than the associated rise in the skill differential. To put it another way, while it is likely that there will be a rise in the skill differential over the next 15 years, and while it may even widen slightly under CAFTA, the absolute gains in income at the bottom of the income pyramid under CAFTA more than offset the gains in wages for the skilled at the top. In short, CAFTA improves the distribution of income relative to the baseline. That is partly because a good part of the gain from CAFTA goes to the rural sector, and partly because the benefits to the poor of faster growth in jobs for the unskilled more than offsets the regressive effects of rising relative wages for the skilled.

8. CONCLUSIONS

Supporters of CAFTA hope that it will enhance growth prospects and reduce poverty in El Salvador. Our results suggest that while the effects of CAFTA on the growth rate and poverty are positive, they will be small unless the agreement affects the investment rate. Thanks to trade liberalization in the 1990s, tariff barriers were not high enough prior to CAFTA to have a large impact on growth when they are dismantled. Critics have complained that smallholders will be hurt by the removal of tariff protection for sensitive products such as corn, rice, beans, and pork that are produced and consumed by the poor. Our results do not support this view. Agriculture in general and subsistence agriculture in particular would both grow slightly faster under CAFTA than they could be expected to otherwise. The increases in the growth rate are not large, but they are positive. One reason for this is that the removal of tariff protection for these commodities under CAFTA will be cautious and gradual. Also we found that the rural–urban wage differential narrows slightly under each of the CAFTA scenarios because poverty falls further in the rural sector than it does in the urban.

CAFTA in general and maquila in particular are good for both rural and urban unskilled labor in El Salvador. Since we have assumed an excess supply of unskilled labor, wage differentials widen in favor of the skilled, which means that for unskilled labor the benefits of CAFTA are expressed in job creation rather than rising wages. CAFTA raises the employment growth rate for unskilled males by 0.3 percent per year in the urban sector and by 0.2 percent in the rural sector; the increase is somewhat larger for female unskilled labor because of maquila. CAFTA also benefits skilled labor, but here much of the benefit comes in the form of rising wages as well as employment growth. While that means that the distribution of income is less equal than it would be without the associated rise in the skill differential, in no case did the rise in inequality fully offset the progressive effects of enhanced job creation due to CAFTA. With CAFTA, poverty declines and distribution improves slightly at the national level and to a more significant extent in the rural sector in all the scenarios relative to the baseline.

In addition to trade liberalization, CAFTA includes significant benefits for foreign investors, in the hope that such inducements will increase the inflow of foreign capital to the country and in turn have a positive impact on production and employment. Our results support this position. If foreign direct investment really does increase in response to CAFTA to the degree that we have assumed in our CAFTA experiment, the impact on the Salvadorian economy will be substantial. Economic growth and employment of the unskilled would rise by roughly one-fourth, and while this may be an overly optimistic projection, it does point to the critical role of increasing the rate of capital formation and technical progress. To the extent that foreign capital can help to achieve this goal, it will provide a powerful push to growth and employment.

These simulations say something important about the growth process in a country like El Salvador in which it seems reasonable to assume that there is idle unskilled labor willing and able to work at a fixed real wage. In such an economy, growth can be increased in one of three ways. First, already employed resources can be moved to sectors where they are more productive. That is what the tariff reductions under CAFTA do, and the result is positive but small. Differences in factor productivity across protected and unprotected sectors are not large enough to have much of a growth impact. Second, the structure of demand can be changed in such a way as to increase the demand for previously unemployed unskilled labor. That is what the maquila simulation does, because maquila uses a lot of unskilled labor relative to skilled labor and capital. Increasing demand for the output of this sector makes the whole economy less skill-intensive. Better yet, the increase in the growth rate is virtually free, because some of the productive resources used were previously unemployed. That has a big impact on poverty and a smaller though positive effect on inequality. Finally, the supply of capital can be increased by increasing the rate of capital formation. That is what happens in the FDI simulation. Note however that any policy that increases the investment rate would have virtually the same positive effect on the growth rate.

APPENDIX A: SUPPLEMENTARY TABLE

Table A.1. Sectoral growth rate

Sector	INITIAL SHARE 2000*	BASE	CAFTA	MAQUILA	ALL CAFTA	FDI
		Annual Percentage growth rate (2000-2020)				
EXPORTS						
CCAFE	4.80	4.55	4.70	4.94	5.09	5.59
CCEREAL	0.15	4.94	5.05	5.39	5.5	6.40
CCARNE	0.35	5.34	5.44	5.79	5.9	7.11
CSILV	0.02	5.32	5.28	5.87	5.83	7.46
CPESCA	0.39	4.80	4.90	5.25	5.35	6.26
CMINERIA	0.03	4.93	4.89	5.32	5.29	6.28
CCARPROD	0.05	4.81	4.88	5.25	5.34	6.52
CLACTEOS	0.08	4.77	4.86	5.09	5.2	6.28
CTRIGPROD	1.08	4.56	4.75	4.84	5.03	5.75
CAZUPROD	1.33	4.31	4.45	4.68	4.82	5.74
COTHAGIND	3.77	4.00	4.11	4.36	4.47	5.28
CBEBTAB	1.25	4.18	4.28	4.47	4.57	5.46
CTEXTILES	10.04	4.85	5.00	5.05	5.21	6.10
CINDUME	0.92	4.28	4.50	4.42	4.65	5.67
CCUERO	0.43	4.53	4.57	4.85	4.89	6.18
CMADERA	0.31	4.52	4.51	4.83	4.83	6.09
CPAPEL	0.87	4.63	4.74	5.02	5.14	5.79
CIMPRENTA	1.77	3.81	3.79	4.09	4.07	5.33
CQUIMICOS	2.92	4.25	4.36	4.61	4.72	5.47
CPETROLEO	3.66	3.68	3.86	4.08	4.27	4.91
CPLASTICO	1.71	4.14	4.13	4.44	4.43	5.59
CMINERALE	0.74	4.15	4.26	4.52	4.64	5.57
CMETALES	5.10	5.14	5.21	5.45	5.54	6.34
CMAQUIN	2.39	4.70	4.81	5.04	5.15	6.00
CTRANSMAQ	3.10	4.37	4.32	4.64	4.61	5.89
CELECT	0.23	4.66	4.82	5.13	5.3	5.66
CCOMER	0.10	4.28	4.49	4.63	4.84	5.43
CHOTYREST	4.66	4.24	4.41	4.58	4.76	5.41
CTRANSP	9.00	4.28	4.46	4.67	4.85	5.40
CCOMUN	2.11	4.11	4.30	4.40	4.6	5.20
CSFINANC	0.14	4.47	4.63	4.77	4.94	5.56
CINMVIV	0.55	4.58	4.72	4.99	5.14	5.91
CSPERDOM	0.64	4.16	4.29	4.57	4.71	5.54
CMAQUILA	35.28	6.24	6.29	7.60	7.65	7.19
IMPORTS						
CCAFE	0.21	7.53	7.77	7.99	8.24	9.07
CCEREAL	3.21	3.97	4.45	4.20	4.69	4.71
COTHCROP	1.09	4.77	4.94	5.08	5.26	5.88
CCARNE	0.44	3.72	4.23	3.98	4.50	4.36
CSILV	0.13	4.27	5.58	4.53	5.85	4.94
CPESCA	0.22	4.04	4.78	4.31	5.06	4.87
CMINERIA	7.23	3.91	4.12	4.32	4.53	5.01

Table A.1. Continued

Sector	INITIAL SHARE 2000*	BASE	CAFTA	MAQUILA	ALL CAFTA	FDI
		Annual Percentage growth rate (2000-2020)				
CCARPROD	1.39	4.36	4.82	4.66	5.13	5.13
CLACTEOS	1.51	4.16	4.60	4.45	4.91	4.95
CTRIGPROD	1.38	4.21	4.63	4.52	4.95	5.05
CAZUPROD	0.03	3.90	6.88	4.15	7.15	4.57
COTHAGIND	3.45	4.59	5.03	4.90	5.35	5.44
CBEBTAB	0.88	3.89	4.53	4.19	4.83	4.66
CTEXTILES	2.67	4.13	5.30	4.44	5.63	5.00
CINDUME	0.60	4.05	5.39	4.39	5.74	4.87
CCUERO	1.10	4.03	4.79	4.33	5.10	4.78
CMADERA	1.45	4.32	4.83	4.70	5.22	5.21
CPAPEL	2.50	4.20	4.47	4.53	4.81	5.20
CIMPRENTA	1.66	4.28	4.74	4.60	5.07	5.12
CQUIMICOS	12.64	4.15	4.48	4.46	4.79	5.05
CPETROLEO	7.91	4.32	4.63	4.67	4.99	5.24
CPLASTICO	2.46	3.94	4.65	4.28	5.00	4.76
CMINERALE	1.00	4.55	5.54	5.19	6.19	5.52
CMETALES	5.77	4.26	4.75	4.75	5.25	5.35
CMAQUIN	16.42	4.24	4.63	4.75	5.15	5.33
CTRANSMAQ	8.54	4.22	4.83	4.68	5.30	5.22
CELECT	1.09	5.09	5.28	5.74	5.94	5.96
CCOMER	0.22	5.10	5.51	5.49	5.91	5.87
CHOTYREST	1.80	4.42	4.82	4.68	5.09	4.91
CTRANSP	2.49	4.89	5.22	5.40	5.73	5.52
CCOMUN	0.56	4.59	4.94	4.95	5.30	5.23
CSFINANC	1.89	4.00	4.33	4.42	4.76	4.81
CINMVIV	4.62	4.67	5.02	5.23	5.58	4.99
CSPERDOM	1.42	4.56	4.98	4.77	5.20	4.88
CMAQUILA	0.01	4.35	4.67	-0.33	-0.02	5.19

Source: Author's worksheets.

APPENDIX B: DOCUMENTATION OF THE SOCIAL ACCOUNTING MATRIX AND HOUSEHOLD SURVEY FOR EL SALVADOR AND TECHNICAL DESCRIPTION OF THE RECURSIVE DYNAMIC CGE

The Social Accounting Matrix for 2000[14]

As noted in the paper, the Social Accounting Matrix (SAM) used in this study is based on the 2000 SAM developed by Carlos Acevedo and described in Acevedo (2005). This SAM distinguishes between accounts for "activities" (the entities that carry out production) and "commodities" (markets for goods and services). The receipts are valued at producer prices in the activity accounts and at market prices in the commodity accounts (i.e. including indirect commodity taxes and transaction costs). Activity outputs are either exported or sold domestically, while commodities comprise of domestic supply and imports. This separation of activities from commodities is preferred because it permits activities to produce multiple commodities (for example, a dairy activity may produce cheese and milk that are delivered into different commodity markets) while any commodity may be produced by multiple activities (for example, different activities for small scale and large-scale maize production may both produce the same maize commodity).

Second, the matrix explicitly associates trade flows with transactions (trade and transportation) costs, also referred to as marketing margins. For each commodity, the SAM accounts for the transaction costs associated with domestic, import, and export marketing. For domestic marketing of domestic output, the marketing margin represents the cost of moving the commodity from the producer to the domestic market. For imports, it represents the cost of moving the commodity from the border (adding to the c.i.f. price) to the domestic market, while for exports; it shows the cost of moving the commodity from the producer to the border (reducing the price received by producers relative to the f.o.b. price).

Third, the government is disaggregated into a core government account and different tax collection accounts, one for each tax type. This disaggregation is often necessary because the economic interpretation of some payments may otherwise be ambiguous. In any given application, the SAM may exclude any (or all) of these specific tax collection accounts. In the SAM, payments between the government and the other domestic institutions represent government transfers.

Fourth, the domestic non-government institutions in the SAM consist of households and enterprises. The enterprises earn factor incomes (reflecting their ownership of capital and/or land) and may also receive transfers from other institutions. Enterprises pay corporate (direct) taxes, save, and transfer profits to other institutions. Assuming that the relevant data are available, it is preferable to have one or more accounts for enterprises when these have tax obligations and savings behavior that are

[14] This section was taken from Acevedo (2005).

independent of and different from the household sector. Enterprises should be disaggregated in a manner that captures differences across various enterprise types in terms of tax rates, savings rates, and the shares of retained earnings that are received by different household types.

Finally, the SAM distinguishes between own home consumption, which is activity-based, and marketed consumption, which is commodity-based. Home consumption, which in the SAM appears as household payments to activities, is valued at producer prices. Household consumption of marketed commodities appears as payments from household accounts to commodity accounts, the values of which include marketing margins and commodity taxes.

The main sources of information were the Input-Output Matrix (IOM) estimated by the Central Bank of Reserve of El Salvador for 2000 and the Multiple Purposes Household Survey (MPHS) elaborated by the National Office of Statistics (Dirección General de Estadística y Censos, DIGESTYC) for the same year. Data from these two sources were complemented by information coming from the national accounts and balance of payments statistics compiled by the Central Bank, tax collection data from the Ministry of Finance, and data on production costs for the agriculture and livestock sectors estimated by the General Office of Agricultural Economy (Dirección General de Economía Agropecuaria, DGEA) at the Agriculture and Livestock Ministry (Ministerio de Agricultura y Ganadería, MAG).

As it is standard in assembling SAMs, production is split into two types of categories: "activities" and "commodities". The activity account may be thought of as the domestic producers account. On the column, it consists of intermediate inputs, value added and value added taxes. This data come from the IOM for year 2000. Along the row, it accounts for domestic production and home consumption. Because there is no own consumption in the Salvadoran macro accounts, this is calculated from microdata on subsistence farming provided by the DGEA and then subtracted from the purchased private consumption entry in the macro SAM. The sum of the activity purchases or income is production at factor costs, or gross domestic output, which in El Salvador SAM equals US$19,960 million.

The factors´ entry in the macro SAM has three columns and respective rows, for aggregated labor, capital, and aggregated land. The factors are divided in eighteen groups: capital, land, and sixteen categories of labor. In turn, the labor force is divided into skilled and unskilled labor, both disaggregated by whether a person works in the tradable or nontradable sector, whether he/she works in an urban or rural area, and by gender. Unskilled labor is defined as those workers who completed at most ninth grade. Skilled workers are those with more than nine years of schooling.

In the case of El Salvador, there is no aggregate data for returns to land, but rather returns to land are included in the returns to capital. This is amended by using estimates from the production costs for agricultural activities estimated by the DGEA.

The outcome is a 123 by 123 matrix which includes 45 activities, 45 commodities, 3 marketing margin accounts, 18 factors of production (16 labor categories plus value added capital and value added land), 1 enterprise account, 4 households groups, a government account, 3 accounts for taxes (taxes are collected and transferred to the government through these accounts), an investment/savings account, a stock change account, and the rest of the world (RoW) account.

The disaggregation of activities and commodities in the micro SAM follows the structure of the 2000 IOM. Therefore, it has 45 production sectors in the economy, meaning that there are 45 activities and 45 commodities.

Table B.1. SAM Production sectors

1. Coffee	24. Printing and publishing
2. Cotton	25. Chemicals
3. Grains	26. Petroleum products
4. Sugar cane	27. Rubber and plastic products
5. Other agricultural activities	28. Mineral products
6. Livestock	29. Metal products
7. Poultry	30. Machinery and equipment
8. Forestry	31. Transport equipment
9. Fisheries	32. Electricity
10. Mining	33. Water
11. Meat products	34. Construction
12. Dairy products	35. Commerce
13. Processed products from fishing	36. Hotels and restaurants
14. Wheat manufacturing	37. Transportation
15. Sugar	38. Communication
16. Other processed foods	39. Financial services
17. Beverages	40. Real estate
18. Tobacco products	41. Housing
19. Textiles	42. Personal services
20. Wearing apparel	43. Domestic services
21. Leather products	44. Public administration
22. Wood products	45. Maquila
23. Paper products	

After the commodities and activities transactions are quantified, the other actors from the macro SAM can be broken down. In particular, aggregate labor is divided by skill level (skilled or unskilled), region (urban-rural) and gender, and households are divided by region (urban or rural) and schooling of the household head.

The micro SAM is used to map the income that the labor categories receive from the production sectors and then direct it to the different households. The mapping is determined using data on household income from the MPHS. The distribution of the activities payments to labor categories is based on the household survey, too. The information provided by the MPHS is crucial to build the micro SAM.[15]

The households are distinguished by location (urban and rural) and the educational level of the household head (whether he/she has completed at least ninth grade), for a total of four household types. The relevant information to classify them according to these categories comes from the MPHS. Labor payments by category get distributed to the different households (known as the "allocation matrix") according to the household survey data (MPHS). The distribution of land payments among households is also based on the MPHS. On the other hand, households receive capital payments via the enterprise account. This is distributed on the assumption that the share of households in total capital payments is determined by their shares in total income.

Table B.2. Labor categories

Labor Category	*Skill*	*Description*	*Gender*
TUWM	Unskilled	Rural	Male
TUNM	Unskilled	Urban	Male
TSWM	Skilled	Rural	Male
TSNM	Skilled	Urban	Male
TUWF	Unskilled	Rural	Female
TUNF	Unskilled	Urban	Female
TSWF	Skilled	Rural	Female
TSNF	Skilled	Urban	Female

The share of a household-type consumption in the total consumption of a commodity is based on the assumption that this share is the same as its share in total income, given by the MPHS. Then, the consumption share is applied to the total consumption of the commodity, as given from the IOM data. This is a bold assumption but it seems reasonable in the absence of data based on a consumption survey.

Data on the rest of the world purchases of exports from the commodity accounts are taken from the 2000 IOM. Rest of the world transfer payments to households are derived from the Central Bank national accounts data on (aggregated) transfer payments, distributed among households according to the shares given by the MPHS. Foreign savings is the same as in the macro SAM. Imports from the rest of the world come from the IOM database, while the other rest of the world receipts (from the capital factor and the government) equal the macro SAM totals. The savings-investment account shows investment in each commodity down the column, as given by the 2000 IOM. Information on the stock change comes from the IOM, too. Receipts from government and the rest of the world are from the macro SAM totals.

[15] The MPHS sample for year 2000 included around 15,000 households.

The SAM was balanced using consistency equations programmed in GAMS (Generic Algebraic Modeling System; See Brooke, A et al, 1988). The entropy approach used to obtain a balanced SAM can be seen in S. Robinson et al (2002).

Before the SAM was balanced some inconsistencies in the data were seen. We corrected for these using national data and leave the economic identities to be solved in the code programmed in GAMS.

It was necessary to aggregate real state services, housing, personal services and domestic services. The data represented in those activities was not very clear and not relevant for our analysis. As well as consolidate the beverages and tobacco activities.

The major problems were seen in the data for coffee and transaction costs. Also, it was necessary to divide the maquila sector in two; one that exports and the other one that imports.

Table B.3. National social accounting matrix used in the CGE model

Receipts	Activities	Commodities	Factors	Households	Enterprises	Government	Savings – investment	Rest of the World (RoW)	TOTAL
Activities		Marketed outputs							Activity income
Commodities	Intermediate inputs			Private consumption		Government consumption	Investment	Exports	Demand
Factors	Value-added								Factor income
Households			Factor income to households	Inter-household transfers	Surplus to households	Transfers to households		Transfers to households	Household income
Enterprises			Factor income to enterprises			Transfers to enterprises		Transfers to enterprises	Enterprise income
Government	Producer and value added tax	Sales taxes, tariffs, export taxes	Factor taxes	Transfers, direct taxes	Direct taxes			Transfers to government	Government income
Savings – Investment				Household savings	Enterprise savings	Government savings		Foreign savings	Savings
Rest of the World (RoW)		Imports	Factor income to RoW		Surplus to RoW	Government transfers			Foreign exchange outflow
TOTAL	Activity expenditures	Commodity supply	Factor expenditures	Household expenditures	Enterprise expenditures	Government expenditures	Investment	Foreign exchange infow	

Source: Adapted from Lofgren, Harris, and Robinson; 2001.

A Formal Statement of the Dynamic CGE Model

Table B.4. The dynamic CGE model

Symbol	Explanation	Symbol	Explanation
$a \in A$	activities	$c \in CMN(\subset C)$	commodities not in *CM*
$a \in ACES(\subset A)$	activities with a CES function at the top of the technology nest	$c \in CT(\subset C)$	transaction service commodities
$a \in ALEO(\subset A)$	activities with a Leontief function at the top of the technology nest	$c \in CX(\subset C)$	commodities with domestic production
$c \in C$	commodities	$f \in F$	factors
$c \in CD(\subset C)$	commodities with domestic sales of domestic output	$i \in INS$	institutions (domestic and rest of world)
$c \in CDN(\subset C)$	commodities not in *CD*	$i \in INSD(\subset INS)$	domestic institutions
$c \in CE(\subset C)$	exported commodities	$i \in INSDNG(\subset INSD)$	domestic non-government institutions
$c \in CEN(\subset C)$	commodities not in *CE*	$h \in H(\subset INSDNG)$	households
$c \in CM(\subset C)$	imported commodities	$fls \in F$	factors with supply curve
PARAMETERS			
$cwts_c$	weight of commodity c in the CPI	$\overline{qg}_c$	base-year quantity of government demand
$dwts_c$	weight of commodity c in the producer price index	$\overline{qinv}_c$	base-year quantity of private investment demand
ica_{ca}	quantity of c as intermediate input per unit of activity a	$shif_{if}$	share for domestic institution I in income of factor f
$icd_{cc'}$	quantity of commodity c as trade input per unit of c' produced and sold domestically	$shii_{ii'}$	share of net income of i' to I (i' ∈ INSDNG'; I ∈ INSDNG)
$ice_{cc'}$	quantity of commodity c as trade input per exported unit of c'	ta_a	Tax rate for activity a
$icm_{cc'}$	quantity of commodity c as trade input per imported unit of c'	te_c	export tax rate
$inta_a$	quantity of aggregate intermediate input per activity unit	tf_f	direct tax rate for factor f
iva_a	quantity of aggregate intermediate input per activity unit	$\overline{tins}_i$	exogenous direct tax rate for domestic institution i
$\overline{mps}_i$	base savings rate for domestic institution i	$tins01_i$	0-1 parameter with 1 for institutions with potentially flexed direct tax rates
$mps01_i$	0-1 parameter with 1 for institutions with potentially flexed direct tax rates	tm_c	import tariff rate
pwe_c	export price (foreign currency)	tq_c	rate of sales tax
pwm_c	import price (foreign currency)	$trnsfr_{if}$	transfer from factor f to institution i

Table B.4. Continued

Symbol	Explanation	Symbol	Explanation
$qdst_c$	quantity of stock change	tva_a	rate of value-added tax for activity *a*
$etals_f$	parameter in labor supply equation		
$INVSHR1_a$	capital shares	PK_r	price of capital
$DKAPS_{fa}$	gross fixed capital formation	QF_{fa}	next period sectoral capital stock
$WFXAV$	average capital rental rate	$deprate^k$	capital stock depreciation rate
GREEK LETTERS			
α_a^a	efficiency parameter in the CES activity function	δ_c^t	CET function share parameter
α_a^{va}	efficiency parameter in the CES value-added function	δ_{fa}^{va}	CES value-added function share parameter for factor *f* in activity *a*
α_c^{ac}	shift parameter for domestic commodity aggregation function	γ_{ch}^m	subsistence consumption of marketed commodity c for household h
α_c^q	Armington function shift parameter	γ_{ach}^h	subsistence consumption of home commodity c from activity a for household h
α_c^t	CET function shift parameter	θ_{ac}	yield of output c per unit of activity a
β_{ach}^h	marginal share of consumption spending on home commodity c from activity a for household h	ρ_a^a	CES production function exponent
β_{ch}^m	marginal share of consumption spending on marketed commodity c for household h	ρ_a^{va}	CES value-added function exponent
δ_a^a	CES activity function share parameter	ρ_c^{ac}	domestic commodity aggregation function exponent
δ_{ac}^{ac}	share parameter for domestic commodity aggregation function	ρ_c^q	Armington function exponent
δ_c^q	Armington function share parameter	ρ_c^t	CET function exponent
VARIABLES			
$\overline{CPI}$	consumer price index	$\overline{MPSADJ}$	savings rate scaling factor (= 0 for base)
$\overline{DTINS}$	change in domestic institution tax share (= 0 for base; exogenous variable)	$\overline{QFS}_f$	quantity supplied of factor
$\overline{FSAV}$	foreign savings (FCU)	$\overline{TINSADJ}$	direct tax scaling factor (= 0 for base; exogenous variable)
$\overline{GADJ}$	government consumption adjustment factor	$\overline{WFDIST}_{fa}$	wage distortion factor for factor f in activity a

Table B.4. Continued

Symbol	Explanation	Symbol	Explanation
$\overline{IADJ}$	investment adjustment factor		
$DMPS$	change in domestic institution savings rates (= 0 for base; exogenous variable)	QF_{fa}	quantity demanded of factor f from activity a
DPI	producer price index for domestically marketed output	QG_c	government consumption demand for commodity
EG	government expenditures	QH_{ch}	quantity consumed of commodity c by household h
EH_h	consumption spending for household	QHA_{ach}	quantity of household home consumption of commodity c from activity a for household h
EXR	exchange rate (LCU per unit of FCU)	$QINTA_a$	quantity of aggregate intermediate input
$GOVSHR$	government consumption share in nominal absorption	$QINT_{ca}$	quantity of commodity c as intermediate input to activity a
$GSAV$	government savings	$QINV_c$	quantity of investment demand for commodity
$INVSHR$	investment share in nominal absorption	QM_c	quantity of imports of commodity
MPS_i	marginal propensity to save for domestic non-government institution (exogenous variable)	QQ_c	quantity of goods supplied to domestic market (composite supply)
PA_a	activity price (unit gross revenue)	QT_c	quantity of commodity demanded as trade input
PDD_c	demand price for commodity produced and sold domestically	QVA_a	quantity of (aggregate) value-added
PDS_c	supply price for commodity produced and sold domestically	QX_c	aggregated quantity of domestic output of commodity
PE_c	export price (domestic currency)	$QXAC_{ac}$	quantity of output of commodity c from activity a
$PINTA_a$	aggregate intermediate input price for activity a	$TABS$	total nominal absorption
PM_c	import price (domestic currency)	$TINS_i$	direct tax rate for institution i (i ∊ INSDNG)
PQ_c	composite commodity price	$TRII_{ii'}$	transfers from institution i' to i (both in the set INSDNG)
PVA_a	value-added price (factor income per unit of activity)	$WFREAL_f$	average real price of factor
PX_c	aggregate producer price for commodity	WF_f	average price of factor
$PXAC_{ac}$	producer price of commodity c for activity a	YF_f	income of factor f
QA_a	quantity (level) of activity	YG	government revenue
QD_c	quantity sold domestically of domestic output	YI_i	income of domestic non-government institution
QE_c	quantity of exports	YIF_{if}	income to domestic institution i from factor f

Table B.4. Continued

EQUATIONS

#	Equation	Domain	Description
Price Block			
1	$PM_c = pwm_c \cdot (1+tm_c) \cdot EXR + \sum_{c' \in CT} PQ_{c'} \cdot icm_{c'c}$ $\begin{bmatrix} import \\ price \\ (LCU) \end{bmatrix} = \begin{bmatrix} import \\ price \\ (FCU) \end{bmatrix} \cdot \begin{bmatrix} tariff \\ adjust- \\ ment \end{bmatrix} \cdot \begin{bmatrix} exchange\ rate \\ (LCU\ per \\ FCU) \end{bmatrix} + \begin{bmatrix} cost\ of\ trade \\ inputs\ per \\ import\ unit \end{bmatrix}$	$c \in CM$	Import price
2	$PE_c = pwe_c \cdot (1-te_c) \cdot EXR - \sum_{c' \in CT} PQ_c \cdot ice_{c'c}$ $\begin{bmatrix} export \\ price \\ (LCU) \end{bmatrix} = \begin{bmatrix} export \\ price \\ (FCU) \end{bmatrix} \cdot \begin{bmatrix} tariff \\ adjust- \\ ment \end{bmatrix} \cdot \begin{bmatrix} exchange\ rate \\ (LCU\ per \\ FCU) \end{bmatrix} - \begin{bmatrix} cost\ of\ trade \\ inputs\ per \\ export\ unit \end{bmatrix}$	$c \in CE$	Export price
3	$PDD_c = PDS_c + \sum_{c' \in CT} PQ_{c'} \cdot icd_{c'c}$ $\begin{bmatrix} domestic \\ demand \\ price \end{bmatrix} = \begin{bmatrix} domestic \\ supply \\ price \end{bmatrix} + \begin{bmatrix} cost\ of\ trade \\ inputs\ per \\ unit\ of \\ domestic\ sales \end{bmatrix}$	$c \in CD$	Demand price of domestic non-traded goods
4	$PQ_c \cdot (1-tq_c) \cdot QQ_c = PDD_c \cdot QD_c + PM_c \cdot QM_c$ $\begin{bmatrix} absorption \\ (at\ demand \\ prices\ net\ of \\ sales\ tax) \end{bmatrix} = \begin{bmatrix} domestic\ demand\ price \\ times \\ domestic\ sales\ quantity \end{bmatrix} + \begin{bmatrix} import\ price \\ times \\ import\ quantity \end{bmatrix}$	$c \in (CD \cup CM)$	Absorption
5	$PX_c \cdot QX_c = PDS_c \cdot QD_c + PE_c \cdot QE_c$ $\begin{bmatrix} producer\ price \\ times\ marketed \\ output\ quantity \end{bmatrix} = \begin{bmatrix} domestic\ supply\ price \\ times \\ domestic\ sales\ quantity \end{bmatrix} + \begin{bmatrix} export\ price \\ times \\ export\ quantity \end{bmatrix}$	$c \in CX$	Marketed output value
6	$PA_a = \sum_{c \in C} PXAC_{ac} \cdot \theta_{ac}$ $\begin{bmatrix} activity \\ price \end{bmatrix} = \begin{bmatrix} producer\ prices \\ times\ yields \end{bmatrix}$	$a \in A$	Activity price
7	$PINTA_a = \sum_{c \in C} PQ_c \cdot ica_{ca}$ $\begin{bmatrix} aggregate \\ intermediate \\ input\ price \end{bmatrix} = \begin{bmatrix} intermediate\ input\ cost \\ per\ unit\ of\ aggregate \\ intermediate\ input \end{bmatrix}$	$a \in A$	Aggregate intermediate input price

Table B.4. Continued

#	Equation	Domain	Description
8	$PA_a \cdot (1-ta_a) \cdot QA_a \; = \; PVA_a \cdot QVA_a + PINTA_a \cdot QINTA_a$ $\begin{bmatrix} \textit{activity price} \\ (\textit{net of taxes}) \\ \textit{times activity level} \end{bmatrix} = \begin{bmatrix} \textit{value-added} \\ \textit{price times} \\ \textit{quantity} \end{bmatrix} + \begin{bmatrix} \textit{aggregate} \\ \textit{intermediate} \\ \textit{input price times} \\ \textit{quantity} \end{bmatrix}$	$a \in A$	Activity revenue and costs
9	$\overline{CPI} = \sum_{c \in C} PQ_c \cdot cwts_c$ $\begin{bmatrix} CPI \end{bmatrix} = \begin{bmatrix} \textit{prices times} \\ \textit{weights} \end{bmatrix}$		Consumer price index
10	$DPI = \sum_{c \in C} PDS_c \cdot dwts_c$ $\begin{bmatrix} \textit{Producer price index} \\ \textit{for non-traded outputs} \end{bmatrix} = \begin{bmatrix} \textit{prices times} \\ \textit{weights} \end{bmatrix}$		Producer price index for non-traded market output
Production and Commodity Block			
11	$QA_a \; = \; \alpha_a^a \cdot \left(\delta_a^a \cdot QVA_a^{-\rho_a^a} + (1-\delta_a^a) \cdot QINTA_a^{-\rho_a^a} \right)^{-\frac{1}{\rho_a^a}}$ $\begin{bmatrix} \textit{activity} \\ \textit{level} \end{bmatrix} = CES \begin{bmatrix} \textit{quantity of aggregate value-added}, \\ \textit{quantity aggregate intermediate input} \end{bmatrix}$	$a \in ACES$	CES technology: activity production function
12	$\frac{QVA_a}{QINTA_a} = \left(\frac{PINTA_a}{PVA_a} \cdot \frac{\delta_a^a}{1 - \delta_a^a} \right)^{\frac{1}{1+\rho_a^a}}$ $\begin{bmatrix} \textit{value-added} - \\ \textit{intermediate-} \\ \textit{input quantity} \\ \textit{ratio} \end{bmatrix} = f \begin{bmatrix} \textit{intermediate-input} \\ - \textit{value-added} \\ \textit{price ratio} \end{bmatrix}$	$a \in ACES$	CES technology: Value-added intermediate input ratio
13	$QVA_a = iva_a \cdot QA_a$ $\begin{bmatrix} \textit{demand for} \\ \textit{value-added} \end{bmatrix} = f \begin{bmatrix} \textit{activity} \\ \textit{level} \end{bmatrix}$	$a \in ALEO$	Leontief technology: Demand for aggregate value-added
14	$QINTA_a = inta_a \cdot QA_a$ $\begin{bmatrix} \textit{demand for aggregate} \\ \textit{intermediate input} \end{bmatrix} = f \begin{bmatrix} \textit{activity} \\ \textit{level} \end{bmatrix}$	$a \in ALEO$	Leontief technology: Demand for aggregate intermediate input
15	$QVA_a \; = \; \alpha_a^{va} \cdot \left(\sum_{f \in F} \delta_{f\,a}^{va} \cdot QF_{f\,a}^{\;-\rho_a^{va}} \right)^{-\frac{1}{\rho_a^{va}}}$ $\begin{bmatrix} \textit{quantity of aggregate} \\ \textit{value-added} \end{bmatrix} = CES \begin{bmatrix} \textit{factor} \\ \textit{inputs} \end{bmatrix}$	$a \in A$	Value-added and factor demands

Table B.4. Continued

#	Equation	Domain	Description
16	$W_f \cdot \overline{WFDIST}_{fa} = PVA_a \cdot (1-tva_a) \cdot QVA_a \cdot \left(\sum_{f \in F'} \delta^{va}_{fa} \cdot QF_{fa}^{-\rho^{va}_a} \right)^{-1} \cdot \delta^{va}_{fa} \cdot QF_{fa}^{-\rho^{va}_a - 1}$ $\left[\begin{array}{c} \textit{marginal cost of} \\ \textit{factor f in activity a} \end{array} \right] = \left[\begin{array}{c} \textit{marginal revenue product} \\ \textit{of factor f in activity a} \end{array} \right]$	$a \in A$ $f \in F$	Factor demand
17	$WFREAL_f = \frac{YF}{CPI * \sum_a QF_{f,a}}$ $\left[\begin{array}{c} \textit{average real wage} \\ \textit{per factor unit} \end{array} \right] = \left[\begin{array}{c} \textit{average wage corrcected} \\ \textit{by consumer index price} \end{array} \right]$	$f \in F$	Real wages
18	$QFS_f = QFS0 * \left[\frac{ \frac{WF_f * WFDIST_f * QF_f}{QFS_f} }{ \frac{CPI}{ \frac{WF0_f}{CPI0} } } \right]^{etals_f}$	$f \in F$	Labor supply
19	$QINT_{ca} = ica_{ca} \cdot QINTA_a$ $\left[\begin{array}{c} \textit{intermediate demand} \\ \textit{for commodity c} \\ \textit{from activity a} \end{array} \right] = f \left[\begin{array}{c} \textit{aggregate intermediate} \\ \textit{input quantity} \\ \textit{for activity a} \end{array} \right]$	$a \in A$ $c \in C$	Disaggregated intermediate input demand
20	$QXAC_{ac} + \sum_{h \in H} QHA_{ach} = \theta_{ac} \cdot QA_a$ $\left[\begin{array}{c} \textit{marketed quantity} \\ \textit{of commodity c} \\ \textit{from activity a} \end{array} \right] + \left[\begin{array}{c} \textit{household home} \\ \textit{consumption} \\ \textit{of commodity c} \\ \textit{from activity a} \end{array} \right] = \left[\begin{array}{c} \textit{production} \\ \textit{of commodity c} \\ \textit{from activity a} \end{array} \right]$	$a \in A$ $c \in CX$	Commodity production and allocation
21	$QX_c = \alpha^{ac}_c \cdot \left(\sum_{a \in A} \delta^{ac}_{ac} \cdot QXAC_{ac}^{-\rho^{ac}_c} \right)^{-\frac{1}{\rho^{ac}_c - 1}}$ $\left[\begin{array}{c} \textit{aggregate} \\ \textit{marketed} \\ \textit{production of} \\ \textit{commodity c} \end{array} \right] = CES \left[\begin{array}{c} \textit{activity-specific} \\ \textit{marketed} \\ \textit{production of} \\ \textit{commodity c} \end{array} \right]$	$c \in CX$	Output aggregation function
22	$PXAC_{ac} = PX_c \cdot QX_c \left(\sum_{a \in A'} \delta^{ac}_{ac} \cdot QXAC_{ac}^{-\rho^{ac}_c} \right)^{-1} \cdot \delta^{ac}_{ac} \cdot QXAC_{ac}^{-\rho^{ac}_c - 1}$ $\left[\begin{array}{c} \textit{marginal cost of com-} \\ \textit{modity c from activity a} \end{array} \right] = \left[\begin{array}{c} \textit{marginal revenue product of} \\ \textit{commodity c from activity a} \end{array} \right]$	$a \in A$ $c \in CX$	First-Order condition for output aggregation function

Table B.4. Continued

#	Equation	Domain	Description
23	$QX_c = \alpha_c^t \cdot \left(\delta_c^t \cdot QE_c^{\rho_c^t} + (1 - \delta_c^t) \cdot QD_c^{\rho_c^t} \right)^{\frac{1}{\rho_c^t}}$ $\begin{bmatrix} aggregate\ marketed \\ domestic\ output \end{bmatrix} = CET \begin{bmatrix} export\ quantity,\ domestic \\ sales\ of\ domestic\ output \end{bmatrix}$	$c \in (CE \cap CD)$	Output transformation (CET) function
24	$\frac{QE_c}{QD_c} = \left(\frac{PE_c}{PDS_c} \cdot \frac{1 - \delta_c^t}{\delta_c^t} \right)^{\frac{1}{\rho_c^t - 1}}$ $\begin{bmatrix} export\text{-}domestic \\ supply\ ratio \end{bmatrix} = f \begin{bmatrix} export\text{-}domestic \\ price\ ratio \end{bmatrix}$	$c \in (CE \cap CD)$	Export-domestic supply ratio
25	$QX_c = QD_c + QE_c$ $\begin{bmatrix} aggregate \\ marketed \\ domestic\ output \end{bmatrix} = \begin{bmatrix} domestic\ market \\ sales\ of\ domestic \\ output\ [for \\ c \in (CD \cap CEN)] \end{bmatrix} + \begin{bmatrix} exports\ [for \\ c \in (CE \cap CDN)] \end{bmatrix}$	$c \in (CD \cap CEN) \cup (CE \cup CDN)$	Output transformation for non-exported commodities
26	$QQ_c = \alpha_c^q \cdot \left(\delta_c^q \cdot QM_c^{-\rho_c^q} + (1 - \delta_c^q) \cdot QD_c^{-\rho_c^q} \right)^{-\frac{1}{\rho_c^q}}$ $\begin{bmatrix} composite \\ supply \end{bmatrix} = f \begin{bmatrix} import\ quantity,\ domestic \\ use\ of\ domestic\ output \end{bmatrix}$	$c \in (CM \cap CD)$	Composite supply (Armington) function
27	$\frac{QM_c}{QD_c} = \left(\frac{PDD_c}{PM_c} \cdot \frac{\delta_c^q}{1 - \delta_c^q} \right)^{\frac{1}{1 + \rho_c^q}}$ $\begin{bmatrix} import\text{-}domestic \\ demand\ ratio \end{bmatrix} = f \begin{bmatrix} domestic\text{-}import \\ price\ ratio \end{bmatrix}$	$c \in (CM \cap CD)$	Import-domestic demand ratio
28	$QQ_c = QD_c + QM_c$ $\begin{bmatrix} composite \\ supply \end{bmatrix} = \begin{bmatrix} domestic\ use\ of \\ marketed\ domestic \\ output\ [for \\ c \in (CD \cap CMN)] \end{bmatrix} + \begin{bmatrix} imports\ [for \\ c \in (CM \cap CDN)] \end{bmatrix}$	$c \in (CD \cap CMN) \cup (CM \cap CDN)$	Composite supply for non-imported outputs and non-produced imports
29	$QT_c = \sum_{c' \in C'} \left(icm_{c\,c'} \cdot QM_{c'} + ice_{c\,c'} \cdot QE_{c'} + icd_{c\,c'} \cdot QD_{c'} \right)$ $\begin{bmatrix} demand\ for \\ transactions \\ services \end{bmatrix} = \begin{bmatrix} sum\ of\ demands \\ for\ imports,\ exports, \\ and\ domestic\ sales \end{bmatrix}$	$c \in CT$	Demand for transactions services

Table B.4. Continued

#	Equation	Domain	Description
Institution Block			
30	$YF_f = \sum_{a \in A} WF_f \cdot \overline{WFDIST}_{f\,a} \cdot QF_{f\,a}$ $\begin{bmatrix} \textit{income of} \\ \textit{factor f} \end{bmatrix} = \begin{bmatrix} \textit{sum of activity payments} \\ \textit{(activity-specific wages} \\ \textit{times employment levels)} \end{bmatrix}$	$f \in F$	Factor income
31	$YIF_{i\,f} = shif_{i\,f} \cdot \left[\left(1 - tf_f\right) \cdot YF_f - trnsfr_{row\,f} \cdot EXR \right]$ $\begin{bmatrix} \textit{income of} \\ \textit{institution i} \\ \textit{from factor f} \end{bmatrix} = \begin{bmatrix} \textit{share of income} \\ \textit{of factor f to} \\ \textit{institution i} \end{bmatrix} \cdot \begin{bmatrix} \textit{income of factor f} \\ \textit{(net of tax and} \\ \textit{transfer to RoW)} \end{bmatrix}$	$i \in INSD$ $f \in F$	Institutional factor incomes
32	$YI_i = \sum_{f \in F} YIF_{i\,f} + \sum_{i' \in INSDNG'} TRII_{i\,i'} + trnsfr_{i\,gov} \cdot \overline{CPI} + trnsfr_{i\,row} \cdot EXR$ $\begin{bmatrix} \textit{income of} \\ \textit{institution i} \end{bmatrix} = \begin{bmatrix} \textit{factor} \\ \textit{income} \end{bmatrix} + \begin{bmatrix} \textit{transfers} \\ \textit{from other domestic} \\ \textit{non-government} \\ \textit{institutions} \end{bmatrix} + \begin{bmatrix} \textit{transfers} \\ \textit{from} \\ \textit{government} \end{bmatrix} + \begin{bmatrix} \textit{transfers} \\ \textit{from} \\ \textit{RoW} \end{bmatrix}$	$i \in INSDNG$	Income of domestic, non-government institutions
33	$TRII_{i\,i'} = shii_{i\,i'} \cdot (1 - MPS_{i'}) \cdot (1 - TINS_{i'}) \cdot YI_{i'}$ $\begin{bmatrix} \textit{transfer from} \\ \textit{institution i' to i} \end{bmatrix} = \begin{bmatrix} \textit{share of net income} \\ \textit{of institution i'} \\ \textit{transfered to i} \end{bmatrix} \cdot \begin{bmatrix} \textit{income of institution} \\ \textit{i', net of savings and} \\ \textit{direct taxes} \end{bmatrix}$	$i \in INSDNG$ $i' \in INSDNG'$	Intra-institutional transfers
34	$EH_h = \left(1 - \sum_{i \in INSDNG} shii_{i\,h}\right) \cdot \left(1 - MPS_h\right) \cdot (1 - TINS_h) \cdot YI_h$ $\begin{bmatrix} \textit{household income} \\ \textit{disposable for} \\ \textit{consumption} \end{bmatrix} = \begin{bmatrix} \textit{household income, net of direct} \\ \textit{taxes, savings, and transfers to} \\ \textit{other non-government institutions} \end{bmatrix}$	$h \in H$	Household consumption expenditure
35	$QH_{c\,h} = \gamma_{c\,h} + \dfrac{\beta^m_{ch} \cdot \left(EH_h - \sum_{c' \in C} PQ_{c'} \cdot \gamma^m_{c'h} - \sum_{a \in A} \sum_{c' \in C} PXAC_{ac'} \cdot \gamma^h_{ac'h} \right)}{PQ_c}$ $\begin{bmatrix} \textit{quantity of} \\ \textit{household demand} \\ \textit{for commodity c} \end{bmatrix} = f \begin{bmatrix} \textit{household} \\ \textit{consumption} \\ \textit{spending,} \\ \textit{market price} \end{bmatrix}$	$c \in C$ $h \in H$	Household consumption demand for marketed commodities

Table B.4. Continued

#	Equation	Domain	Description
36	$QHA_{ach} = \gamma^{h}_{ach} + \dfrac{\beta^{h}_{ach} \cdot \left(EH_h - \sum_{c' \in C} PQ_{c'} \cdot \gamma^{m}_{c'h} - \sum_{a \in A} \sum_{c' \in C} PXAC_{ac'} \cdot \gamma^{h}_{ac'h} \right)}{PXAC_{ac}}$ [quantity of household demand for home commodity c from activity a] = f [household disposable income, producer price]	$a \in A$ $c \in C$ $h \in H$	Household consumption demand for home commodities
37	$QINV_c = \overline{IADJ} \cdot \overline{qinv}_c$ [fixed investment demand for commodity c] = [adjustment factor times base-year fixed investment]	$c \in CINV$	Investment demand
38	$QG_c = \overline{GADJ} \cdot \overline{qg}_c$ [government consumption demand for commodity c] = [adjustment factor times base-year government consumption]	$c \in C$	Government consumption demand
39	$YG = \sum_{i \in INSDNG} TINS_i \cdot YI_i + \sum_{f \in F} tf_f \cdot YF_f + \sum_{a \in A} tva_a \cdot PVA_a \cdot QVA_a$ $+ \sum_{a \in A} ta_a \cdot PA_a \cdot QA_a + \sum_{c \in CM} tm_c \cdot pwm_c \cdot QM_c \cdot EXR + \sum_{c \in CE} te_c \cdot pwe_c \cdot QE_c \cdot EXR$ $+ \sum_{c \in C} tq_c \cdot PQ_c \cdot QQ_c + \sum_{f \in F} YF_{gov\,f} + trnsfr_{gov\,row} \cdot EXR$ [government revenue] = [direct taxes from institutions] + [direct taxes from factors] + [value-added tax] + [activity tax] + [import tariffs] + [export taxes] + [sales tax] + [factor income] + [transfers from RoW]		Government revenue
40	$EG = \sum_{c \in C} PQ_c \cdot QG_c + \sum_{i \in INSDNG} trnsfr_{i\,gov} \cdot \overline{CPI}$ [government spending] = [government consumption] + [transfers to domestic non-government institutions]		Government expenditures

System Constraint Block

#	Equation	Domain	Description
41	$\sum_{a \in A} QF_{f\,a} = \overline{QFS}_f$ [demand for factor f] = [supply of factor f]	$f \in F$	Factor market

Table B.4. Continued

#	Equation	Domain	Description
42	$QQ_c = \sum_{a \in A} QINT_{c\,a} + \sum_{h \in H} QH_{c\,h} + QG_c$ $+ QINV_c + qdst_c + QT_c$ $\begin{bmatrix} composite \\ supply \end{bmatrix} = \begin{bmatrix} intermediate \\ use \end{bmatrix} + \begin{bmatrix} household \\ consumption \end{bmatrix} + \begin{bmatrix} government \\ consumption \end{bmatrix}$ $+ \begin{bmatrix} fixed \\ investment \end{bmatrix} + \begin{bmatrix} stock \\ change \end{bmatrix} + \begin{bmatrix} trade \\ input\ use \end{bmatrix}$	$c \in C$	Composite commodity markets
43	$\sum_{c \in CM} pwm_c \cdot QM_c + \sum_{f \in F} trnsfr_{row\,f} = \sum_{c \in CE} pwe_c \cdot QE_c + \sum_{i \in INSD} trnsfr_{i\,row} + \overline{FSAV}$ $\begin{bmatrix} import \\ spending \end{bmatrix} + \begin{bmatrix} factor \\ transfers \\ to\ RoW \end{bmatrix} = \begin{bmatrix} export \\ revenue \end{bmatrix} + \begin{bmatrix} institutional \\ transfers \\ from\ RoW \end{bmatrix} + \begin{bmatrix} foreign \\ savings \end{bmatrix}$		Current account balance for RoW (in foreign currency)
44	$YG = EG + GSAV$ $\begin{bmatrix} government \\ revenue \end{bmatrix} = \begin{bmatrix} government \\ expenditures \end{bmatrix} + \begin{bmatrix} government \\ savings \end{bmatrix}$		Government balance
45	$TINS_i = \overline{tins}_i \cdot \left(1 + \overline{TINSADJ} \cdot tins01_i\right) + \overline{DTINS} \cdot tins01_i$ $\begin{bmatrix} direct\ tax \\ rate\ for \\ institution\ i \end{bmatrix} = \begin{bmatrix} base\ rate\ adjusted \\ for\ scaling\ for \\ selected\ institutions \end{bmatrix} + \begin{bmatrix} point\ change \\ for\ selected \\ institutions \end{bmatrix}$	$i \in INSDNG$	Direct institutional tax rates
46	$MPS_i = \overline{mps}_i \cdot \left(1 + \overline{MPSADJ} \cdot mps01_i\right) + DMPS \cdot mps01_i$ $\begin{bmatrix} savings \\ rate\ for \\ institution\ i \end{bmatrix} = \begin{bmatrix} base\ rate\ adjusted \\ for\ scaling\ for \\ selected\ institutions \end{bmatrix} + \begin{bmatrix} point\ change \\ for\ selected \\ institutions \end{bmatrix}$	$i \in INSDNG$	Institutional savings rates
47	$\sum_{i \in INSDNG} MPS_i \cdot \left(1 - TINS_i\right) \cdot YI_i + GSAV + EXR \cdot \overline{FSAV} =$ $\sum_{c \in C} PQ_c \cdot QINV_c + \sum_{c \in C} PQ_c \cdot qdst_c$ $\begin{bmatrix} non\text{-}govern\text{-} \\ ment\ savings \end{bmatrix} + \begin{bmatrix} government \\ savings \end{bmatrix} + \begin{bmatrix} foreign \\ savings \end{bmatrix} =$ $\begin{bmatrix} fixed \\ investment \end{bmatrix} + \begin{bmatrix} stock \\ change \end{bmatrix}$		Savings-investment balance

Table B.4. Continued

#	Equation	Domain	Description
48	$TABS = \sum_{h\in H}\sum_{c\in C} PQ_c \cdot QH_{ch} + \sum_{a\in A}\sum_{c\in C}\sum_{h\in H} PXAC_{ac}\cdot QHA_{ach} + \sum_{c\in C} PQ_c \cdot QG_c + \sum_{c\in C} PQ_c \cdot QINV_c + \sum_{c\in C} PQ_c \cdot qdst_c$ $\begin{bmatrix}\text{total}\\ \text{absorption}\end{bmatrix} = \begin{bmatrix}\text{household}\\ \text{market}\\ \text{consumption}\end{bmatrix} + \begin{bmatrix}\text{household}\\ \text{home}\\ \text{consumption}\end{bmatrix} + \begin{bmatrix}\text{government}\\ \text{consumption}\end{bmatrix} + \begin{bmatrix}\text{fixed}\\ \text{investment}\end{bmatrix} + \begin{bmatrix}\text{stock}\\ \text{change}\end{bmatrix}$		Total absorption
49	$INVSHR \cdot TABS = \sum_{c\in C} PQ_c \cdot QINV_c + \sum_{c\in C} PQ_c \cdot qdst_c$ $\begin{bmatrix}\text{investment-}\\ \text{absorption}\\ \text{ratio}\end{bmatrix} \cdot \begin{bmatrix}\text{total}\\ \text{absorption}\end{bmatrix} = \begin{bmatrix}\text{fixed}\\ \text{investment}\end{bmatrix} + \begin{bmatrix}\text{stock}\\ \text{change}\end{bmatrix}$		Ratio of investment to absorption
50	$GOVSHR \cdot TABS = \sum_{c\in C} PQ_c \cdot QG_c$ $\begin{bmatrix}\text{government}\\ \text{consumption-}\\ \text{absorption}\\ \text{ratio}\end{bmatrix} \cdot \begin{bmatrix}\text{total}\\ \text{absorption}\end{bmatrix} = \begin{bmatrix}\text{government}\\ \text{consumption}\end{bmatrix}$		Ratio of government consumption to absorption
51	$WFKAV^a_{ft} = \sum_a \left[\left(\frac{QF_{fat}}{\sum_{a'} QF_{fa't}} \right) \cdot WF_{ft} \cdot WFDIST_{fat} \right]$ $\begin{bmatrix}\text{average capital}\\ \text{rental rate}\end{bmatrix} = \begin{bmatrix}\text{weighted sum of sectors'}\\ \text{capital rental rates}\end{bmatrix}$		Average economy-wide rental rate of capital
52	$INVSHR1^a_{fat} = \left(\frac{QF_{fat}}{\sum_{a'} QF_{fa't}} \right) \cdot \left(\beta^a \cdot \left(\frac{WF_{f,t} \cdot WFDIST_{fat}}{WFKAV^a_{ft}} - 1 \right) + 1 \right)$ $\begin{bmatrix}\text{share of}\\ \text{new capital}\end{bmatrix} = \begin{bmatrix}\text{share of}\\ \text{existing capital}\end{bmatrix} \cdot \begin{bmatrix}\text{capital rental}\\ \text{rate ratio}\end{bmatrix}$		Sector's share of the new capital investment
53	$\Delta DKAPS^a_{fat} = INVSHR1^a_{fat} \cdot \left(\frac{\sum_c PQ_{ct} \cdot QINV_{ct}}{PK_{ft}} \right)$ $\begin{bmatrix}\text{quantity of new}\\ \text{capital by sector}\end{bmatrix} = \begin{bmatrix}\text{share of}\\ \text{new capital}\end{bmatrix} \cdot \begin{bmatrix}\text{total quantity of}\\ \text{new capital}\end{bmatrix}$		Allocate gross fixed capital formation

Table B.4. Continued

#	Equation	Domain	Description
54	$PK_{f\,t} = \sum_{c} PQ_{c\,t} \cdot \frac{QINV_{c\,t}}{\sum_{c'} QINV_{c'\,t}}$ $\begin{bmatrix} \textit{unit price} \\ \textit{of capital} \end{bmatrix} = \begin{bmatrix} \textit{weighted market price} \\ \textit{of investment commodities} \end{bmatrix}$		Price of capital
55	$QF_{f\,a\,t+1} = QF_{f\,a\,t} \cdot \left(1 + \frac{\Delta INVSHR1^{a}_{f\,a\,t}}{QF_{f\,a\,t}} - deprate_{f} \right)$ $\begin{bmatrix} \textit{average capital} \\ \textit{rental rate} \end{bmatrix} = \begin{bmatrix} \textit{weighted sum of sectors'} \\ \textit{capital rental rates} \end{bmatrix}$		Updating quantity of capital
56	$QFS_{f\,t+1} = QFS_{f\,t} \cdot \left(1 + \frac{\sum_{a} \Delta INVSHR1_{f\,a\,t}}{QFS_{f\,t}} - deprate_{f} \right)$ $\begin{bmatrix} \textit{average capital} \\ \textit{rental rate} \end{bmatrix} = \begin{bmatrix} \textit{weighted sum of sectors'} \\ \textit{capital rental rates} \end{bmatrix}$		Updating quantity of capital

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