

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

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May 2007

The authors would like to acknowledge the financial support of the Economic Commission for Latin America and the Caribbean (ECLAC), the World Bank, the Inter-American Development Bank (IDB), the International Food Policy Research Institute (IFPRI) and the technical assistance of the United Nations Development Program (UNDP) and the Regional Unit for Technical Assistance (RUTA). The paper was written under the auspices of a project studying the impact of CAFTA on agriculture and the rural sector in five Central American countries, jointly funded by the World Bank, ECLAC, IDB, the Government of The Netherlands, the Department of International Development (DFID) and the Central American Bank for Economic Integration (BCIE). None of these institutions is responsible for the opinions and conclusions expressed here.

The Central America Free Trade Agreement (CAFTA-DR) negotiated in 2004 between the United States and the five countries of Central America¹ promises the benefits of greater access to the U.S. market for Central American and Dominican exporters and liberalized treatment on rules of origin for the maquila industry, in exchange for reduced barriers to imports and guarantees for foreign direct investment, greater protection for intellectual property by each of the signatories. For El Salvador, CAFTA can be seen as 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 and one in which policy is devoted to attracting foreign investment and expanding exports, particularly to the United States. In effect El Salvador has made a bet that its development prospects will be enhanced by tying itself more firmly to the global economy in general and to the United States in particular².

Even though El Salvador was the very first country in Central America to ratify the CAFTA agreement (in December 2004), this agreement has been controversial. Some feel that El Salvador's poor farmers will be hurt by the lowering of tariffs on sensitive products that they grow. 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 ten years due partly to a series of natural disasters suffered by Salvador since the late 1990s. Whatever the reason for this poor performance might be, it has increased the skepticism over the supposed benefits of CAFTA. The purpose of this paper will be to attempt to separate and quantify the effects that adherence to the Agreement will have in the years ahead. To do that we first 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 model to simulate the effect 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 take the results of the CGE simulations and use them to simulate the impact of the various CAFTA scenarios on poverty and the distribution of income.

I. Trends in income, trade and protection prior to CAFTA

Even before CAFTA, El Salvador has already significantly reduced barriers to imports. Over the course of 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 (See table I.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 as we shall see, the negotiators of CAFTA were quite careful in maintaining protection for sensitive products, at least in the short and medium run.

¹ / The treaty was later extended to include the Dominican Republic.

² / In addition El Salvador dollarized its economy in January of 2001.

To get a sense of the economic environment in which CAFTA was passed, we display several key sectoral and macro time series since 1990 in Table I.1. The first thing that stands out in the table is the deterioration in El Salvador's growth performance since around 1995. Whereas per capita income grew at 4 % per year in the first five years of the 1990s, growth slowed to 1% per year up to year 2000, and then to no growth 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.. Judging by shares, agriculture has been particularly hard hit by trade liberalization, its share of GDP falling by almost 50% after 1990. That was offset to some extent by the rise of a vibrant fishing sector. As one can see from the table industry appears to have maintained its share of GDP since 1990. This is entirely due to the rise of the maquila component which by 2002 comprised 11% of GDP (Morley 2005). Since virtually all of the expansion of maquila happened after 1990, the data suggest that non-maquila manufacturing must have shrunk by at least four percentage points of GDP. Two points follow from this. First maquila will be a significant part of 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 previous trade liberalization. Partly this is due to a succession of natural disasters and partly it is due to the effects of an increasingly overvalued exchange rate due in turn to the success of maquila and to the large quantity of remittances coming from migrants to the United States.

Table I.1: Patterns of Growth and Tariffs in El Salvador
shares (current prices)

	GDP per capita	INV/Y	EXP/Y	IMP/Y	AG/Y	Min +Fish/Y	IND/Y	SVC/Y	Tariff Data	
									average	dispersion
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	0.267	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, Lederman et al (2002).

II. 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 very 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 fast tariffs will be reduced over time. Table II.1 shows the categories which are relevant to El Salvador.

Table II.1: Tariff Categories Under CAFTA

Category	
A	Immediate tariff reduction to zero
B	Linear reduction of tariffs to zero over five years
C	Linear reduction of tariffs over ten years.
D	Linear reduction of tariffs over fifteen years
E	Six Year grace period, then reduction of 33% over next four years, then full liberalization from 12 th to 15 th year.
F	Ten year grace period, then linear reduction to zero over the next ten years.
G	Goods in this category already have zero tariff rate
H	Goods in this category are excluded from tariff reductions under CAFTA, with tariffs remaining at the rates agreed to in WTO.
M	Non-linear reduction in tariffs to zero. 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 nine non-linear 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 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 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 (TRQ's) originally set up under the WTO which define amounts of certain commodities that can be imported free of tariffs.³ In addition for many products safeguard provisions permit a country to apply the MFN tariff level if imports from the US or in the case of the US, imports from Central America exceed the safeguard level. Safeguards are provisions permitted under WTO (and 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 the level of imports beyond the safeguard level. In most cases the safeguard level tariffs fall over time.

Changes in the protection of agriculture-based products under CAFTA

The average tariffs shown in Table I.1 are calculated as the average of the tariffs in all the separate commodity classes weighted by their share in total imports. But that does not give the information we want on changes in the level of protection for agricultural commodities or processed agricultural commodities under CAFTA. We now turn our attention to these changes. As we pointed out above, under CAFTA commodities are divided into various categories according to the time profile of programmed tariff reductions under the agreement.

^{3/} These are products that are politically sensitive and or produced or consumed by the poor.

Table II.2 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. For example in category A, tariffs are eliminated immediately while in B they are reduced to zero in five equal installments over the first five years and in C over the first ten years. Note that these averages are all weighted averages of individual tariff rates, where the weights are determined by the share of the commodity in total imports. As is well known this method of averaging can seriously underestimate the average level of protection when there are tariffs so high that they choke off imports.

Certain commodities like beans, corn and rice are of particular importance to either the income or the consumption of the poor. We have used the information on tariff categories and initial tariffs in table II.2 to calculate the time path of tariff reductions for a number of these “sensitive” commodities and show the results in the lower portion of the table. Note that the table shows only the tariff level, not the impact of quotas which we will discuss in a moment.

The table makes clear the high level of protection 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 US amounted to 41% of the value of production of rice, 50% for milk and 32% for corn.⁵ Other than white corn, tariff protection for all of these sensitive products will disappear over twenty years. But for most of these sensitive products, the liberalization will be very gradual, much of it occurring at least ten 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 five to ten years. It seems that the Salvadoran negotiators of CAFTA were not willing to impose shock treatment on their 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.

Tariffs in Categories A and B are either eliminated immediately or over the first five years of the agreement. Products in these categories are broadly comprised of prime cuts of beef, fish, flowers, various fresh fruits and vegetables, potatoes, and inputs to processed food such as soups and dog food. For the most part, these are not products in which US imports compete with local producers. For fish, fruits and vegetables it is unlikely that US prices would be competitive with local product even at a zero tariff. The picture in 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

^{4/} This pattern is observed both in El Salvador and in the other Central American countries. See Morley (2005).

^{5/} Monge et al (2004).

on local producers. In fact, because CAFTA grants beef import quotas in the U.S., the treaty is on balance likely to be favorable to them.

Category C commodities are those with a ten-year linear tariff reduction schedule. This group is comprised primarily of processed foods. D and F category commodities have a very gradual reduction of tariff protection over either 15 or 20 years. Thus whatever impact CAFTA will have 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 table tells us that the treatment of different agricultural commodities under CAFTA was anything but uniform. 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 ten years after ratification.

El Salvador Tariff Category	Trade		No. prod	Average Tarrif Rates						
	Imports	Exports		Pre CAFTA	First year	5th year	10th year	15th year		
A	18836	1055	398	13.39%	0.00%	0.00%	0.00%	0.00%	0.00%	
B	9376	898	141	12.85%	10.28%	0.00%	0.00%	0.00%	0.00%	
C	17553	7614	153	15.33%	13.80%	7.68%	0.00%	0.00%	0.00%	
D	6249	34825	89	18.24%	16.96%	12.17%	6.07%	0.00%	0.00%	
G	146154	576	245	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
N	2135	335	17	21.18%	19.49%	12.36%	3.53%	0.00%	0.00%	
Yellow corn	48854	0	1	15.00%	15.00%	15.00%	9.00%	0.00%	0.00%	
White corn	644	0	1	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	
Quota	19276	42	42	38.58%	38.50%	38.50%	38.50%	25.68%	0.00%	
total	268433			8.53%	7.35%	6.43%	4.62%	1.89%		

El Salvador	yellow corn	white corn	rice	beans	beef	pork	poultry	dairy
initial	0.150	0.2	0.400	0.15	0.15	0.400	0.370	0.002
year one	0.150	0.2	0.400	0.12	0	0.400	0.306	0.002
year five	0.150	0.2	0.400	0	0	0.400	0.253	0.002
year ten	0.102	0.2	0.400	0	0	0.272	0.228	0.002
year fifteen	0	0.2	0.213	0	0	0	0.121	0.001
year twenty	0	0.2	0	0	0	0	0	0

Source: Morley (2005).

We now allocate these tariff reductions across the sectors which we are going to use in the CGE based simulations presented later in the paper. (See table II.3) As in the previous tables, the average tariffs shown are the weighted averages of individual commodity tariffs where the weights are the import shares of the commodities in question. The table 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 twenty years. As the reader can see, 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. which 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 twenty, but the process is not uniform. As we already saw in table II.3, liberalization for subsistence commodities does not begin until almost ten years after ratification. Protection also drops very rapidly for textiles, leather products and clothing but these are primarily linked to maquila exports, so it is unclear how important this change will turn out to be.

		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	0.12
4	Sugar cane	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 & 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	Dairy 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 with data from the Economic Research Service (ERS).

III. Modeling the Impact of CAFTA

We are going to use a recursive dynamic general equilibrium model to predict the impact of CAFTA on the Salvadorian economy. The main reason for doing this is to incorporate the general equilibrium effects of the changes introduced by CAFTA on the prices, output and employment across different sectors of the economy. As we have already seen trade liberalization under CAFTA is mainly limited to tariff reductions in various agricultural commodities. Those changes will obviously affect prices, output and employment in agriculture. But those changes will also have indirect effects on urban consumers, government revenue, prices, the balance of payments and the exchange rate which may well be larger than the direct effect of the tariff reductions in agriculture.

The recursive dynamic CGE model⁶

Recursive dynamic CGE models have been used in Chenery et al (1999) and El-Said et al (2001) to analyze different development strategies in Korea and Egypt, respectively, in Lofgren (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.

These models are solved in two stages. The first is 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 all exogenous variables needed for the next period by the 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).⁷

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 track 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. However under CAFTA the tariff changes are gradual 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:

The static CGE model used in this part of the research was built based on the standard model used by IFPRI (see Lofgren et al, 2001), which follows the neoclassical-structuralist tradition originally presented in Dervis et al (1982). Basic data for CGE models are obtained from a Social Accounting Matrix (SAM). A SAM is a comprehensive, economy-wide data framework, typically representing the economy of a country.

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

⁶ / This section of the paper is taken from Piñeiro (2006).

⁷ / Lofgren et al (2001) and Thurlow (2004).

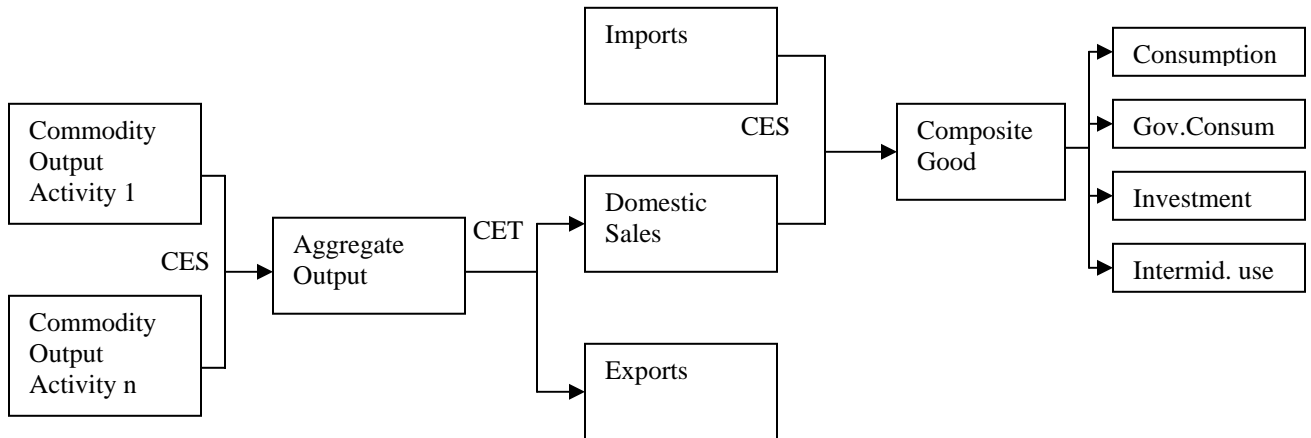
institutions shown in the matrix. The second has the equations that represent the behavior of the different institutions present. The third has the system of constraints that have to be satisfied by the whole system covering the factor and goods markets, the balances for savings-investment, the government 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 in a constant elasticity of substitution function (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 second choice the producers make is the amount of intermediate inputs they will use. This specification is made 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 L and K), intermediate inputs and any relevant taxes and subsidies.

Figure III.1 shows the flow of a single commodity from producers to final demand. First, there is the combination of goods from all producers into an aggregate commodity output. This is achieved using a CES product demand system with the intention of leaving the option to the buyers as to how much to buy of each individual product (maximizing their consumption). 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 will 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 Armington⁸ specification is used, which means that the domestically produced and imported goods are imperfect substitutes.

⁸/ Armington (1969).

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



In this model there are four institutions, households, enterprises, government and the rest of the world, which do three things: (i) produce, (ii) consume, and (iii) accumulate capital. Households save a constant fraction of their disposable income and buy consumption goods with the remainder. Enterprises hire labor supplied by households and distribute all their profits to households. Household income is the sum of salaries, profits and government and rest of the world transfers. Household consumption of goods and services is determined by a linear expenditure system (LES). 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 which determine how various macro constraints are satisfied. (i) El Salvador has a fixed exchange rate, which means that foreign savings is flexible or endogenous to the model⁹ for all the simulation except the one for FDI, in which a change in closure was necessary. For this last experiment the exchange rate is flexible or endogenous and foreign savings is fixed, in order to capture the increases in FDI for the simulation. (ii) For the government, the level of consumption and income taxes are fixed across simulations. (iii) In equilibrium total saving must equal total

⁹ / El Salvador started its dollarization process in 2001.

investment. There are various ways to guarantee this. In all but one of our simulations we fixed the saving rates of households and government which makes total saving and investment positively related to the level of income. (iv) In the labor markets, we have assumed 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 this type of labor. For skilled labor a supply curve was added making wages as well as quantities endogenous to the model (iv) 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. This is done by solving the static model for one specific year and then updating the capital stock, population, domestic labor force, factor productivity, export and import prices, and export demand parameters. The updated model is then solved again for the following year and so on.

The model used in this research is based on Dervis et al (1982) and Thurlow (2003). Total capital accumulation is endogenous. It is calculated as the last period's capital stock plus total investment minus depreciation. 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.

Growth in the labor force by skill class is exogenous and related to population growth which in turn is based on calculated growth projections taken from national data. For unskilled and semi-skilled labor, the total size of the available labor force does not affect the solution in any period because in the simulations we assume that there is an excess or a backlog of unemployed labor which is not absorbed before the end of our simulations. 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. In the CAFTA simulations related with reduction in tariffs, changes in the maquila scheme and import quotas we used a saving-driven closure in the single period solution. In the FDI simulation we imposed as a 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:

1. Updated by exogenous trends (labor force growth, productivity changes, capital stock growth and population growth).

2. Updated by economic behavior (distribution of investment by sector, distribution of labor force by sector and category).
3. Updated by implemented policies (changes in tariffs, import quotas, and FDI as result of implementation of CAFTA).

With the use of general equilibrium models we are able to use these scenarios for the economy and project the growth paths of the endogenous variables and compare the “base year” path (in which there are no CAFTA-related changes in policy variables) and the paths obtained with the proposed policy changes. The simulations run with the Salvadorian model give us the growth path for the Salvadorian economy for the period 2000-2020 under a number of different policy alternatives. These paths are compared to the one obtained with the Base simulation (in which no exogenous policy changes were included) to see the impacts of implementing various CAFTA policies. For this exercise we modified the transfers from the enterprises to the rest of the world in such way that they were eliminated by the year 2005 in all the scenarios including the “base”.

IV. 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, tariff rates which change over time, either because they are endogenous in the model, or because they are policy variables such as tariffs which change over time. In each of our simulations we run the model from its 2000 base, using the observed values for all exogenous variables up to 2005, and then inserting the changes introduced by CAFTA after 2005. We ran each simulation out to 2020 and present the results in the form of growth rates of all the endogenous variables of interest from the 2000 initial values. In each of our tables we display 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 our CAFTA simulations should be compared.

CAFTA: In this simulation we change all the sectoral tariffs according to the time patterns shown in table II.3. Since these tariff changes vary across both time and sector, it is useful to show explicitly the time path of the response to the changes, rather than just the twenty-three year average rate of growth which we will do in figure V.1.

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 world-wide quota system then in force. But its products were not exempt from U.S.

tariffs until the passage of the Caribbean Basin Economic Recovery Expansion Act in 1990. With the passage of NAFTA in 1994, this advantage was partially offset by the more generous treatment of Mexican producers with regards 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 forward 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 of intermediate imports to the textile industry at the observed level of 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 of domestically producing the intermediate inputs to the booming maquila industry.

ALLCAFTA: In this simulation we combine the effects of the tariff reductions plus maquila plus tariff free quotas granted by the US and El Salvador on particular 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 II.2. But CAFTA also established tariff-rate quotas (TRQs) in many of these commodities making possible faster liberalization that is apparent 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 certain quantitative limit as soon as the treaty is implemented (or in the case of chicken legs, in year three). 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 then ask what the impact of the TRQs is likely to be in practice.

For quotas of imports into El Salvador we are interested in the effect of the quota 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. (See Morley, 2005) If they are smaller, they are effectively a transfer of tariff revenue to the importer. In all the 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 change 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% of the level of

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

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% of total production.

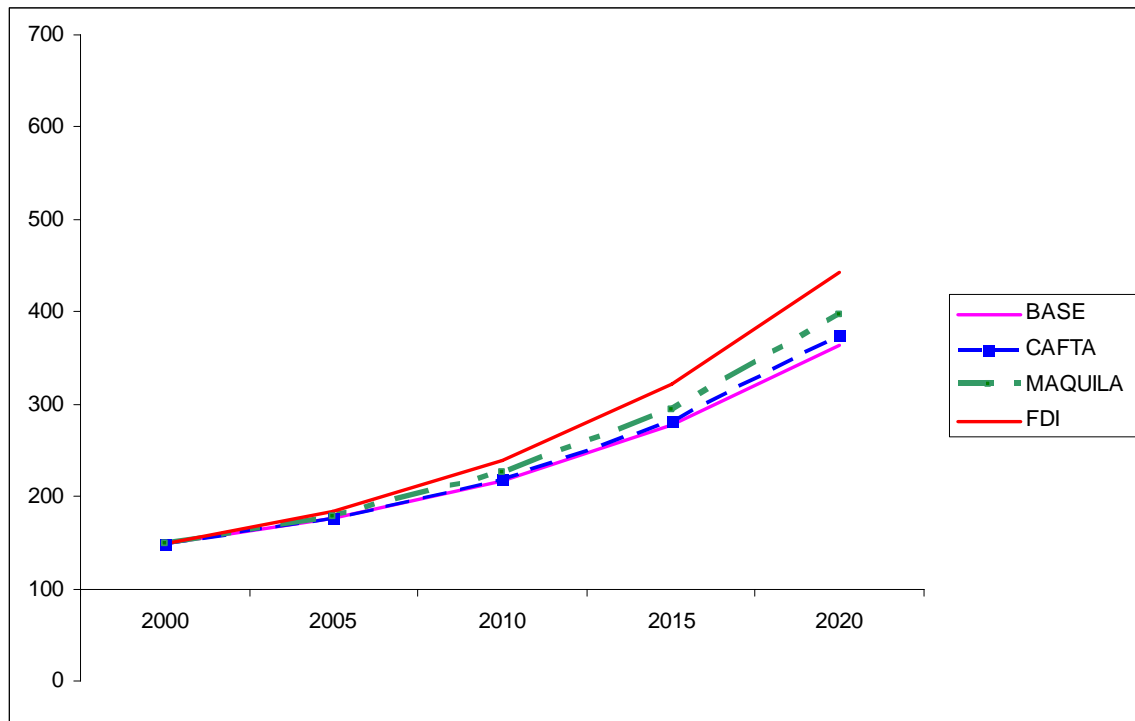
FDI: It is relatively straightforward to model the impact of trade liberalization under CAFTA. But there are many additional items and agreements in the CAFTA treaty that have to do with the treatment of foreign direct investment. All are aimed at defining and protecting the rights of foreign investors 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 very clear idea of just how much additional foreign direct investment El Salvador can expect to receive under the new CAFTA legal conditions, as a first approximation we simply increased by 25% 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 insure that these inflows directly increase investment.

V. Results

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

Our dynamic model makes the fairly optimistic prediction that El Salvador will be able to reach an average annual growth rate of 4.5% over the period 2000-2020. That is far higher than the actual growth rates observed over the last ten years, and that 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% 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.

Figure V.1: Growth in GDP in different CAFTA scenarios



Source: author's worksheets.

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 0.2% per year over the base scenario. Maquila raises the growth rate by an additional .25%. What does increase the growth rate is foreign direct investment. If the CAFTA regulations which are intended to make the host country more hospitable to foreign direct investment 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, we show the growth rates of the main macro aggregates under our four different scenarios in Table V.1 over the twenty years 2000 to 2020. 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 foreign direct investment whose separate effect is shown in the last column.

Table V-1: Annual Rates of Growth of Macro Aggregates 2000-2020						
	INITIAL VALUE	BASE	CAFTA	MAQUILA	ALL CAFTA	FDI
	2000*	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	5.10	5.60	5.69	5.48
Imports	52.12	4.18	4.60	4.58	5.00	5.54
GDP (market price)	158.53	4.48	4.65	4.91	5.09	5.49

* in 2000 billion of salvadorean colones.

Source: author worksheets.

The overall growth rates are as we described them above. 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 bigger 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 non-maquila commodities which shifts more of production in the country over to unskilled, labor-intensive commodities such as maquila. Note that the overall economy becomes less capital-intensive than in the baseline and uses more of unskilled labor which we have assumed is in excess supply. That is what permits aggregate growth to jump by about .5% per year.

As the reader can see, when we combine together the trade liberalization, maquila and quotas in the simulation ALL CAFTA, 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 biggest impact on the growth rate is FDI. Recall that in this simulation we hypothesize that the measures to make FDI in El Salvador more attractive to foreign investors result in an increase in FDI in the amount of 125% of 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% of GDP and the growth rate of investment in the economy rises by almost 25%. By 2020 the capital stock of the economy is 25% 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 or not CAFTA will induce that much additional foreign direct investment. 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

Simulation results by sector for our various scenarios are displayed in Table V.2. Trade liberalization under CAFTA increases production, imports and exports in all the sectors shown in the table. The differences in growth rates between the base run and CAFTA are all small, but they are positive. 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 becomes somewhat more open. As could be 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 the trade liberalization alone. Partly that is due to the faster rate of growth of capital in this scenario (See table V-1). But it is also due to our assumption that there is excess unskilled labor. In that case the positive stimulus of added demand for maquila permits the economy to employ more people, grow faster and increase the rate of growth of the capital stock..

Table V-2: National Production and Trade						
	INITIAL SHARE	BASE	CAFTA	MAQUILA	ALL CAFTA	FDI
	2000*	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
Minery	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
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
Minery	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
Minery	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

* initial share of total exports, imports and production respectively.

Source: author worksheets.

In table V.3 we show the effect of our various policy scenarios on production in all the sectors of our CGE model. The growth rates of exports and imports disaggregated in the same way are shown in annex 1. For most of the sectors in the table both CAFTA and MAQUILA slightly increase the growth rate. When these two effects are combined in the ALL-CAFTA simulation what really stands out is the small size of 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 quite limited impacts either positive or negative of CAFTA on the sectoral growth rates or structure of the economy.

There are two exceptions to this general picture. The first is maquila itself.(see the last row in the table) 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 are fairly dramatic. Note that one would get an equally large response if domestic savers and investors responded to the expanded profit opportunities made possible by CAFTA.

Table v-3: Sectoral Growth Rates						
	INITIAL SHARE	BASE	CAFTA	MAQUILA	ALL CAFTA/	FDI
	2000*	Annual Percentage growth rate (2000-2020)				
PRODUCTION						
CCAFE	1.20	4.57	4.72	4.95	5.10	5.60
CCEREAL	1.71	4.61	4.78	4.98	5.15	5.77
CAZUCAR	0.32	4.08	4.27	4.40	4.60	5.16
COTHCROP	0.01	5.56	5.05	5.86	5.34	6.56
CCARNE	1.98	4.56	4.76	4.91	5.12	5.73
CSILV	0.64	5.01	5.16	5.42	5.58	6.29
CPESCA	0.30	4.53	4.68	4.90	5.06	5.68
CMINERIA	0.33	4.82	4.91	5.24	5.34	5.93
CCARPROD	0.61	4.64	4.83	5.02	5.21	5.85
CLACTEOS	0.74	4.55	4.77	4.87	5.10	5.63
CTRIGPROD	2.17	4.42	4.65	4.71	4.95	5.42
CAZUPROD	0.58	4.22	4.42	4.55	4.75	5.33
COTHAGIND	2.61	4.24	4.41	4.58	4.76	5.36
CBEBTAB	1.75	4.12	4.30	4.42	4.60	5.16
CTEXTILES	2.34	4.68	4.76	4.92	5.01	5.77
CINDUME	0.69	4.34	4.54	4.60	4.81	5.33
CCUERO	0.79	4.38	4.54	4.69	4.86	5.44
CMADERA	0.39	4.58	4.70	4.94	5.07	5.70
CPAPEL	0.62	4.48	4.61	4.84	4.98	5.53
CIMPRENTA	1.33	4.23	4.39	4.54	4.70	5.31
CQUIMICOS	1.34	4.27	4.40	4.61	4.74	5.31
CPETROLEO	2.40	4.03	4.20	4.41	4.59	5.10
CPLASTICO	0.60	4.27	4.25	4.59	4.57	5.42
CMINERALE	1.06	4.38	4.48	4.86	4.96	5.60
CMETALES	1.65	4.97	4.99	5.33	5.36	6.11
CMAQUIN	1.08	4.68	4.78	5.08	5.19	5.85
CTRANSMAC	1.56	4.60	4.57	4.96	4.94	5.80
CELECT	1.72	4.74	4.91	5.25	5.42	5.72
CAGUA	0.20	4.42	4.64	4.80	5.02	5.41
CCONSTRUC	4.52	4.53	4.85	5.14	5.47	5.77
CCOMER	16.08	4.44	4.69	4.80	5.06	5.51
CHOTYREST	5.86	4.26	4.46	4.60	4.80	5.35
CTRANSP	8.50	4.36	4.55	4.76	4.96	5.42
CCOMUN	1.36	4.18	4.39	4.48	4.70	5.20
CSFINANC	2.11	4.39	4.58	4.71	4.91	5.44
CINMIV	9.37	4.59	4.77	5.03	5.22	5.76
CSPERDOM	5.24	4.22	4.41	4.60	4.79	5.43
CGOV	6.09	4.13	4.37	4.63	4.88	5.22
CMAQUILA	8.14	6.24	6.29	7.60	7.65	7.19

Source: author's worksheets.

The impact of CAFTA on factor markets

Table V.4 summarizes the impact of our CAFTA simulations on the growth rates of capital and employment broken down by skill level, gender and place of residence, (rural

or urban). Recall that our definition of skill is based on the level of education where all workers with a high school education or more are classified as skilled. The first thing to note in the table 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 once again compare the base with the CAFTA simulations. In the base rural unskilled employment increases by a bit less than 5% per year. What is of more interest of us here is that, in the ALL CAFTA simulation the growth rate of employment of unskilled in the rural sector is about .7 percentage points (pp) faster than in the base. and almost one 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 over 15% in rural unskilled employment and over 19% in urban. 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. That is an important result which bears on the extent of rural or urban bias of the CAFTA agreement. Our results say that while the opening of job opportunities is higher 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 V-4: Growth Rates of Capital and Labor by gender, skill and place of residence					
	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
RSKLM	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: author's worksheets.

- USKLM-urban male skilled labor
- USKLF-urban female skilled labor
- UUSKLM-urban unskilled male labor
- UUSKLF-urban unskilled female labor
- RSKLM-rural skilled male labor
- RSKLF-rural skilled female labor

RUSKLM-rural unskilled male labor
RUSKLF-rural unskilled female
CAP-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 (See table V.1). That is reflected in a terminal year capital stock 3.3% higher than the base run. Maquila increases the rate of growth of capital formation and leads to a terminal year capital stock of 8.5% 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% of GDP. More important, the rate of growth of investment rises by 35% (from 4.35% to 5.91% (see table V.1). Those two changes raise the investment share from 17% in the base year 2000 to 18% in 2020, and they increase the quantity of capital available to the economy in year 2020 by about one-fourth. 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, because of the assumption of a positively sloped supply curve, some of the impact of increased demand comes in the form of more employment and some comes in the form of higher wages as we shall see in a moment. 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 warning us that the success or failure of CAFTA is likely to depend on whether or not it helps governments to create conditions which encourage investment both foreign and domestic.

Labor Earnings inequality

Our results suggest that there will be a significant rise in the skill differential, with or without CAFTA. (See table V.5). 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 twenty year simulation. We assume that the supply curve of skilled labor, both rural and urban for both sexes rises by 2% 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, there is a decline in the relative wage of the unskilled. In the baseline projection by 2020 unskilled males in the urban sector lose about 37% relative to the skilled and unskilled females lose 36%. Both of those differentials widen a bit in all the alternative CAFTA scenarios. The faster the economy grows the wider the skill differential becomes which is just what one would expect from our assumptions about the supply curves of the two types of labor. As for the urban-rural wage differentials, for unskilled labor of both sexes it is constant by assumption, and therefore not shown in table V.5. The last rows of the

table show the urban/rural differential for skilled males. It narrows very 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 in the form of higher wages only.

		Table v-5: 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
	ALLCAFTA	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	0.95
	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: author's worksheets.

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 V.6. The share of unskilled labor rises in every scenario and the capital share falls in every scenario. In the MAQUILA and FDI scenario there are big increases in the capital stock, output and the employment of unskilled labor. These latter two increases are so large that both the capital and the unskilled labor share rise, at the expense of skilled labor. Note that this happens despite the fact that there is a big increase in the skill differential in both of these scenarios.

		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: author's worksheets.

VI: The Impact of CAFTA on poverty and the distribution of income

Our dynamic CGE model gives an estimate of the effect that CAFTA will have on employment, production and income. The question is what implications those changes have for poverty and the distribution of income. To answer those questions we have to find a way to translate the labor market outcomes of the CGE into a distribution of income across households. The difficulty is that 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 the CGE tells us that 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 sort of questions arises if we are interested in the effect of a change in the skill composition of the labor force. The CGE solution for example may tell us that there is an increase in the fraction of the labor force that is skilled. We then need some way of deciding which members of which families are upgraded.

We will follow here a microsimulation methodology developed by Paes de Barros and Vos. 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 survey¹¹. 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 which 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 new 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 the CGE solution. 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.

There are two things to note 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 duplicated 50 or 100 times and the statistical results tabulated. That 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 Honduras case we repeated these simulations 100 times. The second thing to note is that the 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, then change the sector and skill level of that new labor force and then finally the wage. That seems like the right order, but it is possible that the solution would be different if we had chosen a different sequence of changes.

VII. Results

Table VII-1 gives an overview of the results of our microsimulations. We show 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. We started from the

¹¹ We used the household survey of 2005.

2005 base determined by a 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 the three FGT poverty measures for both extreme and moderate poverty where the poverty lines for each measure were calculated by FUSADES in El Salvador.

Table VII-1: Changes in poverty and distribution under CAFTA in 2020												
	2005 (Base year)		Baseline		Tariff Cut		Maquila		All CAFTA		FDI	
	Mean	S.E.	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 Hh 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%	
Ext poverty incidence	15.5%	7.1%	0.2%	6.3%	0.3%	5.6%	0.2%	5.1%	0.2%	4.8%	0.2%	
Ext poverty gap	6.9%	3.0%	0.1%	2.6%	0.1%	2.3%	0.1%	2.1%	0.1%	1.9%	0.1%	
Ext 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 HH 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 HH 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 Hh 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%	
Ext poverty incidence	18.6%	7.8%	0.3%	6.8%	0.4%	5.9%	0.3%	5.4%	0.3%	5.0%	0.3%	
Ext poverty gap	8.4%	3.3%	0.2%	2.9%	0.2%	2.5%	0.1%	2.3%	0.1%	2.1%	0.1%	
Ext 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 HH 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 HH income	0.47	0.43	0.00	0.42	0.00	0.41	0.00	0.41	0.00	0.41	0.00	
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 Hh 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%	
Ext poverty incidence	13.5%	6.7%	0.3%	5.9%	0.3%	5.4%	0.3%	4.9%	0.2%	4.6%	0.3%	
Ext poverty gap	5.9%	2.7%	0.1%	2.4%	0.1%	2.1%	0.1%	1.9%	0.1%	1.8%	0.1%	
Ext 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 HH 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 HH income	0.47	0.44	0.00	0.44	0.00	0.44	0.00	0.43	0.00	0.43	0.00	

Source: author worksheets

As we have already seen in the previous sections of this paper, our CGE model predicts a fairly optimistic and significant increase of 34% in per capita income between 2005 and 2020 in El Salvador even in the absence of CAFTA. That has a big and favorable impact on poverty both rural and urban, but especially rural. At the national level the 34% increase in per capita income causes poverty to fall by 41% which implies a 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% compared to 29%) and that causes rural poverty to fall at an even faster rate than urban poverty. These results all come from the very 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 very rapid increases in rural employment. With the number of jobs in the countryside growing by around 4.7% per year, and the rural population only growing by 2.5% per year, there is a big increase in participation rates and earning opportunities for rural families all of which moves a large number over the poverty line.

Because of the rapid increase in employment for 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 projection. Whatever the error may be in the baseline projections, there is no reason to think that there will be a relationship between the CAFTA projections and the unknown error in the baseline. Therefore the differentials between the CAFTA forecasts and the baseline should be a robust estimate of the impact of CAFTA.

Consider now what the changes between poverty and distribution estimates across our simulations tell us about the impact of CAFTA. Look first at CAFTA compared to the baseline. This column shows the impact of the tariff reductions alone separate from all the other components of the treaty. And as the reader can see, 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, the impact is particularly favorable in the rural area. There according to our estimates thanks to CAFTA, per capita household income increases by around 5% compared to 3% in the urban area.

This result may seem surprising because of the reduction of tariffs on some agricultural commodities. That ignores three things. First, the average level of tariffs prior to CAFTA was already quite low. (See table I.1). Second, tariffs on sensitive products were reduced slowly and carefully. (See table II-2). 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. (See table V-5) 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 employment which adds the wage 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. There is a very big increase in the demand for female unskilled labor and because of demand side linkages the boom in this sector spreads out and increases 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 which successfully creates employment for this group will have a very large and favorable impact on poverty. The second feature is the linkage between the rural and the urban sector. If the economy creates urban employment that pulls unemployed or inactive workers out of the countryside at the same time that the increase in urban employment and income increases the demand for agricultural production by urban households, all of which has a favorable impact on rural poverty.

Not only does maquila has a big and favorable impact on poverty rates both rural and urban, it also reduces inequality. At the national level the Gini falls from .46 in the baseline to .45. One of the reasons for this is that under maquila the urban-rural households average income differential 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 it is that we can have a very favorable reduction in poverty at the same time there is rising labor income inequality, particularly in the urban sector.

The next scenario ALLCAFTA combines the tariff cuts and the maquila market access conditions. Both trade liberalization and maquila reduce poverty as we have seen. When we measure their joint effect, the results are roughly equal to the sum of the impacts considered separately. In the ALL CAFTA simulation poverty at the national level falls by five percentage points relative to the baseline. The bulk of that 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 over 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 pp) than urban so that the reduction in rural poverty due to maquila is actually bigger than the reduction in urban poverty. .

Decomposing the changes in poverty and distribution

The changes in poverty and distribution that we displayed in table VII-1 for our different scenarios are the result of changes in employment, changes in the skill composition of the employed labor force and changes in relative wages. We can use our microsimulation methodology to get an idea of how important each of these changes is to the final observed changes that are shown in table VII-1.

The microsimulation procedure used in deriving the results displayed in Table VII-1 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 in the microsimulation we make these changes sequentially, one can make a “quasi” decomposition of the overall change 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 would the poverty or distribution level 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 change in poverty and distribution resulting from the particular change in the labor market solution. We have done this and display the results in Table VII-2. 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 the distribution.

Table VII-2 shows three columns for each of our 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% 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 that overall average rate of growth of employment is reached. It then applies the base period wage rates 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 in the column labeled W we show 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 VII-1.

The first point to be gleaned from table VII-2 is the key role of employment growth for the unskilled for trends in 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% in the base line to 5.1%. This small increase is enough to reduce the national poverty rate from 24.5% in the base line to 23.2%. In all of our 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 underlying 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 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.¹² 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 favored the unskilled. Faster than average growth in jobs for this group reduced 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 wages differentials do reduce the poverty rates a bit more than employment growth alone, but still the latter comprises at least 90% 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 there is a positive impact. Rising wage differentials actually reduce poverty relative to what it

¹² Except for ALLCATA where the poverty rates are approximately equal

would have been with the simulated employment growth rates differentiated by skill. That 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 VII-2: Decomposition of CAFTA Effects in 2020

	2005	Baseline			Tariff Cut			Maquila			AIICAFTA			FDI				
		Mean	E	S	W	Mean	E	S	W	Mean	E	S	W	Mean	E	S	W	
National																		
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 Hh 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%		
Ext 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%		
Ext 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%		
Ext 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 HH 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 HH 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 Hh 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%		
Ext 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%		
Ext 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%		
Ext 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 HH 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 HH 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		
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 Hh 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%		
Ext 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%		
Ext 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%		
Ext 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 HH 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 HH 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		

As we have already seen, our model forecasts a reduction in inequality. That is mainly due to the underlying employment trends of the baseline, but that trend is slightly amplified by CAFTA itself. Table 7-2 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 level, the Gini falls by one percentage point, and urban-rural household income differentials narrow.

In all the other simulations, as we have already seen, the growth of the economy is higher than in the baseline and so is employment for the unskilled. Had there been no change in relative wages, that would have resulting 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 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.

Conclusions

Supporters of CAFTA hope that it will enhance growth prospects and reduce poverty in El Salvador. Our results suggest that while the effect of CAFTA on the growth rate and on 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 big growth impact when they are dismantled. Critics have complained that smallholders would 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. Both agriculture in general and subsistence agriculture in particular 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 in CAFTA will be very cautious and gradual. Also we found that the rural urban household income differential narrows under each of the CAFTA scenarios. That in turn

is the main reason that poverty falls further in the rural sector than it does in the urban sector.

CAFTA in general and maquila in particular are good for unskilled labor both rural and urban in El Salvador. Since we have assumed an excess supply of unskilled labor, there is a widening of wage differentials 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 growth rate of unskilled male employment in the urban sector by 0.3 percentage points per year and by 0.2 percentage points in the rural sector and by a somewhat larger amount 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 the inequality because of the differential fully offset the progressive effects of enhanced job creation due to CAFTA. With CAFTA poverty falls and the 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 included significant benefits for foreign investors. The hope was that such inducements would increase the inflow of foreign capital to the country which would 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 one can get an increase in growth 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 we see that 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 it gets a virtually free increase in the growth rate 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.

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Annex 1: Sectoral growth rates

	INITIAL SHARE 2000*	BASE Annual Percentage growth rate (2000-2020)	CAFTA	MAQUILA	ALL CAFTA	FDI
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
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

Annex 2: Documentation of the Social Accounting Matrix and household survey for El Salvador and Technical Description of the Recursive Dynamic CGE.

I. The Social Accounting Matrix for 2000¹³.

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

¹³ / This section was taken from Acevedo (2005).

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 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.

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.¹⁴

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.

<i>Labor Category</i>	<i>Skill</i>	<i>Description</i>	<i>Gender</i>
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

¹⁴ / The MPHS sample for year 2000 included around 15,000 households.

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.

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.

Figure 1. National SAM used in the CGE model

Receipts	Expenditures								
	Activities	Commodities	Factors	Households	Enterprises	Government	Savings-Investment	Rest of the World	TOTAL
Activities		marketed outputs							Activity in
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 inflow	

Source: Adapted from Lofgren et al (2001).

II. A Formal Statement of the Dynamic CGE Model

SETS

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 factors
$c \in C$	commodities	$f \in F$	
$c \in CD(\subset C)$	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	$shii_{i'}$	share of net income of i' to i ($i' \in INSDNG$; $i \in INSDNG$)
$ice_{cc'}$	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	$tinsOI_i$	0-1 parameter with 1 for institutions with potentially flexed direct tax rates
$mpsOI_i$	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
$qdst_c$	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
\overline{IADJ}	investment adjustment factor		

VARIABLES

$DMPS$	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 ($i \in INSDNG$)
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

EQUATIONS

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

8	$PA_a \cdot (1 - ta_a) \cdot QA_a = PVA_a \cdot QVA_a + PINTA_a \cdot QINTA_a$ $\left[\begin{array}{c} \text{activity price} \\ \text{(net of taxes)} \\ \text{times activity level} \end{array} \right] = \left[\begin{array}{c} \text{value-added} \\ \text{price times} \\ \text{quantity} \end{array} \right] + \left[\begin{array}{c} \text{aggregate} \\ \text{intermediate} \\ \text{input price times} \\ \text{quantity} \end{array} \right]$	$a \in A$	Activity revenue and costs
9	$\overline{CPI} = \sum_{c \in C} PQ_c \cdot cwtsc$ $[CPI] = \left[\begin{array}{c} \text{prices times} \\ \text{weights} \end{array} \right]$		Consumer price index
10	$DPI = \sum_{c \in C} PDS_c \cdot dwts_c$ $\left[\begin{array}{c} \text{Producer price index} \\ \text{for non-traded outputs} \end{array} \right] = \left[\begin{array}{c} \text{prices times} \\ \text{weights} \end{array} \right]$		Producer price index for non-traded market output

Production and commodity block

11	$QA_a = \alpha_a^a \cdot \left(\delta_a^a \cdot QVA_a^{-\rho_a} + (1 - \delta_a^a) \cdot QINTA_a^{-\rho_a} \right)^{-\frac{1}{\rho_a}}$ $\left[\begin{array}{c} \text{activity} \\ \text{level} \end{array} \right] = CES \left[\begin{array}{c} \text{quantity of aggregate value-added,} \\ \text{quantity aggregate intermediate input} \end{array} \right]$	$a \in ACES$	CES technology: activity production function
12	$\frac{QVA_a}{QINTA_a} = \left(\frac{PINTA_a}{PVA_a} \cdot \frac{\delta_a^a}{1 - \delta_a^a} \right)^{\frac{1}{1 + \rho_a}}$ $\left[\begin{array}{c} \text{value-added -} \\ \text{intermediate-} \\ \text{input quantity} \\ \text{ratio} \end{array} \right] = f \left[\begin{array}{c} \text{intermediate-input} \\ \text{- value-added} \\ \text{price ratio} \end{array} \right]$	$a \in ACES$	CES technology: Value—Added—Intermediate—Input ratio
13	$QVA_a = iva_a \cdot QA_a$ $\left[\begin{array}{c} \text{demand for} \\ \text{value-added} \end{array} \right] = f \left[\begin{array}{c} \text{activity} \\ \text{level} \end{array} \right]$	$a \in ALEO$	Leontief technology: Demand for aggregate value-added
14	$QINTA_a = inta_a \cdot QA_a$ $\left[\begin{array}{c} \text{demand for aggregate} \\ \text{intermediate input} \end{array} \right] = f \left[\begin{array}{c} \text{activity} \\ \text{level} \end{array} \right]$	$a \in ALEO$	Leontief technology: Demand for aggregate intermediate input
15	$QVA_a = \alpha_a^{va} \cdot \left(\sum_{f \in F} \delta_{fa}^{va} \cdot QF_{fa}^{-\rho_a^{va}} \right)^{-\frac{1}{\rho_a^{va}}}$ $\left[\begin{array}{c} \text{quantity of aggregate} \\ \text{value-added} \end{array} \right] = CES \left[\begin{array}{c} \text{factor} \\ \text{inputs} \end{array} \right]$	$a \in A$	Value-added and factor demands

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

23	$QX_c = \alpha_c^t \cdot \left(\delta_c^t \cdot QE_c^{\rho_c^t} + (1 - \delta_c^t) \cdot QD_c^{\rho_c^t} \right)^{\frac{1}{\rho_c^t}}$ $\left[\begin{array}{l} \text{aggregate marketed} \\ \text{domestic output} \end{array} \right] = CET \left[\begin{array}{l} \text{export quantity, domestic} \\ \text{sales of domestic output} \end{array} \right]$	$c \in (CE \cap CD)$	Output Transformation (CET) Function
24	$\frac{QE_c}{QD_c} = \left(\frac{PE_c}{PDS_c} \cdot \frac{1 - \delta_c^t}{\delta_c^t} \right)^{\frac{1}{\rho_c^t - 1}}$ $\left[\begin{array}{l} \text{export-domestic} \\ \text{supply ratio} \end{array} \right] = f \left[\begin{array}{l} \text{export-domestic} \\ \text{price ratio} \end{array} \right]$	$c \in (CE \cap CD)$	Export-Domestic Supply Ratio
25	$QX_c = QD_c + QE_c$ $\left[\begin{array}{l} \text{aggregate marketed} \\ \text{domestic output} \end{array} \right] = \left[\begin{array}{l} \text{domestic market} \\ \text{sales of domestic} \\ \text{output [for} \\ c \in (CD \cap CEN)] \end{array} \right] + \left[\begin{array}{l} \text{exports [for} \\ c \in (CE \cap CDN)] \end{array} \right]$	$c \in$ $(CD \cap CEN)$ \cup $(CE \cap CDN)$	Output Transformation for Non-Exported Commodities
26	$QQ_c = \alpha_c^q \cdot \left(\delta_c^q \cdot QM_c^{\rho_c^q} + (1 - \delta_c^q) \cdot QD_c^{\rho_c^q} \right)^{\frac{1}{\rho_c^q}}$ $\left[\begin{array}{l} \text{composite} \\ \text{supply} \end{array} \right] = f \left[\begin{array}{l} \text{import quantity, domestic} \\ \text{use of domestic output} \end{array} \right]$	$c \in (CM \cap CD)$	Composite Supply (Armington) Function
27	$\frac{QM_c}{QD_c} = \left(\frac{PDD_c}{PM_c} \cdot \frac{\delta_c^q}{1 - \delta_c^q} \right)^{\frac{1}{1 + \rho_c^q}}$ $\left[\begin{array}{l} \text{import-domestic} \\ \text{demand ratio} \end{array} \right] = f \left[\begin{array}{l} \text{domestic-import} \\ \text{price ratio} \end{array} \right]$	$c \in (CM \cap CD)$	Import-Domestic Demand Ratio
28	$QQ_c = QD_c + QM_c$ $\left[\begin{array}{l} \text{composite} \\ \text{supply} \end{array} \right] = \left[\begin{array}{l} \text{domestic use of} \\ \text{marketed domestic} \\ \text{output [for} \\ c \in (CD \cap CMN)] \end{array} \right] + \left[\begin{array}{l} \text{imports [for} \\ c \in (CM \cap CDN)] \end{array} \right]$	$c \in$ $(CD \cap CMN)$ \cup $(CM \cap CDN)$	Composite Supply for Non-Imported Outputs and Non-Produced Imports
29	$QT_c = \sum_{c' \in C'} (icm_{c,c'} \cdot QM_{c'} + ice_{c,c'} \cdot QE_{c'} + icd_{c,c'} \cdot QD_{c'})$ $\left[\begin{array}{l} \text{demand for} \\ \text{transactions} \\ \text{services} \end{array} \right] = \left[\begin{array}{l} \text{sum of demands} \\ \text{for imports, exports,} \\ \text{and domestic sales} \end{array} \right]$	$c \in CT$	Demand for Transactions Services

Institution block

30	$YF_f = \sum_{a \in A} WF_f \cdot \overline{WFDIST}_{fa} \cdot QF_{fa}$ $\left[\begin{array}{l} \text{income of} \\ \text{factor } f \end{array} \right] = \left[\begin{array}{l} \text{sum of activity payments} \\ \text{(activity-specific wages} \\ \text{times employment levels)} \end{array} \right]$	$f \in F$	Factor Income
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31	$YIF_{if} = shif_{if} \cdot \left[(1 - tf_f) \cdot YF_f - trnsfr_{row f} \cdot EXR \right]$ $\left[\begin{array}{l} \text{income of} \\ \text{institution } i \\ \text{from factor } f \end{array} \right] = \left[\begin{array}{l} \text{share of income} \\ \text{of factor } f \text{ to} \\ \text{institution } i \end{array} \right] \cdot \left[\begin{array}{l} \text{income of factor } f \\ \text{(net of tax and} \\ \text{transfer to RoW)} \end{array} \right]$	$i \in INSD$ $f \in F$	Institutional factor incomes
32	$YI_i = \sum_{f \in F} YIF_{if} + \sum_{i' \in INSDNG'} TRII_{ii'} + trnsfr_{i gov} \cdot \overline{CPI} + trnsfr_{i row} \cdot EXR$ $\left[\begin{array}{l} \text{income of} \\ \text{institution } i \end{array} \right] = \left[\begin{array}{l} \text{factor} \\ \text{income} \end{array} \right] + \left[\begin{array}{l} \text{transfers} \\ \text{from other domestic} \\ \text{non-government} \\ \text{institutions} \end{array} \right] + \left[\begin{array}{l} \text{transfers} \\ \text{from} \\ \text{government} \end{array} \right] + \left[\begin{array}{l} \text{transfers} \\ \text{from} \\ \text{RoW} \end{array} \right]$	$i \in INSDNG$	Income of domestic, non-government institutions
33	$TRII_{ii'} = shii_{ii'} \cdot (1 - MPS_{i'}) \cdot (1 - TINS_{i'}) \cdot YI_{i'}$ $\left[\begin{array}{l} \text{transfer from} \\ \text{institution } i' \text{ to } i \end{array} \right] = \left[\begin{array}{l} \text{share of net income} \\ \text{of institution } i' \\ \text{transferred to } i \end{array} \right] \cdot \left[\begin{array}{l} \text{income of institution} \\ i', \text{ net of savings and} \\ \text{direct taxes} \end{array} \right]$	$i \in INSDNG$ $i' \in INSDNG'$	Intra-Institutional Transfers
34	$EH_h = \left(1 - \sum_{i \in INSDNG} shii_{ih} \right) \cdot (1 - MPS_h) \cdot (1 - TINS_h) \cdot YI_h$ $\left[\begin{array}{l} \text{household income} \\ \text{disposable for} \\ \text{consumption} \end{array} \right] = \left[\begin{array}{l} \text{household income, net of direct} \\ \text{taxes, savings, and transfers to} \\ \text{other non-government institutions} \end{array} \right]$	$h \in H$	Household Consumption Expenditure
35	$QH_{ch} = \gamma_{ch} + \frac{\beta_{ch}^m \cdot \left(EH_h - \sum_{c' \in C} PQ_{c'} \cdot \gamma_{c'h}^m - \sum_{a \in A} \sum_{c' \in C} PXAC_{ac'} \cdot \gamma_{ac'h}^h \right)}{PQ_c}$ $\left[\begin{array}{l} \text{quantity of} \\ \text{household demand} \\ \text{for commodity } c \end{array} \right] = f \left[\begin{array}{l} \text{household} \\ \text{consumption} \\ \text{spending,} \\ \text{market price} \end{array} \right]$	$c \in C$ $h \in H$	Household Consumption Demand for Marketed commodities
36	$QHA_{ach} = \gamma_{ach}^h + \frac{\beta_{ach}^h \cdot \left(EH_h - \sum_{c' \in C} PQ_{c'} \cdot \gamma_{c'h}^m - \sum_{a \in A} \sum_{c' \in C} PXAC_{ac'} \cdot \gamma_{ac'h}^h \right)}{PXAC_{ac}}$ $\left[\begin{array}{l} \text{quantity of} \\ \text{household demand} \\ \text{for home commodity } c \\ \text{from activity } a \end{array} \right] = f \left[\begin{array}{l} \text{household} \\ \text{disposable} \\ \text{income,} \\ \text{producer price} \end{array} \right]$	$a \in A$ $c \in C$ $h \in H$	Household Consumption Demand for Home Commodities
37	$QINV_c = \overline{IADJ} \cdot qinv_c$ $\left[\begin{array}{l} \text{fixed investment} \\ \text{demand for} \\ \text{commodity } c \end{array} \right] = \left[\begin{array}{l} \text{adjustment factor} \\ \text{times} \\ \text{base-year fixed} \\ \text{investment} \end{array} \right]$	$c \in CINV$	Investment Demand

38	$QG_c = \overline{GADJ} \cdot \overline{qg}_c$ $\begin{bmatrix} \text{government} \\ \text{consumption} \\ \text{demand for} \\ \text{commodity } c \end{bmatrix} = \begin{bmatrix} \text{adjustment factor} \\ \text{times} \\ \text{base-year government} \\ \text{consumption} \end{bmatrix}$	$c \in C$	Government Consumption Demand
39	$YG = \sum_{i \in INSDNG} TINS_i \cdot YI_i + \sum_{f \in F} tf_f \cdot YF_f + \sum_{a \in A} tva_a \cdot PVA_a \cdot QVA_a$ $+ \sum_{a \in A} ta_a \cdot PA_a \cdot QA_a + \sum_{c \in CM} tm_c \cdot pwm_c \cdot QM_c \cdot EXR + \sum_{c \in CE} te_c \cdot pwe_c \cdot QE_c \cdot EXR$ $+ \sum_{c \in C} tq_c \cdot PQ_c \cdot QQ_c + \sum_{f \in F} YF_{gov f} + trnsfr_{gov row} \cdot EXR$ $\begin{bmatrix} \text{government} \\ \text{revenue} \end{bmatrix} = \begin{bmatrix} \text{direct taxes} \\ \text{from} \\ \text{institutions} \end{bmatrix} + \begin{bmatrix} \text{direct taxes} \\ \text{from} \\ \text{factors} \end{bmatrix} + \begin{bmatrix} \text{value-} \\ \text{added} \\ \text{tax} \end{bmatrix}$ $+ \begin{bmatrix} \text{activity} \\ \text{tax} \end{bmatrix} + \begin{bmatrix} \text{import} \\ \text{tariffs} \end{bmatrix} + \begin{bmatrix} \text{export} \\ \text{taxes} \end{bmatrix}$ $+ \begin{bmatrix} \text{sales} \\ \text{tax} \end{bmatrix} + \begin{bmatrix} \text{factor} \\ \text{income} \end{bmatrix} + \begin{bmatrix} \text{transfers} \\ \text{from} \\ \text{RoW} \end{bmatrix}$		Government Revenue
40	$EG = \sum_{c \in C} PQ_c \cdot QG_c + \sum_{i \in INSDNG} trnsfr_{i gov} \cdot \overline{CPI}$ $\begin{bmatrix} \text{government} \\ \text{spending} \end{bmatrix} = \begin{bmatrix} \text{government} \\ \text{consumption} \end{bmatrix} + \begin{bmatrix} \text{transfers to domestic} \\ \text{non-government} \\ \text{institutions} \end{bmatrix}$		Government Expenditures
System Constraint Block			
41	$\sum_{a \in A} QF_{fa} = \overline{QFS}_f$ $\begin{bmatrix} \text{demand for} \\ \text{factor } f \end{bmatrix} = \begin{bmatrix} \text{supply of} \\ \text{factor } f \end{bmatrix}$	$f \in F$	Factor market
42	$QQ_c = \sum_{a \in A} QINT_{ca} + \sum_{h \in H} QH_{ch} + QG_c$ $+ QINV_c + qdst_c + QT_c$ $\begin{bmatrix} \text{composite} \\ \text{supply} \end{bmatrix} = \begin{bmatrix} \text{intermediate} \\ \text{use} \end{bmatrix} + \begin{bmatrix} \text{household} \\ \text{consumption} \end{bmatrix} + \begin{bmatrix} \text{government} \\ \text{consumption} \end{bmatrix}$ $+ \begin{bmatrix} \text{fixed} \\ \text{investment} \end{bmatrix} + \begin{bmatrix} \text{stock} \\ \text{change} \end{bmatrix} + \begin{bmatrix} \text{trade} \\ \text{input use} \end{bmatrix}$	$c \in C$	Composite Commodity Markets
43	$\sum_{c \in CM} pwm_c \cdot QM_c + \sum_{f \in F} trnsfr_{row f} = \sum_{c \in CE} pwe_c \cdot QE_c + \sum_{i \in INSD} trnsfr_{i row} + \overline{FSAV}$ $\begin{bmatrix} \text{import} \\ \text{spending} \end{bmatrix} + \begin{bmatrix} \text{factor} \\ \text{transfers} \\ \text{to RoW} \end{bmatrix} = \begin{bmatrix} \text{export} \\ \text{revenue} \end{bmatrix} + \begin{bmatrix} \text{institutional} \\ \text{transfers} \\ \text{from RoW} \end{bmatrix} + \begin{bmatrix} \text{foreign} \\ \text{savings} \end{bmatrix}$		Current Account Balance for RoW (in Foreign Currency)
44	$YG = EG + GSAV$ $\begin{bmatrix} \text{government} \\ \text{revenue} \end{bmatrix} = \begin{bmatrix} \text{government} \\ \text{expenditures} \end{bmatrix} + \begin{bmatrix} \text{government} \\ \text{savings} \end{bmatrix}$		Government Balance

45	$TINS_i = \overline{tins}_i \cdot \left(1 + \overline{TINSADJ} \cdot \overline{tins01}_i\right) + \overline{DTINS} \cdot \overline{tins01}_i$ $\left[\begin{array}{l} \text{direct tax} \\ \text{rate for} \\ \text{institution } i \end{array} \right] = \left[\begin{array}{l} \text{base rate adjusted} \\ \text{for scaling for} \\ \text{selected institutions} \end{array} \right] + \left[\begin{array}{l} \text{point change} \\ \text{for selected} \\ \text{institutions} \end{array} \right]$	$i \in INSDNG$	Direct institutional tax rates
46	$MPS_i = \overline{mps}_i \cdot \left(1 + \overline{MPSADJ} \cdot \overline{mps01}_i\right) + \overline{DMPS} \cdot \overline{mps01}_i$ $\left[\begin{array}{l} \text{savings} \\ \text{rate for} \\ \text{institution } i \end{array} \right] = \left[\begin{array}{l} \text{base rate adjusted} \\ \text{for scaling for} \\ \text{selected institutions} \end{array} \right] + \left[\begin{array}{l} \text{point change} \\ \text{for selected} \\ \text{institutions} \end{array} \right]$	$i \in INSDNG$	Institutional savings rates
47	$\sum_{i \in INSDNG} MPS_i \cdot (1 - TINS_i) \cdot YI_i + GSAV + EXR \cdot \overline{FSAV} =$ $\sum_{c \in C} PQ_c \cdot QINV_c + \sum_{c \in C} PQ_c \cdot qdst_c$ $\left[\begin{array}{l} \text{non-govern-} \\ \text{ment savings} \end{array} \right] + \left[\begin{array}{l} \text{government} \\ \text{savings} \end{array} \right] + \left[\begin{array}{l} \text{foreign} \\ \text{savings} \end{array} \right] =$ $\left[\begin{array}{l} \text{fixed} \\ \text{investment} \end{array} \right] + \left[\begin{array}{l} \text{stock} \\ \text{change} \end{array} \right]$		Savings-Investment Balance
48	$TABS = \sum_{h \in H} \sum_{c \in C} PQ_c \cdot QH_{ch} + \sum_{a \in A} \sum_{c \in C} \sum_{h \in H} PXAC_{ac} \cdot QHA_{ach}$ $+ \sum_{c \in C} PQ_c \cdot QG_c + \sum_{c \in C} PQ_c \cdot QINV_c + \sum_{c \in C} PQ_c \cdot qdst_c$ $\left[\begin{array}{l} \text{total} \\ \text{absorption} \end{array} \right] = \left[\begin{array}{l} \text{household} \\ \text{market} \\ \text{consumption} \end{array} \right] + \left[\begin{array}{l} \text{household} \\ \text{home} \\ \text{consumption} \end{array} \right]$ $+ \left[\begin{array}{l} \text{government} \\ \text{consumption} \end{array} \right] + \left[\begin{array}{l} \text{fixed} \\ \text{investment} \end{array} \right] + \left[\begin{array}{l} \text{stock} \\ \text{change} \end{array} \right]$		Total Absorption
49	$INVSHR \cdot TABS = \sum_{c \in C} PQ_c \cdot QINV_c + \sum_{c \in C} PQ_c \cdot qdst_c$ $\left[\begin{array}{l} \text{investment-} \\ \text{absorption} \\ \text{ratio} \end{array} \right] \cdot \left[\begin{array}{l} \text{total} \\ \text{absorption} \end{array} \right] = \left[\begin{array}{l} \text{fixed} \\ \text{investment} \end{array} \right] + \left[\begin{array}{l} \text{stock} \\ \text{change} \end{array} \right]$		Ratio of Investment to Absorption
50	$GOVSHR \cdot TABS = \sum_{c \in C} PQ_c \cdot QG_c$ $\left[\begin{array}{l} \text{government} \\ \text{consumption-} \\ \text{absorption} \\ \text{ratio} \end{array} \right] \cdot \left[\begin{array}{l} \text{total} \\ \text{absorption} \end{array} \right] = \left[\begin{array}{l} \text{government} \\ \text{consumption} \end{array} \right]$		Ratio of Government Consumption to Absorption
51	$WFKAV_{ft}^a = \sum_a \left[\left(\frac{QF_{fat}}{\sum_{a'} QF_{fa't}} \right) \cdot WF_{ft} \cdot WFDIST_{fat} \right]$ $\left[\begin{array}{l} \text{average capital} \\ \text{rental rate} \end{array} \right] = \left[\begin{array}{l} \text{weighted sum of sectors'} \\ \text{capital rental rates} \end{array} \right]$		average economy-wide rental rate of capital

52	$INVSHR1_{fat}^a = \left(\frac{QF_{fat}}{\sum_a QF_{fa't}} \right) \cdot \left(\beta^a \cdot \left(\frac{WF_{f,t} \cdot WFDIST_{fat}}{WFKAV_{ft}^a} - 1 \right) + 1 \right)$ $\left[\begin{array}{l} \text{share of} \\ \text{new capital} \end{array} \right] = \left[\begin{array}{l} \text{share of} \\ \text{existing capital} \end{array} \right] \cdot \left[\begin{array}{l} \text{capital rental} \\ \text{rate ratio} \end{array} \right]$		sector's share of the new capital investment
53	$\Delta DKAPS_{fat}^a = INVSHR1_{fat}^a \cdot \left(\frac{\sum_c PQ_{ct} \cdot QINV_{ct}}{PK_{ft}} \right)$ $\left[\begin{array}{l} \text{quantity of new} \\ \text{capital by sector} \end{array} \right] = \left[\begin{array}{l} \text{share of} \\ \text{new capital} \end{array} \right] \cdot \left[\begin{array}{l} \text{total quantity of} \\ \text{new capital} \end{array} \right]$		Allocate gross fixed capital formation
54	$PK_{ft} = \sum_c PQ_{ct} \cdot \frac{QINV_{ct}}{\sum_{c'} QINV_{c't}}$ $\left[\begin{array}{l} \text{unit price} \\ \text{of capital} \end{array} \right] = \left[\begin{array}{l} \text{weighted market price} \\ \text{of investment commodities} \end{array} \right]$		price of capital
55	$QF_{fat+1} = QF_{fat} \cdot \left(1 + \frac{\Delta INVSHR1_{fat}^a}{QF_{fat}} - deprete_f \right)$ $\left[\begin{array}{l} \text{average capital} \\ \text{rental rate} \end{array} \right] = \left[\begin{array}{l} \text{weighted sum of sectors'} \\ \text{capital rental rates} \end{array} \right]$		Updating quantity of capital
56	$QFS_{fat+1} = QFS_{fat} \cdot \left(1 + \frac{\sum_a \Delta INVSHR1_{fat}^a}{QFS_{fat}} - deprete_f \right)$ $\left[\begin{array}{l} \text{average capital} \\ \text{rental rate} \end{array} \right] = \left[\begin{array}{l} \text{weighted sum of sectors'} \\ \text{capital rental rates} \end{array} \right]$		Updating quantity of capital

Source: author's worksheets.