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# THE IMPACT OF CAFTA ON EMPLOYMENT, PRODUCTION, AND POVERTY IN HONDURAS

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# CONTENTS

Page

Appendix:

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## 1. INTRODUCTION

The Central American Free Trade Agreement (CAFTA-DR) is one of the key components of the trade reform agenda in Central America. [1] Producers in the region gain preferred access to the U.S. market for a wide range of products; at the same time, tariffs and nontariff barriers protecting them from lower cost U.S. products are reduced. Supporters of CAFTA hold that the reduction of most remaining barriers to trade between the Central American countries and the United States will lead to greater efficiency, increased exports, and higher growth rates for the region. Yet many observers remain skeptical about the supposed benefits of CAFTA. They point out that for agricultural commodities Central America already has been granted preferred access to the U.S. market under the Caribbean Basin Initiative, signed in 1983 and broadened under several later agreements. Some feel that under the CAFTA agreement the protections afforded to their own farmers, particularly smallholders and producers of basic commodities such as beans, corn, pork, chicken and rice, will be significantly reduced. The loss of these protections could negatively affect the incomes of the poor, offsetting all or part of the gains elsewhere in the economy.

The purpose of this paper is to shed some light on this debate, first by looking closely at the agreement to see what the changes in protection and access to the U.S. market mean for Honduras. Second, we use a computable general equilibrium (CGE) model and a microsimulation model to simulate the impact that the CAFTA changes in tariffs and quotas are likely to have on producers, wages, national income, and poverty in Honduras.

[1] CAFTA originally included five Central American countries: Costa Rica, El Salvador, Guatemala, Honduras, and Nicaragua. The treaty was later expanded to include the Dominican Republic (DR).

## II. PATTERNS OF PROTECTION AND TRADE PRIOR TO CAFTA

In order to appreciate the likely impact of CAFTA on the economy of Honduras, it is useful to look at the level of protection prior to CAFTA and also at production trends in key sectors of the economy. Table 1 displays statistics on trends in production and tariffs since 1990. As can be seen in the right hand columns, Honduras underwent a fairly dramatic period of trade liberalization in the early 1990s—well before the CAFTA agreement. In 1990, Honduras had the highest tariffs in Central America; five years later its tariffs were the lowest in the region. Based on this history and given the relatively low level of tariffs in 1999, it seems likely that CAFTA's impact will not be too great. However, its impact on particular sectors and commodities could be high, especially where levels of protection were still high in 2005 when the CAFTA agreement was signed. To get a sense of how important that could be, one has to look at the disaggregated tariff data in detail, which we shall do in a moment. But first consider the sectoral production and trade data in Table 1.

Trade liberalization does not appear to have been much of a boon to the Honduran economy. Between 1990 and 2004 per capita income rose by just 0.5 percent per year, one of the slowest growth rates in all Latin America. This performance did not reflect low investment. Indeed, according to the table, trade liberalization was accompanied by a significant increase in the share of capital formation in gross domestic product (GDP). Nor was it due to a failure to increase exports. The export share increased slightly over the decade when measured in current prices and much more when measured in constant prices. Rather, the opening of the economy led to a massive increase in the import share, which was not balanced by an equivalent increase in exports, leading to an increase in the trade deficit.

Looking at trends in the sectoral composition of output, it is evident that the share of agriculture contracts sharply and manufacturing increases. Both reflect the rise of the maquila sector. Honduras has the largest and fastest growing maquila sector in Central America. By 2005, maquila comprised 27 percent of total exports, and its value added contributed 36 percent to industrial production (Banco Central de Honduras 2006). Meanwhile agriculture managed to grow by only 1.3 percent per year after 1995, reflecting low prices for its main export crops, natural disasters, and an exchange rate increasingly affected by maquila.

Honduras does not have high tariffs on industrial commodities. Thus the CAFTA tariff reductions will primarily affect agriculture. Yet, as the table indicates, this is a sector that had already suffered a severe decline in the years before CAFTA. Whether the positive effect of opening the United States to Honduran exports will offset the negative effect of further reducing tariffs on agricultural commodities in Honduras is a key question to be answered in this paper.

Table 1

HONDURAS NATIONAL ACCOUNT DATA

Shares (current prices)

| | | | | | | | | | | | Tariff data | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GDP/capita | I/Y | X/Y | M/Y | Ag. | Mfg. | Constr. | Utilities | Mining | Svc. | Average | Dispersion |
| 1990 | 685.7 | 0.202 | 0.372 | 0.399 | 0.200 | 0.145 | 0.046 | 0.028 | 0.015 | 0.566 | 0.419 | 0.218 |
| 1995 | 700.4 | 0.240 | 0.437 | 0.481 | 0.187 | 0.155 | 0.048 | 0.047 | 0.017 | 0.546 | 0.097 | 0.075 |
| 1997 | | | | | | | | | | | 0.097 | 0.054 |
| 1999 | | | | | | | | | | | 0.081 | 0.078 |
| 2000 | 713.6 | 0.261 | 0.413 | 0.552 | 0.140 | 0.170 | 0.046 | 0.041 | 0.017 | 0.585 | | |
| 2001 | 714.2 | 0.238 | 0.378 | 0.542 | 0.122 | 0.177 | 0.043 | 0.038 | 0.016 | 0.604 | | |
| 2002 | 714.2 | 0.222 | 0.380 | 0.531 | 0.119 | 0.182 | 0.037 | 0.039 | 0.017 | 0.606 | | |
| 2003 | 720.7 | 0.234 | 0.383 | 0.549 | 0.113 | 0.183 | 0.041 | 0.042 | 0.017 | 0.605 | | |
| 2004 | 738.7 | 0.248 | 0.397 | 0.588 | 0.115 | 0.181 | 0.037 | 0.042 | 0.016 | 0.609 | | |

Source: ECLAC, *Anuario Estadístico*. Shares for 2004 are estimates based on a chain index from 2003 using country data from ECLAC. *Estudio Económico*. Tariff data are from Lederman and others (2002).

## 1. Trade liberalization under CAFTA

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

Table 2

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 12th to 15th 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 1st year, 8% per year from 3rd to 6th year and 16% per year from 7th to 10th 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 7th to 11th year and 60% from 12th to 15th year. |
| P | Ten year grace period, then elimination over 7 years. 33% from 11th to the 14th year and 67% from the 15th to the 18th year. |

Source: CAFTA-DR Treaty.

For a subset of sensitive agricultural products, CAFTA also expands a system of tariff rate quotas (TRQs) originally set up under the World Trade Organization (WTO), which define 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

[2] The reader should note that formally CAFTA only reduces Honduran tariffs on goods imported from the United States. In this paper, for simplicity, we treat the CAFTA tariff reductions as if they applied to all imported commodities. This implies that our estimates of the effects of tariff reductions overstate the impact. The reason for this simplifying assumption is that the tariff rates are so low that the differences between the true effect and the estimates are necessarily small.

[3] These are products that are politically sensitive because they are or produced or consumed by the poor.

United States to that country, or imports from the country to the United States, exceed the safeguard level. Safeguards are provisions permitted under WTO (and the General Agreement on Tariffs and Trade) by which imports beyond the safeguard level can be temporarily restricted if the affected industry can show that it will suffer serious injury. In most cases, the safeguard-level tariffs fall over time.

## 2. Changes in the protection of agriculture-based products under CAFTA

We now turn our attention to changes in the level of protection of agricultural commodities under CAFTA (Table 3). Once the CAFTA commodities are divided into categories according to the time profile of programmed tariff reductions under the agreement, the amount of trade in each of the tariff categories for all agricultural and processed agricultural products can be determined, as well as 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 5 years and in C over the first 10 years. Note that these are all weighted averages of individual tariff rates, where the share of the commodity in total imports determines the weight. It is well known, however, that this method of averaging can seriously underestimate the average level of protection, when tariffs are so high that they choke off imports. The last category in each table is comprised of all the commodities that have quotas, which in Honduras is mainly yellow corn, chicken, and dairy products.

Certain commodities, like beans, corn, and rice, are of particular importance to either income or consumption of the poor or both. We use the information on tariff categories and initial tariffs in Table 2 to calculate the time path of tariff reductions for a number of these politically sensitive commodities and show the results in the second half of Table 3. Note that the table shows only the tariff level, not the impact of quotas, which will be discussed later.

Other than white corn in several countries, tariff protection for all of these sensitive products will disappear over the next 20 years. But for most products, liberalization will be very gradual, much of it occurring at least 10 years after the treaty goes into effect. This is important. In Central America, many have protested that CAFTA will hurt small farmers by reducing protection of commodities of particular importance to smallholders and the poor. The evidence in the table makes it quite clear that this will not be the case, at least for the first 5 to 10 years. It seems that the Honduran negotiators of CAFTA were not willing to impose a shock treatment on the producers of these sensitive commodities. But it is also clear that over the long run, the reductions in tariffs for these commodities are considerable. Domestic producers are given a fairly long time to adopt new crops or new and more efficient production techniques. But in the long run, they will have to adjust to a far lower level of protection, particularly in rice, beans, poultry, and dairy products.

The table also makes clear the high level of protection afforded to domestic producers of sensitive products, particularly dairy, poultry, and rice. [4] This pattern may, at least to some extent reflect the desire of Central American governments to protect their producers from subsidized

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[4] This pattern is observed both in Honduras and in other Central American countries (Morley 2006).

exports from the United States. A recent study estimated that subsidies in the United States amounted to 41 percent of the value of production of rice, 50 percent of milk, and 32 percent of corn (Monge, Sagot and González, 2004).

Table 3

TARIFF LEVELS OVER TIME IN CAFTA

| | Trade | | | Average tariff rates | | | | |
|---|---|---|---|---|---|---|---|---|
| Tariff category | Imports | Exports | N° products | Pre CAFTA | First year | 5th year | 10th year | 15th year |
| A | 26 000 | 192 298 | 365 | 0.127 | 0.000 | 0.000 | 0.000 | 0.000 |
| B | 5 908 | 30 360 | 124 | 0.140 | 0.112 | 0.000 | 0.000 | 0.000 |
| C | 15 670 | 9 227 | 175 | 0.166 | 0.149 | 0.083 | 0.000 | 0.000 |
| D | 16 685 | 50 656 | 137 | 0.147 | 0.137 | 0.098 | 0.049 | 0.000 |
| F | 78 | 10 | 7 | 0.150 | 0.150 | 0.150 | 0.150 | 0.075 |
| G | 107 545 | 830 | 235 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| N | 4 510 | 0 | 10 | 0.139 | 0.127 | 0.081 | 0.023 | 0.000 |
| O | 869 | 379 | 4 | 0.150 | 0.150 | 0.150 | 0.090 | 0.000 |
| Quota | 50 482 | 1 514 | 33 | 0.416 | 0.416 | 0.416 | 0.416 | 0.277 |
| Total | 227 747 | | | 0.136 | 0.119 | 0.107 | 0.097 | 0.061 |
| Total without rice and yellow corn | | | | 0.072 | | | | |

| | Tariffs on sensitive commodities | | | | | |
|---|---|---|---|---|---|---|
| | Pre CAFTA | First year | 5th year | 10th year | 15th year | 20th year |
| Yellow corn | | 0.450 | 0.450 | 0.302 | 0.000 | 0.000 |
| White corn | 0.450 | 0.450 | 0.450 | 0.450 | 0.450 | 0.450 |
| Rice | 0.450 | 0.450 | 0.450 | 0.450 | 0.252 | 0.000 |
| Beans | 0.150 | 0.140 | 0.103 | 0.050 | 0.000 | 0.000 |
| Beef | 0.150 | 0.120 | 0.000 | 0.000 | 0.000 | 0.000 |
| Pork | 0.150 | 0.150 | 0.150 | 0.090 | 0.000 | 0.000 |
| Poultry | 0.549 | 0.520 | 0.455 | 0.411 | 0.230 | 0.000 |
| Dairy | 0.121 | 0.118 | 0.116 | 0.113 | 0.055 | 0.000 |

Source: Morley (2006).

Tariffs in categories A and B are either eliminated immediately or over the first five years of the agreement. Products in these categories broadly include prime cuts of beef, fish, flowers, various fresh fruits and vegetables, potatoes, and inputs to processed foods such as soups and dog food. For the most part, these are not products in which U.S. imports compete with local producers. For fish, fruits, and vegetables, it is unlikely that U.S. prices would be competitive with local products, 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 on local producers. In fact, because CAFTA grants beef import quotas in the United States, the treaty is on balance likely to be favorable to them.

Category C commodities are those with a 10-year linear tariff reduction schedule. This group is composed primarily of processed foods. D and F category commodities have a 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 what could be called processed agricultural commodities, such as animal or vegetable fats, candies and other products made from sugar, products made from chocolate, leather, flour, beverages, and vegetables or fruits. In Honduras, the category also includes potatoes and some beans. The F category where there is a 10-year grace period followed by a 10-year tariff elimination is composed completely of dairy products.

The table tells us that the treatment of different agricultural commodities under CAFTA is anything but uniform. More than 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 products, tariffs are either not lowered at all, or not lowered significantly until at least 10 years after ratification.

We now allocate these tariff reductions across the sectors that we are going to use in the CGE-based simulations presented later in the paper (Table 4). 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 20 years. Trade liberalization in the 1990s reduced protection in all manufacturing sectors other than textiles and processed foods to a low level. Other than textiles, all the sectors that had significant tariffs were agricultural, which means that for the most part, further trade liberalization under CAFTA will primarily affect agriculture. Tariffs go to zero in all sectors by year 20, but the process is not uniform. As we saw in Table 3, liberalization for subsistence commodities does not begin until almost 10 years after ratification. Protection drops rapidly for textiles and bananas, but since these are both export sectors, it is not clear how important this change in protection really is.

Table 4

CHANGING TARIFF RATES OVER TIME BY SECTOR 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 12th to 15th year. |
| F | Ten year grace period, then linear reduction to zero over the next ten years. |
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| N | Elimination of tariffs in 12 equal annual steps. |
| O | Six year grace period and then elimination in nine non-linear steps, 40% from 7th to 11th year and 60% from 12th to 15th year. |
| P | Ten year grace period, then elimination over 7 years. 33% from 11th to the 14th year and 67% from the 15th to the 18th year. |

Source: CAFTA-DR Treaty.

## III. MODELING THE IMPACT OF CAFTA ON EMPLOYMENT AND PRODUCTION

To predict the impact of CAFTA on the Honduran economy, we use a recursive dynamic general equilibrium model, in order to incorporate the general equilibrium effects of the changes introduced by CAFTA on 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 they will also have indirect effects on urban consumers, government revenue, prices, the balance of payments, and the exchange rate, which well may be larger than the direct effect of the tariff reductions in agriculture as well as second-round effects. In this chapter, we give a short overview of the model, with a complete mathematical and technical discussion relegated to the appendixes 1 to 4.

### 1. The recursive dynamic CGE model

Recursive dynamic CGE models [5] have been used in Chenery, Robinson, and Syrquin (1999) and El-Said, Lofgren and Robinson (2001) to analyze development strategies in Korea and Egypt, respectively; in Lofgren, Harris and Robinson (2001) as a tool to model changes in poverty resulting from various policy alternatives; and finally in Thurlow (2003), who developed a recursive dynamic model for South Africa.

These models are solved in two stages. In the first stage, a solution is sought for a one-year equilibrium using a static CGE model (see Lofgren, Harris and Robinson. 2001). 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). [6]

This model for Honduras is solved for 1997 (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 and to 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

[5] This section of the paper is taken from Piñeiro (2006).

[6] See Lofgren, Harris and Robinson (2001) and Thurlow (2003).

equilibrium changes resulting from a change in tariffs. Under CAFTA, however, 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.

## 2. First step: The single-period solution

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 SAM used in this paper is for 1997 and is based on the SAM developed by Jose Cuesta and reported in Cuesta (2005).

The CGE model has three components. The first shows the payments that are registered in the SAM, following the same disaggregation of factors, activities, commodities, and institutions shown in the matrix. The second is the equations that represent the behavior of the different institutions present. The third is the system of constraints that have to be satisfied by the whole system, including 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 (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 or capital (value added). Finally, output prices depend on the value added (cost of labor and capital), intermediate inputs, and any relevant taxes and subsidies.

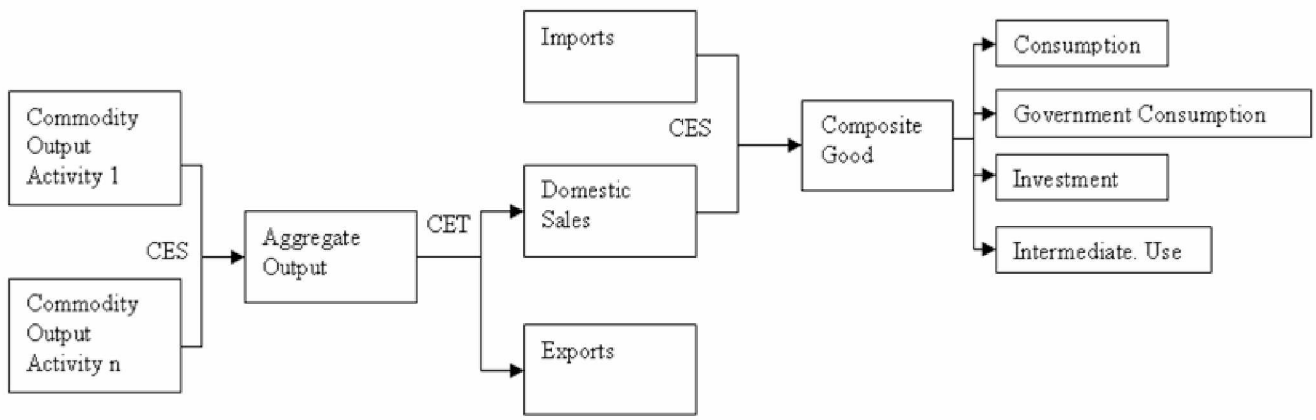
Figure 1 shows the flow of a single commodity from producers to final demand. First, goods from all producers are aggregated into commodity outputs using a CES product demand system. The aggregate output is sold domestically or internationally. The producers' allocation between domestic sales and exports is specified via a constant elasticity of transformation (CET) function, assuming imperfect transformability between exports and domestic sales. The producers 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 Armington (1969) specification is used, which means that the domestically produced and imported goods are imperfect substitutes.

In this model, there are four institutions: households, enterprises, government, and the rest of the world, which do three things: produce, consume, and accumulate capital. Households save a constant coefficient of their disposable income and buy consumption goods. They own the enterprises and they work in them. As a result, household income is the sum of salaries, profits, government transfers, 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 the rest of the world and buys capital goods (investment).

**Figure 1**

**FLOW OF GOODS FROM PRODUCERS TO THE NATIONAL COMPOSITE COMMODITY**




## 3. Closures and assumptions on factor supplies

The closures are the mechanisms that determine how various macro constraints are satisfied. (1) Honduras has a flexible exchange rate, which means that foreign savings are fixed. (2) For the government, the level of consumption and income taxes are fixed across simulations. (3) In equilibrium, total saving must equal total investment. There are various ways to guarantee this. In all but one of our simulations, we fix the saving rates of households and government, which relates total saving and investment positively to the level of income. (4) In the labor markets, we assume that there is an excess supply of unskilled and semi-skilled 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 these two types of labor. For skilled labor, a supply curve is added, making wages as well as quantities endogenous to the model. (5) Capital is fully employed and sector specific, which means that profit rates are free to vary across sectors.

## 4. Second step: Between periods

In the second step of the recursive model, the linkages between periods are introduced. To do this, we solve the static model for one specific year and then update 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. Total capital accumulation is endogenous (in all but the foreign direct investment [FDI] scenario) since it is equal to total saving, which is endogenous. By definition, it is equal to the last period's capital stock plus total investment minus depreciation.[7] 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 with the average profit rate of the economy as a whole. Sectors with higher (lower) average profit rates will get higher (lower) shares of the available investment. Over time sector profit rates should converge.

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

Turning to the supply of labor by skill, the model determines only the amount of employment. It does not distinguish between those who are unemployed and those of working age who are not in the labor force. This is an important distinction for skilled labor. For unskilled labor, we assume that there will be an excess supply of labor up to 2020, which is equivalent to assuming that the rate of growth of employment does not exhaust the available stock of either unemployed or inactive unskilled labor.

For skilled labor, we assume an upward sloping supply curve with an elasticity of +5 with respect to the real wage, shifting rightward by 2 percent per year. In addition to unemployment, Honduras has a large pool of well-educated but inactive labor, especially among women. We assume that the growth in this group will be high enough up to 2020 to supply the amount of skilled labor called for in our sequence of short-run solutions. This assumption may be unrealistic in the FDI scenario because it requires a rapid growth rate of employment.

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 to tariff reductions, changes in the maquila scheme, and import quotas, we use a savings-driven closure in the single period solution. In the FDI simulation, we impose as a constraint that all additions to FDI must be devoted to fixed investment. Therefore, in this simulation, total saving is investment driven.

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[7] To estimate the capital stock in the base period 1997, we assume a lifetime of 12 years for capital where all the depreciation occurs in the final year. With this assumption, the estimate of the capital stock in 1997 is completely independent of the assumed initial capital output ratio and depends only on the level of investment observed between 1984 and 1996. The initial level of capital turns out to be 2.26 times the level of GDP at market prices. In the dynamic simulations, we set depreciation in year $t$ at 8 percent of the capital stock, so that the transition equations at time $t$ depend only on the solution at time $t$-1.

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

a) By exogenous trends (labor force growth, productivity changes, capital stock growth, and population growth);

b) By economic behavior (distribution of investment by sector and distribution of labor force by sector and category); and

c) By implemented policies (changes in tariffs, import quotas, and FDI as a result of the implementation of CAFTA.

For the resulting dynamic model, we first do a forward simulation to 2020 to create what we call a base run, in which there are no CAFTA-related changes in exogenous variables. [8] We then run the model with various CAFTA policy alternatives and compare those results with the base run. Because we may not have completely captured important aspects of dynamic behavior or because of misspecifications in the model itself, we put less weight on the absolute values of our projects than we do on the comparison of the base run with the various CAFTA alternatives. In other words, we are less confident of the growth or employment forecasts of our base run or CAFTA alternatives than we are of the differences between them.

[8] For this exercise, we modified the transfers from the enterprises to the rest of the world in such a way that they were eliminated by the year 2005 in all the scenarios including the "base."

## IV. THE CAFTA SIMULATIONS

The dynamic model described in the previous section is recursive. It solves the system of equations for all the endogenous variables for each period and then updates variables either because they are endogenous in the model or because they are policy variables such as tariffs that change over time. In each of the simulations, we run the model from its 1997 base, using the observed values for all exogenous variables up to 2005, and then insert the changes introduced by CAFTA in 2005 and beyond. We run each simulation out to 2020 and present the results in the form of growth rates of all the endogenous variables of interest from the 1997 initial values. Each table displays the initial values for each variable and the annual average growth rate from 1997 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 against which each of the CAFTA simulations should be compared.

**Tariffcut1:** In this simulation, we change all the sectoral tariffs according to the time patterns shown in Table 4. 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 23-year average rate of growth.

**Maquila:** Textiles are an area of potentially large benefits but equally large and uncertain risks because of the expiration of the Multifiber Agreement in January 2005. In the past, (before 2000) in Central America maquila was almost entirely limited to the assembly of clothing from imported inputs. Since 1984, when the Caribbean Basin Economic Recovery Act was passed, the maquila industry has been exempt from the worldwide quota system then in force. But its products were not exempt from U.S. tariffs until the U.S. Congress passed the Caribbean Basin Economic Recovery Expansion Act in 1990. With the passage of the North American Free Trade Agreement (NAFTA) in 1994, this advantage was partially offset by the more generous treatment of Mexican producers with regard to rules of origin. The Caribbean Trade Promotion Act (CBTPA), passed in 2000, extended to the Central American countries the market access conditions for maquila granted to Mexico under NAFTA, with similar liberalized restrictions on rules of origin. Imports of knitted or shaped apparel were permitted into the United States free of tariffs, provided the intermediate inputs from the yarn up to the final good were produced in a CAFTA country.[9] 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 1997 prior to the passage of the CBTPA. Then starting in 2005, we reduce these intermediate imports to the very low levels observed after 2000. This simulation then shows

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

the positive effect of domestically producing a greater share of the intermediate inputs to the booming maquila industry.

**Quotas:** For imports into Honduras, certain commodities of particular importance to the poor, either as consumers or producers, are given special treatment under CAFTA. Tariffs for these commodities were typically quite high prior to CAFTA, and the rate of tariff reduction under CAFTA in most cases will be slow, as shown in Table 3. But CAFTA also established TRQs in many of these commodities, making liberalization faster than is apparent from the tariff category in which these commodities were placed. These are the commodities for which CAFTA could have a significant effect in the short run, since CAFTA will permit tariff-free imports up to certain quantitative limits 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 specifically from Honduras. We now look at the most important of these commodities and ask what the impact of the TRQs is likely to be in practice.

What is the effect of the Honduran 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 2006). If they are smaller, they are effectively a transfer of tariff revenue to the importer. In the Honduras case, yellow corn is the only product where the initial quota is bigger than the level of imports. But no yellow corn is produced in Honduras. For pork and chicken legs, the quota is approximately equal to the level of imports, but both are quite small relative to the level of production, which means that if there is a price effect it must be small. Therefore, in the quota simulation, we assume that these quotas have no effect on the domestic price of imports.

The other possible impact of the quota component of CAFTA is the favorable effect of liberalized quotas in the United States for certain Honduran exports. As in the import case, expanded quotas in the United States only affect the domestic price and production in Honduras for products for which the CAFTA quotas are larger than the current level of exports. That is the case for sugar, beef, and some dairy products. The value of the additional quota is equal to the U.S. tariff times the international price times the quantity of imports permitted into the U.S. market tariff-free. In addition, when the market-clearing domestic price of these commodities changes, the size of the change depends on the size of the liberalized quota, compared with the initial level of production. In fact, when we make this comparison, we find that the change in the domestic price of these commodities is virtually zero.[10] We have therefore not reported simulations for the quota changes in the sections that follow.

**Foreign direct investment (FDI):** It is relatively straightforward to model the impact of trade liberalization under CAFTA. But there are many additional items and agreements under CAFTA that have to do with the treatment of FDI. All are aimed at defining and protecting the rights of foreign investors with respect to the protection of intellectual property and expropriation. Many observers see these conditions 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 to the Honduran economy. Since no one has a very clear idea of just how much additional FDI Honduras can expect to receive under the new CAFTA legal conditions, as

[10] See Morley (2006) for details.

a first approximation, we simply increase by 25 percent the level of FDI that came into Honduras between 2000 and 2004 and keep that increase the same all the way to 2020. This gives rise to two effects. The first and less important one is the simple effect on balance of payments of an increased inflow of foreign resources. The second and more important effect is on total capital formation. These inflows go to capital formation. Therefore, in this simulation, we change our saving–investment closure to ensure that these inflows directly increase investment.

## V. RESULTS OF THE CGE SIMULATIONS

Our model projects that without CAFTA the Honduran economy would grow at a relatively slow rate of 3.1 percent per year from its 1997 base up to 2020, or at a slightly lower rate between 2005 and 2020 because of the large increases in the level of transfers between 1997 and 2005. The model reproduces quite well both the observed growth rate and fluctuations in it between 1997 and 2005, which gives us some confidence in the simulations of the effects of CAFTA. This low rate reflects three things: first, the relatively low rate of investment in the base year; second, the low rate of growth of observed productivity in the recent past; and third, the treatment of maquila. We assume no growth in productivity in any of the runs reported here. Lifting that assumption has little effect on the comparisons between the base run and the CAFTA alternatives.

Maquila requires further comment. One usually simulates the effect of a change from current conditions. The maquila case is different, however, because the favorable treatment for inputs to maquila started in 2000 but would have expired in 2008 in the absence of CAFTA. The baseline simulation is our best forecast of what the growth rate would be without maquila, while the maquila simulation forecasts growth if temporary benefits to maquila were made permanent. Without maquila, growth in Honduras is predicted to fall to 3.1 percent per year, whereas the growth rate jumps to 4.5 percent with the conversion of the benefits for maquila from temporary to permanent (Table 5).

Table 5

RATES OF GROWTH OF MACROECONOMIC AGGREGATES IN CAFTA SIMULATIONS

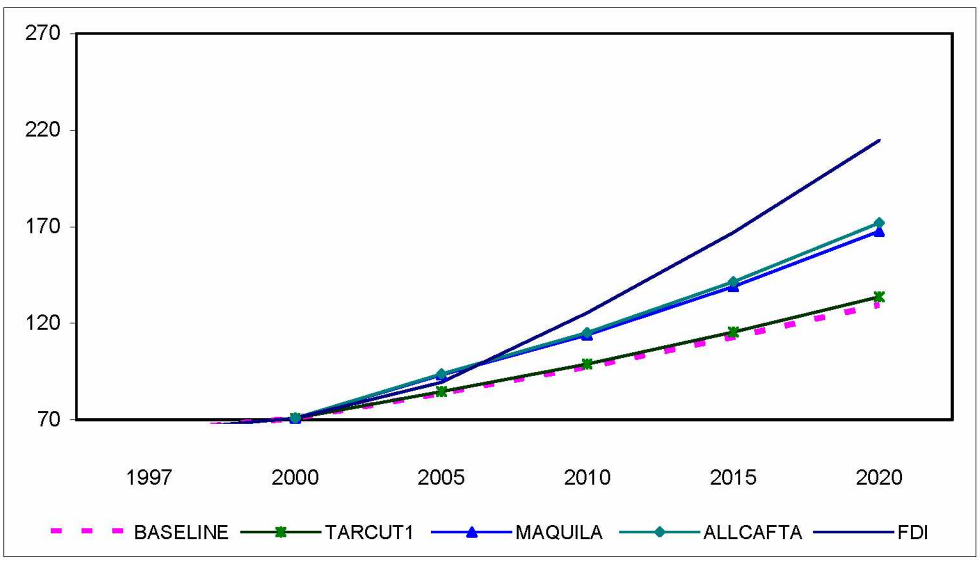
| | Initial value | Annual percentage growth rate (1997-2020) | | | | | |
|---|---|---|---|---|---|---|---|
| | 1997 a/ | Base | CAFTA | Maquila | Quotas | All CAFTA | FDI b/ |
| Absorption | 74.10 | 3.35 | 3.47 | 4.62 | 3.35 | 4.72 | 5.35 |
| Private consumption | 50.80 | 3.33 | 3.44 | 4.73 | 3.34 | 4.82 | 5.24 |
| Fixed Investment | 15.87 | 3.67 | 3.81 | 4.69 | 3.67 | 4.81 | 6.84 |
| Government consumption | 5.42 | 3.42 | 3.58 | 4.39 | 3.43 | 4.54 | |
| Exports | 28.06 | 2.40 | 2.64 | 3.40 | 2.40 | 3.60 | 5.04 |
| Imports | 32.00 | 3.22 | 3.40 | 3.98 | 3.23 | 4.13 | 5.29 |
| GDP (market price) | 70.17 | 3.06 | 3.19 | 4.46 | 3.06 | 4.57 | 5.26 |

Source: Authors' worksheets.
a/ In 1997 billion of lempiras.
b/ FDI is foreign direct investment.

In Figure 2, we show various projections of real GDP at market prices, starting in year 2000. The dashed line is the baseline showing our estimate of how Honduras will grow in the absence of CAFTA. The remaining lines show the effect of the CAFTA tariff cuts, the liberalization of rules of imports for maquila, and an increase in FDI. [11] Other than FDI and maquila, each of these effects is positive, but none of them is large, particularly tariff cuts and quotas. The tariff cuts, for example, while positive, add less than 0.02 percent to the overall growth rate. Higher tariff-free quotas for sugar, beef, and dairy in the United States are like a small foreign exchange windfall to the economy. While that windfall is positive, it also tends to cause the exchange rate to appreciate, discouraging exports and encouraging imports, both of which reduce the net positive impact of the quotas themselves.

**Figure 2**

**PROJECTIONS OF REAL GDP, 1997-2020**




Source: Authors' worksheets.

These results confirm what we should have expected. Past trade liberalization in Honduras reduced average tariffs to a level where the further reductions resulting from the CAFTA agreement simply are not large enough on average to have much of an impact. On sensitive products such as corn, beans, and rice, either the tariff reductions permitted by CAFTA are not large, or they are spread out over a long period. In either case, the net effect on the overall growth rate is small. This does not necessarily mean that the effect on particular sectors is not large.

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[11] We do not show the quota line on the graph because the effect is so small that the line is indistinguishable from the baseline projection.

Table 5 shows the rates of growth of the main macroeconomic aggregates in the different simulations, assuming that government saving is fixed and that productivity growth continues to be zero. [12] The last column on the right shows the combined effect of all of the changes other than FDI, while each of the other columns shows the separate effect of each of the changes. The table confirms what is implied in Figure 2. Tariff reductions and liberalization of quotas both have positive effects on growth, but the effects are very small. Trade liberalization does make the Honduran economy more open, increasing the rates of growth of both exports and imports, but the positive effect on the growth rate of GDP is small.

In contrast, the liberalized rules of origin for maquila do have a significant impact on the growth rate of the economy. CAFTA makes permanent the CBTPA rules of origin for the intermediate inputs for many lines of textile exports to the United States. In the simulation, we make permanent the sharp reductions in imported inputs to the maquila sector that were observed in Honduras after 2000 when the CBTPA went into effect. This alone raises the level of output in 2020 by about 38 percent relative to what it would have been in the baseline simulation. Maquila alone brings the growth rate up from 3.06 to 4.5 percent per year. Comparing the ALLCAFTA column in the table with the maquila column, we see that virtually the entire positive impact of CAFTA on the growth rate is due to maquila.

Several other growth patterns should be noted. First the rate of growth of domestic spending or absorption exceeds the growth rate of production in all the simulations, which implies that an increasing share of domestic spending is supplied by imports in the base line and in all the CAFTA simulations Since the rate of growth of exports is less than the growth rate of the economy, this implies an increase in the trade deficit. This pattern is misleading. In the base year 1997, there was a large negative transfer from Honduras enterprises to the rest of the world. This transfer was eliminated by 2005. In our simulation, we adjust the transfer account so that it follows the observed balance-of-payments data. That means that there is a large positive change in the transfer account, permitting a rapid increase in imports and a decline in exports up to 2005. After 2005, the trade deficit is assumed to be fixed in real terms. Since real income is rising, the trade deficit as a fraction of total income is falling. Using a 2005 base, exports grow at 4 percent and imports grow at only 2.6 percent in the base simulation. In fact, the rate of growth of exports exceeds that of both the economy and the rate of growth of imports after 2005 in all the simulations.

### 1. The impact of CAFTA on sectoral growth rates

The sectoral growth rates of trade and domestic production in Table 6 show that trade liberalization under CAFTA increases exports, imports, and production in both the primary and secondary sectors. The effects are all small but positive. Thus, despite the fears of some that the

[12] We also ran a set of simulations where we dropped the assumption of fixed government saving. This change had little impact on the results, which means that even though the loss of government revenue from tariffs is significant in an accounting sense, whether or not that loss is offset by an increase in other taxes or a higher government deficit makes little difference in the overall growth rate or the sectoral composition of output.

rise in imports due to falling trade barriers would more than offset any expansion in exports, our results suggest that this will not happen.

The sectoral effects of maquila are more complex. Liberalized rules of origin on intermediate inputs in maquila cause a big reduction in imports to the textile industry. On balance, one might expect the exchange rate to appreciate, causing exports to fall and imports to rise enough to offset the reduction in textile imports. But that is not what happens. Instead, there is a significant increase in national production, employment, and demand, which is large enough to require a depreciation of the exchange rate to induce more exports and choke off some of the demand for imports.[13] Effectively, the economy becomes slightly more closed by import substitution in the textile industry, and the resulting rise in employment increases demand and output in all other sectors.

Table 6

NATIONAL PRODUCTION AND TRADE

| | Initial share 1997 a/ | Annual percentage growth rate (1997-2020) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Base | CAFTA | Maquila | Quotas | All CAFTA | FDI |
| **Exports** | 100.00 | | | | | | |
| Agricultural sector | 26.53 | 1.96 | 2.23 | 2.64 | 1.96 | 2.86 | 5.01 |
| Primary sector | 29.18 | 1.97 | 2.26 | 2.63 | 1.97 | 2.86 | 5.01 |
| Minery | 2.65 | 2.08 | 2.54 | 2.55 | 2.08 | 2.91 | 5.09 |
| Secondary sector | 47.91 | 2.60 | 2.86 | 3.76 | 2.60 | 3.98 | 5.24 |
| Manufacturing sector | 47.85 | 2.60 | 2.86 | 3.76 | 2.60 | 3.98 | 5.24 |
| Food industry | 25.74 | 2.88 | 3.09 | 4.27 | 2.88 | 4.45 | 5.47 |
| **Imports** | 100.00 | | | | | | |
| Agricultural sector | 9.59 | 3.39 | 3.65 | 4.66 | 3.39 | 4.91 | 5.45 |
| Primary sector | 20.22 | 3.16 | 3.40 | 4.28 | 3.16 | 4.50 | 5.43 |
| Minery | 10.62 | 2.94 | 3.16 | 3.91 | 2.94 | 4.11 | 5.42 |
| Secondary sector | 39.68 | 3.23 | 3.45 | 3.44 | 3.24 | 3.62 | 5.35 |
| Manufacturing sector | 39.44 | 3.23 | 3.44 | 3.43 | 3.24 | 3.61 | 5.35 |
| Food industry | 0.00 | 3.57 | 3.64 | 4.64 | 3.58 | 4.71 | 5.61 |
| **Production** | 100.00 | | | | | | |
| Agricultural sector | 43.18 | 3.26 | 3.37 | 4.57 | 3.26 | 4.66 | 5.39 |
| Primary sector | 43.21 | 3.26 | 3.37 | 4.57 | 3.26 | 4.66 | 5.39 |
| Minery | 0.03 | 2.29 | 2.59 | 2.90 | 2.29 | 3.10 | 5.17 |
| Secondary sector | 19.72 | 3.08 | 3.24 | 4.21 | 3.08 | 4.35 | 5.39 |
| Manufacturing sector | 13.19 | 2.88 | 3.05 | 4.04 | 2.88 | 4.18 | 5.23 |
| Food industry | 4.88 | 3.14 | 3.30 | 4.43 | 3.14 | 4.57 | 5.51 |

Source: Authors' worksheets.
a/ Initial share of total exports, imports and production respectively.

[13] The import share rises from 40.7 percent in 2005 to 47.4 percent in 2020, and exports grow by 5.3 percent per year after 2005.

In Table 7 we show the effects of the different CAFTA simulations on production for all of the disaggregated sectors included in the CGE model. The full details of exports and imports by sector in the different experiments are relegated to Appendix 1, Table A1. Table 7 helps us to understand why the Honduran economy is relatively insensitive to CAFTA. Consider agriculture, CAFTA has a positive impact on exports and production of coffee, and bananas, but it has virtually no effect on the subsistence part of agriculture (that is, the production of corn, beans, rice, and other commodities produced by the poor). Since this subsistence sector comprises over 80 percent of total agricultural production in Honduras, agriculture as a whole is insensitive to CAFTA. Similarly, maquila has a large positive effect on textiles, but at the base level, production in textiles is not large enough to give the entire manufacturing sector a big push forward.

The fact that the tariff reductions and TRQs granted by Honduras under CAFTA do not cause significant price reductions in the short run does not mean that domestic producers will be unaffected by the agreement in the long run. In the long run, the level of protection for many important commodities will be eliminated. But the tariff reductions are gradual, which will give farmers time to adjust and to become more competitive. What will be critical from a policy perspective is that this time is used wisely to increase productivity, switch to more profitable crops, and take advantage of the new export opportunities opened up by CAFTA.

Table 7

PRODUCTION AND ANNUAL PERCENTAGE GROWTH RATES

| | | Annual percentage growth rate | | | | | |
|---|---|---|---|---|---|---|---|
| Sector | 1997 shr | Baseline | CAFTA | Maquila | Quotas | All CAFTA | FDI |
| Banana | 0.71 | 1.30 | 1.72 | 1.77 | 1.30 | 2.13 | 4.59 |
| Coffee | 1.20 | 2.23 | 2.51 | 2.97 | 2.23 | 3.21 | 6.83 |
| Mining | 0.03 | 2.29 | 2.59 | 2.90 | 2.29 | 3.10 | 6.02 |
| Livestock | 0.91 | 3.21 | 3.35 | 4.74 | 3.22 | 4.84 | 6.39 |
| Non-trad. Ag. | 6.94 | 2.81 | 2.93 | 3.86 | 2.81 | 3.95 | 6.15 |
| Subsist. Ag. | 33.44 | 3.41 | 3.52 | 4.79 | 3.41 | 4.88 | 6.41 |
| Food | 4.88 | 3.14 | 3.30 | 4.43 | 3.14 | 4.57 | 6.51 |
| Textiles | 2.13 | 2.96 | 3.08 | 4.51 | 2.97 | 4.61 | 6.23 |
| Paper | 1.33 | 2.51 | 2.65 | 3.31 | 2.52 | 3.42 | 6.03 |
| Chemicals | 1.83 | 2.63 | 2.78 | 3.58 | 2.63 | 3.69 | 5.41 |
| Metals | 1.14 | 2.99 | 3.12 | 3.95 | 2.99 | 4.05 | 6.23 |
| Other mfg | 1.88 | 2.50 | 2.85 | 3.33 | 2.50 | 3.63 | 5.95 |
| Elec, water | 1.72 | 2.93 | 3.10 | 4.09 | 2.93 | 4.23 | 6.1 |
| Construction | 4.81 | 3.63 | 3.78 | 4.68 | 3.63 | 4.81 | 7.09 |
| Commerce | 14.10 | 3.00 | 3.15 | 4.01 | 3.00 | 4.14 | 6.61 |
| Hotels | 2.94 | 2.76 | 2.92 | 4.57 | 2.77 | 4.67 | 5.94 |
| Transport | 4.53 | 2.94 | 3.15 | 3.76 | 2.94 | 3.93 | 6.64 |
| Finance | 3.08 | 2.87 | 3.00 | 3.76 | 2.87 | 3.87 | 6.02 |
| Personal svc | 1.19 | 3.01 | 3.14 | 3.97 | 3.01 | 4.09 | 6.15 |
| Government | 4.77 | 2.97 | 3.07 | 3.71 | 2.97 | 3.79 | 6.32 |
| Other svc | 6.46 | 3.02 | 3.13 | 3.91 | 3.02 | 4.01 | 6.33 |
| Total | 100.00 | | | | | | |

Source: Authors' worksheets.

## 2. Foreign direct investment

One of the main purposes of the CAFTA agreement is to attract more FDI to Central America by reducing or eliminating the risk of expropriation, or other unfavorable actions by national governments that specifically target foreign enterprises. These components of the agreement have elicited a good deal of unfavorable comment within Latin America because they appear to infringe on the sovereignty of host-country governments. Our purpose here is not to enter into this dispute but rather to make a rough estimate of the effects on the economy of these components of the agreement, assuming that they in fact succeed in attracting more FDI. This exercise is somewhat different from what we have done so far, because we have no observable econometric basis on which to make an estimate of the response of foreign investors to the new CAFTA incentives for FDI. In our FDI simulation, we assume an increase of 25 percent over the observed capital transfers to Honduras between 2000 and 2004. Furthermore, we make all of this increased FDI a net addition to domestic capital formation. In other words, here the saving–investment closure is investment driven.

Consider now what the FDI simulation tells us about the effect of additional inflows of FDI. Compare the FDI column in each of the Tables 5-7 with the base simulation. By assumption, we are both increasing total saving and forcing more of it into investment. As a result the share of investment in GDP in 2020 rises to 31.9 percent, compared with only 25.9 percent in the base run. That additional capital coupled with the additional employment it induces leads to dramatic increases in production in all sectors. Overall the growth rate of the economy jumps from 3.0 to 5.3 percent (see Figure 2 ). Instead of growing by 4.0 percent per year between 2005 and 2020, exports now grow at twice that rate (7.9 percent).

No one should take these results as a firm prediction of the likely effects of CAFTA on either FDI or growth. Rather it is a way of emphasizing the central importance of investment to future growth in Honduras under CAFTA. If the more favorable treatment of FDI really does bring in more foreign capital, and if that foreign capital is invested in new capital, this will have a dramatic positive effect on the development prospects of the Honduran economy.

## 3. CAFTA and domestic factor markets

Consider next the impact of CAFTA on wages, employment, and the rate of return to capital. The available data permit us to disaggregate labor by education, gender, and type of employment (wage versus self-employment). Unfortunately, they do not permit a rural–urban breakdown.[14] We have assumed that there is an excess supply of labor, both male and female with less than 10 years of education. That implies that the base-period level of real wages for these types of labor is fixed. The simulations then determine the amount of employment of unskilled or semi-skilled labor that is consistent with the supply of skilled labor and capital as well as the other macro constraints.

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[14] In a later paper, we will combine information from a recent household survey with the results reported here to get an estimate of the impact of CAFTA on rural and urban incomes.

The changes in employment of unskilled and semi-skilled labor by gender and labor type in the different simulations are presented in Table 8, while Table 9 shows what happens to relative wages. The numbers in the table 8 are units of employment normalized by total payments to each category of labor in the base year.

Unskilled and semi-skilled labor in Honduras is concentrated in self-employment in small farms in the countryside and in the informal sector in the cities and towns. In the baseline simulation, employment growth is slightly higher than the growth rate of the population (3.0 percent for male wage labor, 3.3 percent for male self-employed, and slightly less for females in each category. It is assumed that there is an excess supply of unskilled labor willing to work at the constant real wage. Under those conditions the increase in the supply of capital permits a relatively rapid increase in the employment of the unskilled, particularly in the FDI simulation. In all the simulations, the growth rate of employment is higher than the expected rate of growth in the supply of unskilled labor, which implies that in the absence of CAFTA or some other policy change, the pool of unemployed unskilled labor should fall in Honduras.

Trade liberalization by itself (TARCUT1 column) has a positive effect, but the total impact is small. That is consistent with the relatively small size of the production impacts under CAFTA. As before, what does make a difference is maquila. By 2020, maquila will create an additional 22 million units of employment for males and 4.3 million units for women, raising the growth of employment for both sexes to about 4.5 percent. Increased FDI also has a significant positive effect for male wage labor. That is because of the strong link between investment and the construction sector, which is a large employer of unskilled wage labor.

When one compares wage trajectories or wage differentials by skill category, the results suggest that there will be a slight rise in earnings inequality, with or without CAFTA (Table 9). The supply curve of skilled labor is projected to rise by 2 percent per year, somewhat 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. [15] Since wages for the unskilled and semi-skilled 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 the unskilled lose 12 percent in wages relative to the skilled. Trade liberalization makes the wage pyramid for the employed slightly less equal. That is because 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.

The maquila and FDI simulations accentuate this picture. Both of them increase the growth rate of the economy by a significant amount, and as we can see, the faster the economy grows, the faster wages of the skilled grow relative to the unskilled. That increases the inequality of earnings. But at the same time there is a higher rate of growth of employment for the unskilled

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[15] For the maquila and FDI simulations, we assume that the rate of growth of working-age skilled labor is 2.5 percent per year after 2010 to reflect increases in school attendance and higher levels of education in younger age cohorts. This makes the participation and unemployment rates consistent with the higher rates of growth of employment called for in these two simulations.

and semi-skilled of both sexes. The unskilled are better off because more of them have jobs, and the skilled are better off because all of them have higher real wages.

Table 8

EMPLOYMENT BY SKILL AND GENDER

| | Baseline | Tarcut1 | Maquila | Quota | All CAFTA | FDI |
|---|---|---|---|---|---|---|
| | Male unskilled and semiskilled wage labor | | | | | |
| Initial | 7 127 | 7 127 | 7 127 | 7 127 | 7 127 | 7 127 |
| 2000 | 7 711 | 7 711 | 7 711 | 7 711 | 7 711 | 7 852 |
| 2005 | 9 007 | 9 151 | 10 318 | 9.01 | 10 432 | 10 134 |
| 2010 | 10 423 | 10 682 | 12 592 | 10 427 | 12 831 | 13 707 |
| 2015 | 12 095 | 12 527 | 15 372 | 12 102 | 15 807 | 18.21 |
| 2020 | 13 925 | 14 551 | 18 612 | 13 935 | 19 293 | 23 399 |
| | Self-employment of unskilled and semi-skilled male labor | | | | | |
| Initial | 25 624 | 25 624 | 25 624 | 25 624 | 25 624 | 25 624 |
| 2000 | 30 165 | 30 165 | 30 165 | 30 165 | 30 165 | 28 817 |
| 2005 | 36.87 | 37 218 | 43.09 | 36 889 | 43 354 | 37 357 |
| 2010 | 41 838 | 42 458 | 51 301 | 41 862 | 51 843 | 50 633 |
| 2015 | 47 771 | 48 849 | 61 601 | 47 807 | 62 663 | 67 237 |
| 2020 | 54 213 | 55 852 | 73 475 | 54.26 | 75 261 | 86 381 |
| | Employment of female unskilled and semi-skilled wage labor | | | | | |
| Initial | 1 368 | 1 368 | 1 368 | 1 368 | 1 368 | 1 368 |
| 2000 | 1 458 | 1 458 | 1 458 | 1 458 | 1 458 | 1 461 |
| 2005 | 1 687 | 1 712 | 2 036 | 1 687 | 2 052 | 1 866 |
| 2010 | 1 966 | 2 012 | 2 535 | 1 966 | 2 576 | 2 585 |
| 2015 | 2 289 | 2 366 | 3 132 | 2.29 | 3 209 | 3 449 |
| 2020 | 2 642 | 2 754 | 3 834 | 2 644 | 3 957 | 4 453 |
| | Self-employment of female unskilled and semi-skilled labor | | | | | |
| Initial | 3 856 | 3 856 | 3 856 | 3 856 | 3 856 | 3 856 |
| 2000 | 4 332 | 4 332 | 4 332 | 4 332 | 4 332 | 4 337 |
| 2005 | 5 154 | 5 232 | 6 146 | 5 156 | 6 204 | 5 726 |
| 2010 | 5 897 | 6 035 | 7 461 | 5 899 | 7 591 | 7 657 |
| 2015 | 6 762 | 6 989 | 9 017 | 6 766 | 9 252 | 10 052 |
| 2020 | 7.71 | 8 034 | 10 841 | 7 716 | 11 207 | 12 824 |
| Skilled labor-male | | | | | | |
| Initial | 6 148 | 6 148 | 6 148 | 6 148 | 6 148 | 6 148 |
| 2000 | 6 482 | 6 482 | 6 482 | 6 482 | 6 482 | 6 553 |
| 2005 | 7 429 | 7 559 | 8 346 | 7.43 | 8 448 | 8 193 |
| 2010 | 8 629 | 8 852 | 10 156 | 8 632 | 10 351 | 11 112 |
| 2015 | 9.97 | 10 329 | 12 317 | 9 975 | 12 665 | 14 425 |
| 2020 | 11 399 | 11 911 | 14 747 | 11 406 | 15.28 | 18 126 |
| Skilled labor-female | | | | | | |
| Initial | 1 812 | 1 812 | 1 812 | 1 812 | 1 812 | 1 812 |
| 2000 | 1 935 | 1 935 | 1 935 | 1 935 | 1 935 | 1 933 |
| 2005 | 2 229 | 2 255 | 2 502 | 2.23 | 2 521 | 2 436 |
| 2010 | 2.58 | 2 628 | 3.04 | 2.58 | 3 085 | 3 319 |
| 2015 | 2 971 | 3 054 | 3 664 | 2 973 | 3 747 | 4 322 |
| 2020 | 3.39 | 3.51 | 4 371 | 3 392 | 4.5 | 5 447 |

Source: Authors' worksheets.
Note: These are normalized units of employment not numbers of jobs.

## 4. Capital

The growth of capital is central to understanding our projections of the likely effect of CAFTA on the economy. In Table 10, we show how the stock of capital is expected to grow over time and how the gross rate of return to capital changes in the different scenarios. In the baseline simulation, investment starts at 22.6 percent of GDP and grows to 26 percent by 2020. As a result, there is a slight deepening of capital as well as a slight reduction in the rate of return. Trade liberalization (TARCUT1) slightly raises both the growth rate of capital and the rate of return. However, the time path of the rate of return is not linear. In all the simulations it peaks in 2005. After that, the increased rate of capital formation drives the rate of return to capital back toward or below its initial level. Maquila has a big impact on the profitability of capital and its growth rate. Upon adoption of the liberalized rules of origin, which we first incorporate in the model in 2005, the rate of return to capital jumps from 10 to 15 percent. From 2005 to 2020, the rate of growth of capital increases to 4.5 percent per year. That is enough to bring the rate of return back toward its initial level, but at much higher levels of employment for the unskilled and higher wages for the skilled.

Table 9

RELATIVE REAL WAGES BY SKILL FOR HONDURAS IN THE CGE SCENARIOS

| | Initial | 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|---|
| Unskilled women | | | | | | |
| Baseline | 1 000 | 1 000 | 1 000 | 1 000 | 1 000 | 1 000 |
| Tarcut1 | 1 000 | 1 000 | 1 000 | 1 000 | 1 000 | 1 000 |
| Maquila | 1 000 | 1 000 | 1 000 | 1 000 | 1 000 | 1 000 |
| ALLCAFTA | 1 000 | 1 000 | 1 000 | 1 000 | 1 000 | 1 000 |
| FDI | 1 000 | 1 000 | 1 000 | 1 000 | 1 000 | 1 000 |
| Skilled women | | | | | | |
| Baseline | 1 000 | 1 009 | 1 037 | 1 070 | 1 102 | 1 132 |
| Tarcut1 | 1 000 | 1 009 | 1 040 | 1 074 | 1 109 | 1 141 |
| Maquila | 1 000 | 1 009 | 1 061 | 1 104 | 1 149 | 1 192 |
| ALLCAFTA | 1 000 | 1 009 | 1 063 | 1 109 | 1 155 | 1 200 |
| FDI | 1 000 | 1 012 | 1 060 | 1 129 | 1 190 | 1 246 |
| Unskilled men | | | | | | |
| Baseline | 1 000 | 1 000 | 1 000 | 1 000 | 1 000 | 1 000 |
| Tarcut1 | 1 000 | 1 000 | 1 000 | 1 000 | 1 000 | 1 000 |
| Maquila | 1 000 | 1 000 | 1 000 | 1 000 | 1 000 | 1 000 |
| ALLCAFTA | 1 000 | 1 000 | 1 000 | 1 000 | 1 000 | 1 000 |
| FDI | 1 000 | 1 000 | 1 000 | 1 000 | 1 000 | 1 000 |
| Skilled men | | | | | | |
| Baseline | 1 000 | 1 009 | 1 037 | 1 070 | 1 102 | 1 132 |
| Tarcut1 | 1 000 | 1 009 | 1 040 | 1 074 | 1 109 | 1 141 |
| Maquila | 1 000 | 1 009 | 1 061 | 1 104 | 1 149 | 1 192 |
| ALLCAFTA | 1 000 | 1 009 | 1 063 | 1 109 | 1 155 | 1 200 |
| FDI | 1 000 | 1 009 | 1 053 | 1 123 | 1 183 | 1 239 |

Source: Authors' worksheets.

The FDI simulation shows what happens when there is a really rapid rate of capital formation. Not only does the rate of growth of the economy increase, but the rate of capital deepening increases. Not surprisingly, the rate of capital formation is so high that it drives down the rate of return to below its level in year 2000.

Table 10

THE SUPPLY AND RETURN TO CAPITAL

| | Supply of capital | | | | | |
|---|---|---|---|---|---|---|
| | Initial | 2000 | 2005 | 2010 | 2015 | 2020 |
| Baseline | 158.88 | 165 951 | 190 374 | 229 282 | 272 740 | 319 541 |
| Tarcut1 | 158.88 | 165 951 | 190 374 | 230 238 | 275 570 | 325 316 |
| Maquila | 158.88 | 165 951 | 190 374 | 240 576 | 301 310 | 370 903 |
| Allcafta | 158.88 | 165 951 | 190 374 | 241 407 | 304 067 | 376 942 |
| FDI | 158.88 | 165 951 | 212 745 | 320 673 | 436 536 | 569 130 |
| | Rate of return to capital | | | | | |
| Baseline | 0.3 | 0.113 | 0.118 | 0.108 | 0.103 | 0.099 |
| Tarcut1 | 0.3 | 0.113 | 0.123 | 0.113 | 0.108 | 0.105 |
| Maquila | 0.3 | 0.113 | 0.159 | 0.144 | 0.137 | 0.133 |
| Allcafta | 0.3 | 0.113 | 0.163 | 0.149 | 0.143 | 0.138 |
| FDI | 0.3 | 0.122 | 0.126 | 0.097 | 0.092 | 0.088 |

Source: Authors' worksheets.

## 5. Factor shares

To better understand the distributional implications of CAFTA, it is useful to look at what happens to factor shares in the various experiments. We know that trade liberalization, maquila, and FDI all increase the growth rate of the economy. We know also that the skilled get higher wages, capital a higher rate of return, and the unskilled, more jobs. How does all this translate into shares of GDP? Table 11 gives us the answers. In the baseline simulation, both skilled and unskilled labor gain relative to capital for which the fall in the rate of return exceeds the increase in capital intensity. In the short run, CAFTA benefits capital at the expense of both skilled and unskilled labor. In all the simulations in 2005, the capital share rises relative to the baseline, especially in maquila and FDI. But that is not the end of the story. We know that there is a big increase in capital formation, too. That drives down the rate of return in all the simulations, so that by 2020 the share of capital falls from its peak in 2005 and is in fact below its initial level in all of the experiments except maquila. [16] Thus while CAFTA favors capital in the short run, in the longer run (to 2020) trade liberalization favors skilled labor at the expense of capital, while maquila favors capital at the expense of unskilled labor, which tells us that the rate of growth of employment of the unskilled, even though quite large, is not as rapid as the growth rate of the economy. In FDI, the situation is reversed. Here the decline in the profit rate after 2005 and the

[16] Note that the experiment called ALLCAFTA is dominated by maquila.

increase in employment are so rapid that both skilled and unskilled labor gain at the expense of capital.

Table 11

FACTOR SHARES AS PERCENTAGE OF GDP AT FACTOR COST

| | | Initial | 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|---|---|
| Unsk+semiskilled | Baseline | 0.59 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 |
| Labor | Tarcut1 | 0.59 | 0.60 | 0.60 | 0.60 | 0.60 | 0.59 |
| | Maquila | 0.59 | 0.60 | 0.58 | 0.58 | 0.58 | 0.58 |
| | Quota | 0.59 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 |
| | Allcafta | 0.59 | 0.60 | 0.57 | 0.58 | 0.57 | 0.57 |
| | FDI | 0.59 | 0.58 | 0.56 | 0.59 | 0.60 | 0.60 |
| Skilled labor | Baseline | 0.12 | 0.12 | 0.11 | 0.12 | 0.12 | 0.13 |
| | Tarcut1 | 0.12 | 0.12 | 0.11 | 0.12 | 0.13 | 0.13 |
| | Maquila | 0.12 | 0.12 | 0.11 | 0.11 | 0.12 | 0.12 |
| | Quota | 0.12 | 0.12 | 0.11 | 0.12 | 0.12 | 0.13 |
| | Allcafta | 0.12 | 0.12 | 0.11 | 0.12 | 0.12 | 0.12 |
| | FDI | 0.12 | 0.12 | 0.11 | 0.13 | 0.14 | 0.14 |
| Capital | Baseline | 0.28 | 0.29 | 0.28 | 0.28 | 0.27 | 0.27 |
| | Tarcut1 | 0.28 | 0.29 | 0.29 | 0.28 | 0.28 | 0.28 |
| | Maquila | 0.28 | 0.29 | 0.31 | 0.30 | 0.30 | 0.30 |
| | Quota | 0.28 | 0.29 | 0.28 | 0.28 | 0.27 | 0.27 |
| | Allcafta | 0.28 | 0.29 | 0.32 | 0.31 | 0.31 | 0.30 |
| | FDI | 0.28 | 0.31 | 0.32 | 0.28 | 0.27 | 0.26 |

Source: Authors' worksheets.

## VI. CAFTA AND GROWTH DYNAMICS IN HONDURAS

Honduras has been stuck on a slow growth trajectory for many years. The results here suggest that CAFTA will not do much to change that unless it leads to a significant increase in capital accumulation. The trade liberalization measures contained in the agreement do have a positive effect on growth and employment, but the effect is small. As a result of trade liberalization in the 1990s, tariff barriers simply are not high enough to have a large impact on growth when they are dismantled.

What are these CGE results telling us about growth dynamics and a growth strategy for Honduras? In this study, Honduras is treated as an economy constrained by the available supply of skilled labor and capital. The country can obtain higher levels of output or higher growth rates or both by shifting factors of production to more productive uses, by employing more of the excess potential supply of unskilled labor, or by raising the rate of capital accumulation or human capital formation. Except for the FDI scenario, we did not change the rate of capital accumulation. Our tariff-cut scenario tells us that the impact of shifting scarce factors between sectors in response to changes in tariffs does not produce much additional growth, either because the levels of protection prior to CAFTA were not large or because the allocation of capital and skilled labor was already close to optimal. In a word, there is not too much to be gained by eliminating Harberger triangles.

Maquila is different. It shifts some of the total supply of human and physical capital to a sector with a relatively high demand for unskilled labor, which increases the growth rate even with a constant total supply of capital. That is because it puts more of the potential but unused supply of unskilled labor to work. Productivity-enhancing investments in agriculture might well do the same thing. Indeed any growth strategy that increases the demand for unskilled labor, holding constant the supply of complementary factors, would increase output and growth.

The FDI scenario reminds us of how large an impact can be obtained by increasing the growth rate of capital in the economy. If FDI really does increase in response to CAFTA to the degree that we assume in our CAFTA experiment, the impact on the Honduran economy will be dramatic. Both economic growth and employment of the unskilled could double. While this is undoubtedly an overly optimistic projection, it does point to the critical role of increasing the rate of capital formation and technical progress in the Honduran economy. From a growth perspective, the crucial challenge for Honduras is to create condtions that will attract more capital, both domestic and foreign.

CAFTA improves employment prospects for the unskilled. Our simulations assume an excess supply of unskilled labor. In all the CAFTA simulations, job creation is positive, small in the case of trade liberalization but substantial for maquila and FDI. At the same time, since there is an increase in the demand for skilled labor, wage inequality increases. Thus CAFTA increases the earnings of both skilled and unskilled labor. The unskilled are better off because more of them have jobs, and the skilled are better off because all of them have higher real wages. We look more closely at the distributional implications of CAFTA in the next section.

In the short run, CAFTA benefits capital at the expense of both skilled and unskilled labor. In all the simulations in 2005 the capital share rises relative to the baseline, especially in maquila and FDI. But that is not the end of the story. It turns out that in the longer run, increases in capital formation drive down the rate of return, so that by 2020 the share of profits in GDP is below its initial level in all but the maquila experiments. In the long run trade liberalization favors skilled labor at the expense of capital, while maquila favors capital at the expense of unskilled labor. For FDI, the decline in the profit rate after 2005 and the increase in employment of the unskilled is so rapid that both skilled and unskilled labor gain at the expense of capital.

## VII. THE IMPACT OF CAFTA ON POVERTY AND THE DISTRIBUTION OF INCOME

Our dynamic CGE model estimates the effect that CAFTA will have on employment, production, and income. What implications do 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. That is, the CGE provides information about employment creation and wages for individuals, whereas individuals must be treated as members of households for distributional and poverty purposes. Thus if the CGE tells us that a certain number of additional jobs have been created, we have to decide which formerly unemployed individuals will get those jobs and which families they come from. The same problem 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 share of the labor force that is skilled. We then need a way of deciding which members of which families have upgraded their skills.

Following a microsimulation methodology developed by Vos and Paes de Barros, [17] we use a household survey as close as possible to the base year of the CGE to get a base-period distribution of the labor force across the households represented in the survey. First, the labor force is divided among the various skills represented in the CGE model, and rates of unemployment for each are calculated. Second, random numbers are assigned to the group, which will shrink in size, and that group is ranked according to random numbers. 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. Third, working with the newly simulated labor force by type, we repeat the procedure to change the skill or sectoral composition of that labor force. Finally, the wage of the newly composed labor force 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.

Two things about this procedure should be noted. First, the selection of individuals to be moved from one labor category to another is entirely random, not based on any behavioral model. This is not entirely 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. Second, the solution we are proposing is sequential. That is, we start with unemployment, adjusting it to obtain a new labor force determined by the CGE model; then we change the sector and skill level of that new labor force and 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.

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[17] See their description of the method in Vos, Taylor and Paes de Barros (2002).

### 1. Results of the microsimulations

For an overview of the results of the microsimulations, we show various poverty and distribution statistics for the baseline and each of the four alternate scenarios reported in previous sections of this paper (Table 12). Starting from the 2004 base determined by a household survey from that year, we do microsimulations for the years 2010, 2015, and 2020, of which only the first and last are reported in the table. The table reports average labor and per capita income, distribution statistics, and the three Foster, Greer and Thorbecke (FGT) poverty measures (the poverty index, the poverty gap and the severity of poverty) for both extreme and moderate poverty. The two poverty lines are calculated by ECLAC on the basis of national household surveys, adjusted by changes in the cost of living between 2002 and 2004. [18] Standard errors and confidence intervals for the key poverty and distribution statistics for each of the simulations for year 2020 are reported in table 13.

In the baseline scenario, without CAFTA, the model predicts that poverty will fall from 70 percent in 2004 to 66.4 in 2020, with slightly larger percentage reductions in extreme poverty and the poverty gap and slightly larger improvements for the urban poor than for the rural poor (Table 12). All of these changes are significant (Table 13). According to the simulations, per capita income is expected to rise by 0.7 percent per year, which implies that poverty elasticity in this baseline scenario is only –0.5. Growth does help the poor but not as much as it does in many other countries.

Because of the increase in relative wages for the skilled and the faster rate of growth in the urban sector, there is a slight increase in income inequality. The changes are small and they are largely confined to the urban sector.

To consider the effect of CAFTA on poverty and inequality, we compare the figures for 2020 for each of the CAFTA scenarios with those of the base line for that year. According to the model, CAFTA unambiguously helps the poor, both rural and urban—an important result. Tariff cuts alone reduce the national poverty incidence—rural and urban—by roughly 1.0 percentage point. They also appear to reduce extreme poverty more in the rural than in the urban sector, with the incidence of rural extreme poverty falling by 1.5 percentage points, compared with only 1.0 percentage point in the urban sector. All of these changes are statistically significant (Table 13).

This result may seem surprising, particularly since protection in agriculture is reduced under CAFTA. The poor gain because the growth rates of both employment and income are projected to be higher under CAFTA than without it. And while it is true that protection for agriculture falls under CAFTA, there are two points to keep in mind. First, protection of sensitive products like corn, beans, and rice is reduced very slowly. Second, the reductions in tariffs permit expansions elsewhere that more than offset whatever negative effects CAFTA may have in particular subsectors.

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[18] For the urban sector, the poverty and extreme poverty lines are equal to $88 and $42 in US dollars. For the rural sector, the two lines are $55 and $28. All of these are relatively high lines by the standards of countries at the Honduras level of development.

Not only does the tariff reduction under CAFTA help the poor, it also slightly improves the distribution of income. Compare the Theil coefficients in 2020 in the baseline and tariff-cut scenarios. The Gini coefficient appears to be unchanged, but the Theil, which gives more weight to the bottom of the distribution, goes down by two points in the rural sector and one in the urban. Both changes are statistically significant. This is an important and somewhat surprising result. Recall that in the tariff-cut scenario the rate of growth of skilled employment increases slightly over the baseline and so does the relative wage of the skilled. 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, adding the wages of formerly unemployed, unskilled workers to the ranks of the employed makes a sufficient difference at the bottom of the income pyramid to more than offset the absolute gains in employment and wages for the skilled.

The continuation of special market-access conditions for the maquila industry under CAFTA is even more favorable for the poor than the tariff reductions under CAFTA. Compare the MAQUILA column for 2020 in Table 12 with either the BASELINE or TARCUT columns. At the national level, poverty falls by a remarkable 7 percentage points relative to the baseline and 6 percentage points relative to tariff cuts. Even though the maquila industry is mainly an urban activity, poverty actually declines further in the rural sector than it does in the urban. This is because the additional employment and income generated in this sector increases the demand for agricultural commodities produced by the poor just as much as it does for items produced in the cities.

The effects on the distribution of household income in the maquila scenario illustrate the progressive impact of this industry on the Honduran economy. The distribution of labor income does not change much because rising skill differentials for the skilled in the urban sector just about offset gains by the unskilled in the rural sector. But when we look at the change in distribution of family income, the picture is entirely different. There the additional income generated by job growth, particularly for the unskilled, drives the national Gini down from 0.65 to 0.62 and the Theil, from 1.02 to 0.94, and both changes are statistically significant. And as a closer look at the urban and rural distribution data shows, the favorable impact of maquila is actually greater in the rural sector than in the urban.

The reason for these favorable results is job creation, particularly for unskilled women. Employment growth overall in the maquila simulation rises from 2.7 percent in the baseline to 3.7 percent. For unskilled women, the growth rate rises from 2.8 to 4.0 percent. This is the rare case of a growth and employment trajectory led by unskilled labor. It underlines the general point that the most effective way to reduce poverty is through job creation. If the leading sectors are themselves big employers of the unskilled, as maquila is, the result is all the more favorable for the poor.

Table 12

CHANGES IN POVERTY AND DISTRIBUTION UNDER CAFTA

| | 2004 | 2010 | | | | | 2020 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Baseline | Tarcut1 | Maquila | All CAFTA | FDI | Baseline | Tarcut1 | Maquila | Allcafta | FDI |
| **National** | | | | | | | | | | | |
| Labor income | 3 349.1 | 3 402.9 | 3 405.1 | 3 406.4 | 3 409.4 | 3 431.6 | 3 469.5 | 3 477.4 | 3 463.9 | 3 470.4 | 3 449.3 |
| Theil - labor income | 0.93 | 0.95 | 0.95 | 0.94 | 0.94 | 0.94 | 0.96 | 0.96 | 0.95 | 0.95 | 0.95 |
| Gini - labor income | 0.63 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 |
| Per capita Hh income | 1 643.7 | 1 715.1 | 1 728.9 | 1 811.8 | 1 828.3 | 2 065.2 | 1 833.3 | 1 880.9 | 2 115.0 | 2 165.0 | 2 602.6 |
| Poverty incidence | 70.07% | 68.79% | 68.47% | 66.16% | 65.80% | 59.76% | 66.38% | 65.33% | 59.10% | 57.99% | 50.84% |
| Poverty gap | 40.68% | 39.35% | 39.03% | 36.83% | 36.48% | 30.99% | 37.13% | 36.08% | 30.38% | 29.48% | 24.35% |
| Poverty severity | 28.77% | 27.60% | 27.33% | 25.40% | 25.09% | 20.47% | 25.67% | 24.76% | 19.95% | 19.25% | 15.28% |
| Ext poverty incidence | 45.27% | 43.75% | 43.37% | 40.60% | 40.20% | 33.41% | 40.90% | 39.71% | 32.62% | 31.50% | 25.46% |
| Ext poverty gap | 23.81% | 22.69% | 22.42% | 20.56% | 20.26% | 15.91% | 20.83% | 19.95% | 15.41% | 14.78% | 11.29% |
| Ext poverty severity | 16.08% | 15.21% | 15.00% | 13.57% | 13.35% | 10.10% | 13.79% | 13.12% | 9.75% | 9.31% | 6.85% |
| Theil - per capita HH income | 1.03 | 1.03 | 1.02 | 0.99 | 0.99 | 0.93 | 1.02 | 1.01 | 0.94 | 0.93 | 1.02 |
| Gini - per capita HH income | 0.65 | 0.65 | 0.65 | 0.64 | 0.64 | 0.62 | 0.65 | 0.65 | 0.62 | 0.62 | 0.63 |
| **Rural** | | | | | | | | | | | |
| Labor income | 1 879.3 | 1 910.4 | 1 915.3 | 1 952.6 | 1 959.9 | 2048.0 | 1 957.3 | 1 973.8 | 2 061.5 | 2 072.4 | 2 129.4 |
| Theil - labor income | 1.01 | 1.00 | 1.00 | 0.98 | 0.98 | 0.94 | 0.99 | 0.99 | 0.94 | 0.94 | 0.91 |
| Gini - labor income | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.63 | 0.64 | 0.64 | 0.63 | 0.63 | 0.63 |
| Per capita Hh income | 879.6 | 916.2 | 923.5 | 977.5 | 990.7 | 1142.0 | 980.5 | 1 008.5 | 1 170.1 | 1 200.3 | 1 467.8 |
| Poverty incidence | 79.54% | 78.32% | 78.03% | 75.66% | 75.15% | 68.91% | 75.88% | 74.85% | 68.06% | 66.80% | 59.20% |
| Poverty gap | 50.20% | 48.65% | 48.34% | 45.79% | 45.21% | 38.75% | 46.01% | 44.79% | 37.85% | 36.76% | 30.65% |
| Poverty severity | 37.02% | 35.58% | 35.29% | 32.95% | 32.44% | 26.72% | 33.15% | 32.05% | 25.93% | 25.03% | 20.03% |
| Ext poverty incidence | 59.54% | 57.76% | 57.38% | 54.16% | 53.49% | 45.26% | 54.24% | 52.87% | 44.08% | 42.70% | 35.12% |
| Ext poverty gap | 33.17% | 31.69% | 31.39% | 28.99% | 28.46% | 22.74% | 29.20% | 28.06% | 21.93% | 21.07% | 16.27% |
| Ext poverty severity | 22.74% | 21.56% | 21.32% | 19.44% | 19.04% | 14.67% | 19.62% | 18.73% | 14.09% | 13.46% | 10.01% |
| Theil - per capita HH income | 0.99 | 0.98 | 0.97 | 0.93 | 0.92 | 0.83 | 0.95 | 0.93 | 0.83 | 0.82 | 0.89 |
| Gini - per capita HH income | 0.63 | 0.63 | 0.63 | 0.62 | 0.62 | 0.59 | 0.62 | 0.62 | 0.59 | 0.59 | 0.59 |

/Continued

Table 12 (Concluded)

| | 2004 | 2010 | | | | | 2020 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Baseline | Tarcut1 | Maquila | All CAFTA | FDI | Baseline | Tarcut1 | Maquila | Allcafta | FDI |
| **Urban** | | | | | | | | | | | |
| Labor income | 4 779.9 | 4 847.5 | 4 841.2 | 4 793.3 | 4 800.4 | 4 732.0 | 4 923.6 | 4 915.6 | 4 790.7 | 4 791.5 | 4 687.5 |
| Theil - labor income | 0.74 | 0.76 | 0.76 | 0.77 | 0.77 | 0.79 | 0.79 | 0.79 | 0.82 | 0.82 | 0.84 |
| Gini - labor income | 0.58 | 0.58 | 0.58 | 0.59 | 0.59 | 0.60 | 0.59 | 0.59 | 0.60 | 0.60 | 0.61 |
| Per capita Hh income | 2462.7 | 2 571.4 | 2 592.2 | 2 706.1 | 2 726.3 | 3 054.8 | 2 747.5 | 2 816.2 | 3 128.0 | 3 199.1 | 3 819.1 |
| Poverty incidence | 59.90% | 58.55% | 58.20% | 55.96% | 55.76% | 49.93% | 56.16% | 55.10% | 49.47% | 48.53% | 41.86% |
| Poverty gap | 30.45% | 29.36% | 29.03% | 27.20% | 27.10% | 22.66% | 27.59% | 26.72% | 22.35% | 21.66% | 17.60% |
| Poverty severity | 19.91% | 19.03% | 18.77% | 17.29% | 17.21% | 13.76% | 17.64% | 16.93% | 13.53% | 13.03% | 10.17% |
| Ext poverty incidence | 29.94% | 28.70% | 28.31% | 26.03% | 25.93% | 20.69% | 26.57% | 25.57% | 20.30% | 19.48% | 15.08% |
| Ext poverty gap | 13.76% | 13.02% | 12.79% | 11.51% | 11.44% | 8.58% | 11.84% | 11.23% | 8.41% | 8.03% | 5.94% |
| Ext poverty severity | 8.93% | 8.39% | 8.21% | 7.27% | 7.23% | 5.19% | 7.54% | 7.09% | 5.09% | 4.85% | 3.47% |
| Theil - per capita HH income | 0.88 | 0.88 | 0.87 | 0.85 | 0.86 | 0.82 | 0.88 | 0.87 | 0.83 | 0.83 | 0.92 |
| Gini - per capita HH income | 0.60 | 0.60 | 0.60 | 0.59 | 0.59 | 0.58 | 0.60 | 0.60 | 0.58 | 0.58 | 0.59 |

Source: Authors' worksheets.

Table 13

STANDARD ERRORS AND CONFIDENCE INTERVALS FOR POVERTY AND DISTRIBUTION ESTIMATES IN 2020

| | Baseline-2020 | | | Tarcut1-2020 | | | Maquila-2020 | | | All Cafta-2020 | | | FDI--2020 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | 95% conf. interval | | Mean | 95% conf. interval | | Mean | 95% conf .interval | | Mean | 95% conf. interval | | Mean | 95% conf. interval | |
| **National** | | | | | | | | | | | | | | | |
| Labor income | 3 469.5 | 3 469.1 | 3 469.8 | 3 477.4 | 3 477.1 | 3477.7 | 3 463.9 | 3 463.6 | 3 464.2 | 3 470.4 | 3 470.1 | 3 470.6 | 3 449.3 | 3 449.0 | 3 449.5 |
| Theil - labor income | 0.963 | 0.963 | 0.963 | 0.963 | 0.963 | 0.963 | 0.954 | 0.954 | 0.954 | 0.954 | 0.954 | 0.954 | 0.947 | 0.947 | 0.947 |
| Gini - labor income | 0.640 | 0.640 | 0.640 | 0.641 | 0.641 | 0.641 | 0.639 | 0.639 | 0.639 | 0.640 | 0.640 | 0.640 | 0.638 | 0.638 | 0.638 |
| Per capita Hh income | 1 833.3 | 1 833.1 | 1 833.4 | 1 880.9 | 1 880.8 | 1881.1 | 2 115.0 | 2 114.9 | 2 115.2 | 2 165.0 | 2 164.8 | 2 165.1 | 2 602.6 | 2 602.5 | 2 602.8 |
| Poverty incidence | 66.38% | 66.33% | 66.42% | 65.33% | 65.29% | 65.37% | 59.10% | 59.04% | 59.15% | 57.99% | 57.93% | 58.05% | 50.84% | 50.77% | 50.91% |
| Poverty gap | 37.13% | 37.11% | 37.15% | 36.08% | 36.05% | 36.11% | 30.38% | 30.35% | 30.41% | 29.48% | 29.44% | 29.51% | 24.35% | 24.32% | 24.39% |
| Poverty severity | 25.67% | 25.65% | 25.70% | 24.76% | 24.73% | 24.79% | 19.95% | 19.92% | 19.99% | 19.25% | 19.22% | 19.28% | 15.28% | 15.25% | 15.30% |
| Ext poverty incidence | 40.90% | 40.85% | 40.94% | 39.71% | 39.65% | 39.76% | 32.62% | 32.55% | 32.68% | 31.50% | 31.43% | 31.58% | 25.46% | 25.39% | 25.52% |
| Ext poverty gap | 20.83% | 20.80% | 20.85% | 19.95% | 19.92% | 19.98% | 15.41% | 15.37% | 15.45% | 14.78% | 14.75% | 14.82% | 11.29% | 11.26% | 11.32% |
| Ext poverty severity | 13.79% | 13.77% | 13.82% | 13.12% | 13.09% | 13.15% | 9.75% | 9.71% | 9.78% | 9.31% | 9.28% | 9.34% | 6.85% | 6.83% | 6.88% |
| Theil - per capita HH income | 1.019 | 1.018 | 1.019 | 1.009 | 1.009 | 1.010 | 0.940 | 0.940 | 0.941 | 0.934 | 0.933 | 0.934 | 1. 016 | 1.015 | 1.016 |
| Gini - per capita HH income | 0.648 | 0.648 | 0.648 | 0.645 | 0.645 | 0.645 | 0.625 | 0.625 | 0.625 | 0.623 | 0.623 | 0.623 | 0.628 | 0.628 | 0.628 |
| **Rural** | | | | | | | | | | | | | | | |
| Labor income | 1 957.3 | 1 954.7 | 1 959.8 | 1 973.8 | 1 971.1 | 1 976.5 | 2 061.5 | 2 058.7 | 2 064.4 | 2 072.4 | 2 069.4 | 2 075.4 | 2 129.4 | 2 125.8 | 2 132.9 |
| Theil - labor income | 0.994 | 0.992 | 0.996 | 0.986 | 0.984 | 0.988 | 0.943 | 0.941 | 0.945 | 0.937 | 0.934 | 0.939 | 0.911 | 0.909 | 0.913 |
| Gini - labor income | 0.642 | 0.642 | 0.642 | 0.641 | 0.641 | 0.641 | 0.635 | 0.634 | 0.635 | 0.634 | 0.633 | 0.634 | 0.629 | 0.629 | 0.630 |
| Per capita Hh income | 980.5 | 979.5 | 981.6 | 1 008.5 | 1 007.4 | 1 009.6 | 1 170.1 | 1 168.7 | 1 171.5 | 1 200.3 | 1 198.7 | 1 201.9 | 1 467.8 | 1 466.1 | 1 469.6 |
| Poverty incidence | 75.88% | 75.81% | 75.96% | 74.85% | 74.80% | 74.91% | 68.06% | 67.95% | 68.16% | 66.80% | 66.68% | 66.91% | 59.20% | 59.08% | 59.33% |
| Poverty gap | 46.01% | 45.96% | 46.06% | 44.79% | 44.74% | 44.84% | 37.85% | 37.79% | 37.92% | 36.76% | 36.69% | 36.83% | 30.65% | 30.59% | 30.70% |
| Poverty severity | 33.15% | 33.10% | 33.20% | 32.05% | 32.00% | 32.09% | 25.93% | 25.87% | 26.00% | 25.03% | 24.97% | 25.10% | 20.03% | 19.98% | 20.08% |
| Ext poverty incidence | 54.24% | 54.16% | 54.31% | 52.87% | 52.78% | 52.96% | 44.08% | 43.98% | 44.18% | 42.70% | 42.57% | 42.83% | 35.12% | 35.01% | 35.24% |
| Ext poverty gap | 29.20% | 29.14% | 29.25% | 28.06% | 28.01% | 28.12% | 21.93% | 21.86% | 22.01% | 21.07% | 21.00% | 21.14% | 16.27% | 16.21% | 16.33% |
| Ext poverty severity | 19.62% | 19.57% | 19.67% | 18.73% | 18.68% | 18.78% | 14.09% | 14.02% | 14.15% | 13.46% | 13.40% | 13.51% | 10.01% | 9.96% | 10.05% |
| Theil - per capita HH income | 0.949 | 0.948 | 0.951 | 0.934 | 0.932 | 0.935 | 0.833 | 0.831 | 0.834 | 0.820 | 0.819 | 0.822 | 0.889 | 0.888 | 0.890 |
| Gini - per capita HH income | 0.622 | 0.622 | 0.622 | 0.618 | 0.617 | 0.618 | 0.589 | 0.589 | 0.590 | 0.586 | 0.585 | 0.586 | 0.587 | 0.586 | 0.587 |

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Table 13 (Concluded)

| | Baseline-2020 | | | Tarcut1-2020 | | | Maquila-2020 | | | All Cafta-2020 | | | FDI-2020 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | 95% conf. interval | | Mean | 95% conf. interval | | Mean | 95% conf. interval | | Mean | 95% conf. Interval | | Mean | 95% conf. interval | |
| **Urban** | | | | | | | | | | | | | | | |
| Labor income | 4 923.6 | 4 921.1 | 4 926.1 | 4 915.6 | 4 912.8 | 4 918.4 | 4 790.7 | 4 787.8 | 4 793.7 | 4 791.5 | 4 788.4 | 4 794.6 | 4 687.5 | 4 684.0 | 4 691.0 |
| Theil - labor income | 0.788 | 0.787 | 0.789 | 0.794 | 0.793 | 0.794 | 0.817 | 0.816 | 0.818 | 0.821 | 0.820 | 0.822 | 0.836 | 0.835 | 0.837 |
| Gini - labor income | 0.593 | 0.592 | 0.593 | 0.595 | 0.595 | 0.595 | 0.603 | 0.603 | 0.604 | 0.605 | 0.605 | 0.605 | 0.610 | 0.609 | 0.610 |
| Per capita Hh income | 2 747.5 | 2 746.4 | 2 748.5 | 2 816.2 | 2 815.0 | 2 817.3 | 3 128.0 | 3 126.4 | 3 129.5 | 3 199.1 | 3 197.3 | 3 200.8 | 3 819.1 | 3 817.3 | 3 821.0 |
| Poverty incidence | 56.16% | 56.11% | 56.22% | 55.10% | 55.03% | 55.16% | 49.47% | 49.39% | 49.55% | 48.53% | 48.46% | 48.61% | 41.86% | 41.76% | 41.95% |
| Poverty gap | 27.59% | 27.56% | 27.62% | 26.72% | 26.69% | 26.75% | 22.35% | 22.30% | 22.39% | 21.66% | 21.61% | 21.70% | 17.60% | 17.55% | 17.64% |
| Poverty severity | 17.64% | 17.61% | 17.66% | 16.93% | 16.91% | 16.96% | 13.53% | 13.49% | 13.57% | 13.03% | 12.99% | 13.07% | 10.17% | 10.14% | 10.20% |
| Ext poverty incidence | 26.57% | 26.51% | 26.63% | 25.57% | 25.51% | 25.64% | 20.30% | 20.23% | 20.38% | 19.48% | 19.39% | 19.56% | 15.08% | 14.99% | 15.16% |
| Ext poverty gap | 11.84% | 11.81% | 11.87% | 11.23% | 11.20% | 11.26% | 8.41% | 8.36% | 8.45% | 8.03% | 7.99% | 8.07% | 5.94% | 5.90% | 5.97% |
| Ext poverty severity | 7.54% | 7.51% | 7.56% | 7.09% | 7.06% | 7.11% | 5.09% | 5.05% | 5.12% | 4.85% | 4.82% | 4.88% | 3.47% | 3.44% | 3.49% |
| Theil - per capita HH income | 0.878 | 0.877 | 0.879 | 0.872 | 0.871 | 0.872 | 0.828 | 0.828 | 0.829 | 0.825 | 0.824 | 0.826 | 0.921 | 0.920 | 0.921 |
| Gini - per capita HH income | 0.599 | 0.598 | 0.599 | 0.597 | 0.597 | 0.597 | 0.584 | 0.583 | 0.584 | 0.583 | 0.583 | 0.583 | 0.594 | 0.594 | 0.594 |

Source: Authors' worksheets.

There is, however, a problem of perception with respect to maquila. CAFTA does not actually change current conditions for the domestic textile industry. Rather it makes permanent the liberalized rules of origin enjoyed by the industry since 2000. In the popular mind that may not seem like much of a benefit, since the country already has it. But without CAFTA, the temporary benefits granted in 2000 will expire. Our results say that if that happened, growth would fall by 1.4 percent per year and employment for unskilled and semi-skilled labor would fall by 26 percent relative to what can be expected with CAFTA.[19] Although these are large effects, one must keep in mind that they do not take into account possible changes in external conditions due to the end of the Multifiber Agreement in 2005.

The next scenario, ALLCAFTA, applies both the CAFTA tariff cuts and maquila market access conditions at the same time. The results are approximately equal to the sum of the two scenarios considered separately. Tariff cuts alone reduce poverty by about 1 percentage point relative to the baseline. Adding those same tariff cuts to maquila reduces poverty by about 1 percentage point relative to what was achieved under maquila alone. We see the same favorable effect on the distribution statistics for household income; the national Theil falls by one point relative to maquila just as it did relative to the baseline in the TARCUT1 scenario.

The ALLCAFTA simulation is our best estimate of the effects that CAFTA is likely to have on poverty and the distribution of income.[20] If we compare the results of ALLCAFTA with those of MAQUILA, it is obvious that maquila is the part of the agreement that really makes a difference. Tariff cuts help. They are progressive and increase the rate of growth of employment slightly. Maquila is another story entirely. It generates a lot of employment, significantly reduces both moderate and extreme poverty levels in both the rural and urban sectors, and increases the overall growth rate of the economy. Of the total change in poverty in the ALLCAFTA simulation (8.4 percentage points) fully 87 percent comes from the maquila component, and only 13 percent from tariff cuts. Much attention has been focused on the effects of CAFTA tariff cuts on agriculture. Our results indicate that this focus misses the main favorable impact of the agreement—making permanent the favorable market access conditions of the CBTPA.

The FDI simulation, which we look at next, underlines the key point we have just made about the central role of employment creation in poverty reduction. Recall that in the FDI simulation, we ask what would happen if the CAFTA treatment of foreign direct investment did in fact result in an increased inflow of foreign funds linked to productive investments in the private sector. We repeat our earlier point that this simulation is purely speculative. We have no way of knowing whether foreign firms will react favorably to CAFTA. Instead we are interested in examining what the implications would be if they did respond favorably.

To do that, we assume that FDI increased by 25 percent over the level of observed capital transfers to Honduras between 2000 and 2004. But the really important part of this simulation is the assumption that all this additional foreign exchange is channeled into productive investment.

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[19] This percentage is the difference between total employment for the unskilled and semi-skilled male and female labor in 2020 in the maquila experiment, compared with the baseline in 2020.

[20] The FDI simulation, which we will examine next, is far more speculative, since it incorporates uncertain reactions of foreign investors to changes in the treatment of intellectual property rights and legal protections for foreign investment.

The results of this increase in capital formation are dramatic. In Table 12, we see that per capita income in 2020 in the FDI run is fully 41 percent higher than the base run, and even 20 percent higher than in the ALLCAFTA simulation. Growth rises to 5.3 percent, compared to 3.1 percent in the base run. All that additional growth and output mean more employment as well. With higher capital formation comes more employment, with the total number of jobs expanding at 5.8 percent per year, more than double the growth rate in the base run.

The results for poverty are as dramatic as those on employment and production. By 2020 the national poverty rate falls by 7 percentage points relative to the ALLCAFTA scenario and almost 16 points compared with the baseline. Because, by assumption, this additional capital is available to all sectors, rural and urban, FDI benefits both sectors and the extremely poor as well. This complements the earlier point that employment creation is a central element in sustainable poverty reduction. This simulation makes the point that the surest way to rapidly increase employment is through higher rates of capital formation. Indeed, the rate of job creation in this simulation is so high that whether it is feasible is unclear.

While increased FDI has a large positive impact on poverty, it also increases inequality, partly as a result of a rise in inequality in the urban sector more than offsetting a rise in equality in the rural sector. Overall, the Theil indicates that the distribution of labor income is almost constant, compared with the baseline scenario, while it actually improves slightly using the Gini. In the rural sector, the distribution of labor income is significantly more equitable in the FDI simulation than in the baseline, but just the opposite is true in the urban sector. These differences are accentuated by the profit component. The declining profit rate in the FDI simulation is more than offset by the very large increase in the total supply of capital and in the incomes of the holders of capital in the survey. This is particularly obvious if one compares the distributions of household income in the ALLCAFTA and FDI simulations. In the ALLCAFTA simulation, all the distribution statistics show equality increasing, reflecting higher employment growth led by the unskilled. In the FDI simulation, the rate of employment growth is even higher and is led by the unskilled. But in the Theil, there is a big increase in inequality in the household distribution, particularly at the national level, even though the distribution of wage income in the rural sector is actually more equal in the FDI than in the ALLCAFTA. That has to reflect the influence of returns to capital.

### 2. Decomposing the changes in poverty and distribution

The changes in poverty and distribution in Table 12 for the different scenarios are the result of changes in employment, in the skill composition of the employed labor force, and in relative wages. We can use the microsimulation methodology to get an idea of how important each of these changes is to the final observations in the table.

The microsimulation procedure used to derive the results in Table 12 is a way of estimating the poverty and distributional impact of the changes in the labor market, determined by a CGE equilibrium solution and including changes in unemployment, labor force structure, or skill composition and relative wages. Since these changes are made sequentially in the microsimulation, we can make a “quasi-decomposition” of the overall change in poverty or distribution, according to statistics calculated separately at each stage of the microsimulation. In other words, we can ask what the poverty or distribution level would be if the overall employment growth had stayed as it was in the CGE solution but with labor force structure and relative wages held constant. We can repeat this 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 (see Table 14). We call this a "quasi-decomposition" because one cannot build up to the final CGE solution in this way. The CGE is not asked to determine the rate of growth of total employment, holding the labor force structure constant. If it were, the overall rate of growth of employment would almost certainly 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 undertake 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.

There are three columns for each of the scenarios for the year 2020 in Table 14. The first, labeled E, gives the results from employment growth alone, holding both the skill composition (S) and relative wages (W) 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 2.7 percent per year between 2005 and 2020. That rate is applied to all the categories of labor used in the model. The microsimulation brings enough workers out of unemployment or inactivity to reach that rate and then assigns them the average wage observed in the base year for that particular type of labor.

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 12.

There are three main points to be gleaned from Table 14. First, the growth in total employment is far and away the most important driver of poverty reduction in all of the scenarios. Second, employment in each of the growth strategies, even maquila, is led by skilled labor. Third, despite the rise in the wage differential in favor of the better educated, poverty incidence is lower when we incorporate the higher differential into household income. We now discuss the evidence supporting these conclusions and the implications.

Table 14

DECOMPOSITION OF CAFTA EFFECTS IN 2020

| | 2004 | Baseline | | | Tarcut1 | | | Maquila | | | All CAFTA | | | FDI | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | E | S | W | E | S | W | E | S | W | E | S | W | E | S | W |
| **National** | | | | | | | | | | | | | | | | |
| Labor income | 3 349.1 | 3 358.9 | 3 376.2 | 3 469.5 | 3 357.2 | 3 378.8 | 3 477.4 | 3 341.1 | 3 344.2 | 3 463.9 | 3 341.4 | 3 345.6 | 3 470.4 | 3 315.6 | 3 291.1 | 3 449.3 |
| Theil - labor income | 0.93 | 0.93 | 0.93 | 0.96 | 0.92 | 0.93 | 0.96 | 0.91 | 0.91 | 0.95 | 0.91 | 0.91 | 0.95 | 0.89 | 0.89 | 0.95 |
| Gini - labor income | 0.63 | 0.63 | 0.63 | 0.64 | 0.63 | 0.63 | 0.64 | 0.63 | 0.63 | 0.64 | 0.63 | 0.63 | 0.64 | 0.63 | 0.62 | 0.64 |
| Per capita Hh income | 1 643.7 | 1 751.5 | 1 756.2 | 1 833.3 | 1 783.0 | 1 790.6 | 1 880.9 | 1 971.8 | 1 972.6 | 2 115.0 | 2 006.8 | 2 007.6 | 2 165.0 | 2 142.9 | 2 129.4 | 2 602.6 |
| Poverty incidence | 70.07% | 66.95% | 67.01% | 66.38% | 66.02% | 66.05% | 65.33% | 60.08% | 60.13% | 59.10% | 58.93% | 59.07% | 57.99% | 54.44% | 54.48% | 50.84% |
| Poverty gap | 40.68% | 37.45% | 37.55% | 37.13% | 36.49% | 36.59% | 36.08% | 31.03% | 31.08% | 30.38% | 30.12% | 30.24% | 29.48% | 26.46% | 26.45% | 24.35% |
| Poverty severity | 28.77% | 25.91% | 26.01% | 25.67% | 25.04% | 25.16% | 24.76% | 20.43% | 20.48% | 19.95% | 19.71% | 19.81% | 19.25% | 16.80% | 16.77% | 15.28% |
| Ext poverty incidence | 45.27% | 41.31% | 41.43% | 40.90% | 40.15% | 40.29% | 39.71% | 33.43% | 33.49% | 32.62% | 32.29% | 32.46% | 31.50% | 27.88% | 27.85% | 25.46% |
| Ext poverty gap | 23.81% | 21.02% | 21.13% | 20.83% | 20.17% | 20.30% | 19.95% | 15.82% | 15.87% | 15.41% | 15.17% | 15.27% | 14.78% | 12.55% | 12.51% | 11.29% |
| Ext poverty severity | 16.08% | 13.93% | 14.01% | 13.79% | 13.25% | 13.37% | 13.12% | 10.02% | 10.06% | 9.75% | 9.56% | 9.64% | 9.31% | 7.70% | 7.66% | 6.85% |
| Theil - per capita HH income | 1.03 | 0.98 | 0.98 | 1.02 | 0.96 | 0.96 | 1.01 | 0.87 | 0.87 | 0.94 | 0.86 | 0.86 | 0.93 | 0.80 | 0.79 | 1.02 |
| Gini - per capita HH income | 0.65 | 0.64 | 0.64 | 0.65 | 0.63 | 0.64 | 0.65 | 0.61 | 0.61 | 0.62 | 0.61 | 0.61 | 0.62 | 0.59 | 0.59 | 0.63 |
| **Rural** | | | | | | | | | | | | | | | | |
| Labor income | 1 879.3 | 1 945.0 | 1 942.9 | 1 957.3 | 1 957.9 | 1 958.7 | 1 973.8 | 2 045.6 | 2 043.3 | 2 061.5 | 2 054.7 | 2 053.6 | 2 072.4 | 2 107.8 | 2 105.4 | 2 129.4 |
| Theil - labor income | 1.01 | 0.98 | 0.98 | 0.99 | 0.97 | 0.97 | 0.99 | 0.93 | 0.93 | 0.94 | 0.92 | 0.92 | 0.94 | 0.89 | 0.89 | 0.91 |
| Gini - labor income | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.63 | 0.63 | 0.63 | 0.63 | 0.63 | 0.63 | 0.63 | 0.63 | 0.63 |
| Per capita Hh income | 879.6 | 955.6 | 953.2 | 980.5 | 975.8 | 975.3 | 1 008.5 | 1 115.4 | 1 115.2 | 1 170.1 | 1 137.1 | 1 138.9 | 1 200.3 | 1 247.5 | 1 246.1 | 1 467.8 |
| Poverty incidence | 79.54% | 76.14% | 76.29% | 75.88% | 75.22% | 75.31% | 74.85% | 68.81% | 68.78% | 68.06% | 67.61% | 67.58% | 66.80% | 62.45% | 62.51% | 59.20% |
| Poverty gap | 50.20% | 46.24% | 46.41% | 46.01% | 45.21% | 45.28% | 44.79% | 38.58% | 38.56% | 37.85% | 37.53% | 37.53% | 36.76% | 32.89% | 32.92% | 30.65% |
| Poverty severity | 37.02% | 33.36% | 33.52% | 33.15% | 32.39% | 32.48% | 32.05% | 26.55% | 26.53% | 25.93% | 25.67% | 25.68% | 25.03% | 21.82% | 21.83% | 20.03% |
| Ext poverty incidence | 59.54% | 54.67% | 54.82% | 54.24% | 53.46% | 53.49% | 52.87% | 45.10% | 45.07% | 44.08% | 43.74% | 43.82% | 42.70% | 37.95% | 38.06% | 35.12% |
| Ext poverty gap | 33.17% | 29.40% | 29.56% | 29.20% | 28.40% | 28.50% | 28.06% | 22.54% | 22.52% | 21.93% | 21.69% | 21.70% | 21.07% | 17.97% | 17.97% | 16.27% |
| Ext poverty severity | 22.74% | 19.77% | 19.91% | 19.62% | 18.96% | 19.08% | 18.73% | 14.54% | 14.52% | 14.09% | 13.91% | 13.92% | 13.46% | 11.21% | 11.18% | 10.01% |
| Theil - per capita HH income | 0.99 | 0.91 | 0.92 | 0.95 | 0.89 | 0.90 | 0.93 | 0.78 | 0.78 | 0.83 | 0.76 | 0.76 | 0.82 | 0.69 | 0.69 | 0.89 |
| Gini - per capita HH income | 0.63 | 0.62 | 0.62 | 0.62 | 0.61 | 0.61 | 0.62 | 0.58 | 0.58 | 0.59 | 0.57 | 0.58 | 0.59 | 0.55 | 0.55 | 0.59 |

/Continued

Table 14 (Concluded)

| | 2004 | Baseline | | | Tarcut1 | | | Maquila | | | All CAFTA | | | FDI | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | E | S | W | E | S | W | E | S | W | E | S | W | E | S | W |
| **Urban** | | | | | | | | | | | | | | | | |
| Labor income | 4 779.9 | 4 720.3 | 4 754.5 | 4 923.6 | 4 696.5 | 4 737.1 | 4 915.6 | 4 564.0 | 4 575.0 | 4 790.7 | 4 549.8 | 4 566.7 | 4 791.5 | 4 448.0 | 4 403.5 | 4 687.5 |
| Theil - labor income | 0.74 | 0.75 | 0.75 | 0.79 | 0.76 | 0.76 | 0.79 | 0.77 | 0.77 | 0.82 | 0.77 | 0.77 | 0.82 | 0.77 | 0.77 | 0.84 |
| Gini - labor income | 0.58 | 0.58 | 0.58 | 0.59 | 0.58 | 0.58 | 0.59 | 0.59 | 0.59 | 0.60 | 0.59 | 0.59 | 0.60 | 0.59 | 0.59 | 0.61 |
| Per capita Hh income | 2 462.7 | 2 604.6 | 2 616.9 | 2 747.5 | 2 648.3 | 2 664.5 | 2 816.2 | 2 889.8 | 2 891.6 | 3 128.0 | 2 939.0 | 2 938.9 | 3 199.1 | 3 102.7 | 3 076.3 | 3 819.1 |
| Poverty incidence | 59.90% | 57.07% | 57.04% | 56.16% | 56.14% | 56.10% | 55.10% | 50.70% | 50.84% | 49.47% | 49.60% | 49.93% | 48.53% | 45.85% | 45.86% | 41.86% |
| Poverty gap | 30.45% | 28.00% | 28.04% | 27.59% | 27.13% | 27.25% | 26.72% | 22.92% | 23.05% | 22.35% | 22.17% | 22.41% | 21.66% | 19.55% | 19.49% | 17.60% |
| Poverty severity | 19.91% | 17.90% | 17.94% | 17.64% | 17.15% | 17.29% | 16.93% | 13.86% | 13.98% | 13.53% | 13.31% | 13.51% | 13.03% | 11.41% | 11.33% | 10.17% |
| Ext poverty incidence | 29.94% | 26.96% | 27.05% | 26.57% | 25.87% | 26.10% | 25.57% | 20.89% | 21.06% | 20.30% | 19.99% | 20.26% | 19.48% | 17.07% | 16.89% | 15.08% |
| Ext poverty gap | 13.76% | 12.02% | 12.07% | 11.84% | 11.34% | 11.49% | 11.23% | 8.60% | 8.72% | 8.41% | 8.18% | 8.36% | 8.03% | 6.73% | 6.64% | 5.94% |
| Ext poverty severity | 8.93% | 7.65% | 7.67% | 7.54% | 7.11% | 7.24% | 7.09% | 5.16% | 5.26% | 5.09% | 4.89% | 5.04% | 4.85% | 3.94% | 3.88% | 3.47% |
| Theil - per capita HH income | 0.88 | 0.84 | 0.84 | 0.88 | 0.83 | 0.83 | 0.87 | 0.76 | 0.76 | 0.83 | 0.75 | 0.76 | 0.83 | 0.71 | 0.71 | 0.92 |
| Gini - per capita HH income | 0.60 | 0.59 | 0.59 | 0.60 | 0.58 | 0.59 | 0.60 | 0.57 | 0.57 | 0.58 | 0.56 | 0.56 | 0.58 | 0.55 | 0.55 | 0.59 |

Source: Authors' worksheets.

Consider the employment effect first. To see how big a component of the total change in poverty it is, compare the change in poverty between 2004 and the column labeled E with the total change between 2004 and column W for each scenario. For example, in the tariff-cut scenario, national poverty falls from 70.1 percent in 2004 to 66.0 percent in 2020 just from employment creation, holding skill structure and relative wages constant. When we allow both of those other factors to vary in column W, poverty falls an additional 0.7 percentage points to 65.3 percent. In other words, out of the total change of 4.74 percentage points in poverty, induced by CAFTA, 85 percent comes from employment growth alone. The same pattern is repeated in each of the other scenarios. The faster the economy grows, the more employment it creates and the more poverty reduction there is, even if that growth is skill-intensive as is the case in the FDI scenario.

All the growth strategies, including the baseline, generate a higher demand for skilled labor than for unskilled. That is why in each scenario the incidence of poverty in the S column is higher than in E. Recall that by definition in the sequential microsimulation exercise, the E column tells us what the poverty incidence would be if the structure of employment was unchanged from the base, and employment in each skill class grew at the average rate of growth of total employment generated by the CGE model. In the S column simulation, we permit employment for different skill classes to grow at the rate determined by the CGE. At the national level in every case, growth of the skilled labor force was higher than the average rate of growth of total employment, which means that employment for the unskilled underlying column S is lower than in the E column. This is what makes the poverty rates slightly higher in S than in E. What is also interesting is that the degree of skill intensity appears to be slightly lower in the tariff-cut scenario than in the base run. In the latter, increasing skill intensity drives up poverty by 0.06 percent between E and S, whereas in the TARCUT1 microsimulation, the increase in poverty is only 0.03 percent. That says that growth under CAFTA-induced trade liberalization is less skill intensive than it would have been in the absence of CAFTA. There are some rather curious divergences between the rural and urban sectors. In the base run, the incidence of rural poverty rises quite a bit in response to more skill-intensive growth. In each of the other simulations, it rises a bit less and in fact falls in both the MAQUILA and the ALLCAFTA simulations, which implies that CAFTA increases the rate of growth of unskilled labor in the rural sector relative to what it would have been otherwise. The opposite is true in the urban sector. In both the base run and TARCUT1, poverty is lower with the simulated change in skill intensity, and that is only reversed when we require much higher overall growth rates of employment in the MAQUILA, ALLCAFTA, and FDI simulations.

The third result to be taken from Table 14 is that increasing the skill differential, which we do in each of the W columns, reduces the incidence of poverty. Furthermore, when the FDI columns are compared with any of the others, we see that the faster the rise in the wage differential and the more employment created for the skilled, the bigger the reduction in poverty. This is a surprising result. Recall that in the model real wages for the unskilled are constant, whereas employment and wages are endogenously determined for skilled labor. The faster the rate of growth in the demand for the skilled, the bigger the wage differential will be. The difference between columns E and S is the isolated effect of the wage changes coming from the CGE, since employment growth by skill is the same in both columns. This means that there must have been many poor households with educated members who were either unemployed or out of the labor force in the base year 2004. Putting them to work, even at the base-period wage, is one of the reasons that the poverty rate falls from 2004 to the E column of each of the simulations. When we add on the rise in the relative wage as well, we reduce poverty even more. In the base run, for example, at the national level, the additional employment of skilled and unskilled labor (column S) reduces the poverty rate from 70.1 to 67.0 percent. Since we are assuming a constant real wage for the unskilled, the only change between columns S and W is that in W we increase the relative wage of the skilled by 12 percent relative to its base level, and that reduces poverty from 67.0 to 66.4 percent. The same result is repeated in each of the other simulations, and for both the rural and the urban sectors. Rising skill intensity and rising skill differentials obviously help richer households. The distribution of labor income becomes less equal. But our results say that they help the poor as well.

## VIII. CONCLUSIONS

In order to calculate the effects of CAFTA, we built a dynamic CGE model with which to compare the trajectory of employment and output with and without CAFTA. This comparison shows that the impact of trade liberalization under CAFTA will be small but positive. Even with constant rates of capital formation, it unambiguously increases the amount of employment for the unskilled and helps the poor in both the rural and urban sectors. At the same time, in all the alternative CAFTA scenarios, relative wages for the skilled rise, while poverty declines. And in spite of the rise in the wage differential, the distribution of household income actually improves slightly because so many of the new workers in the CAFTA scenarios come from poor families.

Critics of CAFTA complain that smallholders will be hurt by the removel of tariff protection for sensitive products such as corn, rice, beans, and pork, which are produced and consumed by the poor. Our results do not support this view. Both agriculture in general and subsistence agriculture in particular grow faster under CAFTA than could be expected otherwise. The increases in the growth rate are not large, but they are positive. That is partly because tariffs for many sensitive products will be reduced very slowly or not at all, and partly because the rise of employment in other sectors more than compensates for any loss of employment in the sensitive sectors themselves.

In spite of the importance of agriculture in the Honduran economy, it appears that the CAFTA provisions regarding the maquila sector are actually more significant for poverty, employment, and growth. Making permanent the liberalized rules of origin of the CBTPA Treaty increases the annual rate of growth of GDP by 1.3 percent and employment growth by 1.4 percent, relative to what they would have been had CAFTA not been approved. That has a dramatic impact on poverty and the distribution of household income because so many of the new workers are unskilled women from poor families. We estimate that by 2020, maquila will lower the poverty rate by 6 percentage points and the Gini coefficient by 3 percentage points relative to the tax cut scenario. All of these results underline the critical importance of job creation in increasing the growth rate of the economy and lowering its poverty rate. However, because the maquila benefits under CAFTA are not a change from current treatment but rather a conversion from a temporary to a permanent benefit, approving CAFTA will not raise the growth rate of the economy by 1.3 percent, relative to its current growth trajectory. Rather, without CAFTA, we project that the economy will grow 1.3 percent less than it would if the maquila benefits of the CBTPA are made permanent.

The key to growth and poverty reduction in Honduras lies in finding a way to create more jobs, particularly for the unskilled. Maquila is one way to do this. It changes skill intensity in the economy progressively without increasing overall capital requirements. But CAFTA needs to be complemented by policies that stimulate more capital formation as well. Higher rates of capital formation as demonstrated in the FDI scenario have a large and positive impact on growth, employment, and poverty. Unfortunately, there is no assurance that the effects of CAFTA on foreign investment will actually lead to the higher rates of investment that we used in our simulation. CAFTA is not a magic bullet. By itself it will not solve Honduras's problems of poverty and slow growth. For that, complementary policies that make agriculture more productive and stimulate higher rates of capital formation are needed.

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# Appendix A

## SUPPLEMENTARY TABLE

Table A.1

GROWTH RATES OF TRADE BY SECTOR

| | Initial share 1997 a/ | Annual percentage growth rate (1997-2020) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Base | CAFTA | Maquila | Quotas | All CAFTA | FDI |
| **Exports** | | | | | | | |
| Banana | 7.71 | 1.01 | 1.49 | 1.38 | 1.01 | 1.80 | 4.39 |
| Coffee | 7.08 | 2.01 | 2.33 | 2.68 | 2.01 | 2.95 | 6.66 |
| Mining | 2.65 | 2.08 | 2.54 | 2.55 | 2.08 | 2.91 | 5.88 |
| Livestock | 0.40 | 2.92 | 3.12 | 4.93 | 2.92 | 5.08 | 6.27 |
| Non-trad. Ag. | 11.28 | 2.45 | 2.58 | 3.21 | 2.45 | 3.32 | 5.93 |
| Subsist. Ag. | 0.06 | 3.02 | 3.17 | 4.57 | 3.02 | 4.69 | 6.19 |
| Food | 25.74 | 2.88 | 3.09 | 4.27 | 2.88 | 4.45 | 6.4 |
| Textiles | 5.26 | 2.19 | 2.34 | 3.31 | 2.19 | 3.43 | 5.93 |
| Paper | 2.64 | 2.30 | 2.48 | 2.95 | 2.30 | 3.09 | 5.93 |
| Chemicals | 1.20 | 2.25 | 2.45 | 3.11 | 2.25 | 3.27 | 5.01 |
| Metals | 0.44 | 2.70 | 2.91 | 3.50 | 2.70 | 3.68 | 6.03 |
| Other mfg. | 12.57 | 2.23 | 2.71 | 3.00 | 2.24 | 3.41 | 5.72 |
| Elec, water, | 0.06 | 2.67 | 2.83 | 3.40 | 2.67 | 3.53 | 6.02 |
| Hotels | 8.09 | 2.50 | 2.68 | 4.60 | 2.50 | 4.71 | 5.82 |
| Transport | 4.82 | 2.69 | 2.95 | 3.29 | 2.69 | 3.51 | 6.5 |
| Finance | 1.00 | 2.43 | 2.52 | 3.00 | 2.44 | 3.07 | 5.63 |
| Government | 5.33 | 2.60 | 2.70 | 3.11 | 2.60 | 3.19 | 6.05 |
| Other svc. | 3.67 | 2.74 | 2.84 | 3.47 | 2.74 | 3.55 | 6.22 |
| Total | 100.00 | | | | | | |
| **Imports** | | | | | | | |
| Banana | 0.03 | 3.37 | 3.62 | 4.37 | 3.37 | 4.62 | 6.06 |
| Coffee | 0.00 | 3.94 | 4.21 | 5.14 | 3.94 | 5.42 | 8.13 |
| Mining | 10.62 | 2.94 | 3.16 | 3.91 | 2.94 | 4.11 | 6.42 |
| Livestock | 4.73 | 3.42 | 3.68 | 4.51 | 3.43 | 4.75 | 6.49 |
| Non-trad. Ag | 4.82 | 3.36 | 3.63 | 4.80 | 3.36 | 5.06 | 6.5 |
| Subsist. Ag. | 0.01 | 3.55 | 3.71 | 4.66 | 3.56 | 4.81 | 6.5 |
| Food | 0.00 | 3.57 | 3.64 | 4.64 | 3.58 | 4.71 | 6.72 |
| Textiles | 6.46 | 3.39 | 3.65 | -24.56 | 3.40 | -24.37 | 6.46 |
| Paper | 3.54 | 2.87 | 3.12 | 3.92 | 2.88 | 4.13 | 6.21 |
| Chemicals | 7.58 | 3.04 | 3.30 | 4.08 | 3.05 | 4.30 | 5.85 |

/Continued

Table A-1 (Concluded)

| | Initial share 1997 a/ | Annual percentage growth rate (1997-2020) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Base | CAFTA | Maquila | Quotas | All CAFTA | FDI |
| Metals | 6.35 | 3.26 | 3.48 | 4.37 | 3.27 | 4.56 | 6.42 |
| Other mfg. | 15.51 | 3.32 | 3.48 | 4.32 | 3.32 | 4.47 | 6.66 |
| Elec,water | 0.15 | 3.17 | 3.52 | 4.73 | 3.17 | 5.05 | 6.17 |
| Construction | 0.08 | 3.76 | 3.99 | 4.92 | 3.76 | 5.14 | 6.86 |
| Hotels | 2.27 | 3.41 | 3.51 | 4.47 | 3.42 | 4.56 | 6.23 |
| Transport | 11.95 | 3.34 | 3.46 | 4.47 | 3.34 | 4.58 | 6.85 |
| Finance | 2.00 | 3.38 | 3.56 | 4.65 | 3.39 | 4.80 | 6.47 |
| Personal svc. | 1.65 | 3.37 | 3.49 | 4.42 | 3.38 | 4.52 | 6.53 |
| Government | 0.25 | 3.65 | 3.76 | 4.75 | 3.65 | 4.85 | 6.81 |
| Other svc. | 21.98 | 3.38 | 3.50 | 4.49 | 3.39 | 4.60 | 6.47 |
| Total | 100.00 | | | | | | |

Source: Authors' worksheets.

Appendix B

# DOCUMENTATION OF THE SOCIAL ACCOUNTING MATRIX, HOUSEHOLD SURVEY FOR HONDURAS, AND TECHNICAL DESCRIPTION OF THE RECURSIVE DYNAMIC CGE

## a) The Social Accounting Matrix for 1997

The Social Accounting Matrix (SAM) used in this study is based on the 1997 SAM developed by Jose Cuesta and described in Cuesta (2005). First, 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 (including indirect commodity taxes and transaction costs). Activity outputs are either exported or sold domestically, while commodities comprise 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 both cheese and milk, which are delivered to different commodity markets). And any commodity may be produced by multiple activities (for example, the same maize commodity may be produced by both small- and large-scale production activities.

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

Fourth, the domestic nongovernment institutions in the SAM consist of households and enterprises. The enterprises earn factor incomes (reflecting their ownership of capital or land or both) 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 1997 macro SAM for Honduras uses as data sources the national accounts prepared by the Central Bank; information on capital flows from the Ministry of Finance; data on labor behavior and on income and expenditure from the Permanent Household Survey (EPH) and Incomes and Expenditures National Household Survey (ENIGH) household surveys, respectively. Final household consumption, private investment, public investment, government recurrent and investment expenditures, value added, remittances, net capital inflows, interest payments, and other factor payments abroad all come from the national accounts and balance of payments. Exports (at f.o.b.), imports (at c.i.f.), government savings, and all categories of taxes come from the Honduras Ministry of Finance statistical sourcebook The proportion of self-consumption in total household consumption is estimated at 12.6 percent from the ENIGH 1997 household survey. The distribution of value added between households and firms results from initially pro-rating total value added with a 60–40 percent thumb rule for labor and capital, respectively. Government transfers to firms include net public transfers to public enterprises providing electricity, water, sanitation, telephone, and forestry-related services.

Government transfers to households include subsidy schemes to public transportation, residential electricity consumption, family allowances, schooling grants and scholarships, among others. Transaction costs are estimated, assuming a 15 percent share of the gross domestic supply, exports, and imports, respectively. This estimated share is in line with estimated margin costs for the transportation of food, agricultural products, and manufactures reported by Gehlhar (1998) as part of the Global Trade Analysis Project (GTAP)[21] worldwide project. The net domestic supply entry is estimated as the difference between gross domestic output, exports, households' self-consumption, and transaction costs. The government investment deficit is the residual that balances out the total government recurrent column, while intermediate demand is the entry that allows the gross output total to balance out. Categories of taxes are aggregated into two indirect taxes (one on production, the other on sales), tariffs, export taxes, export subsidies, and direct income taxes.

Activities and commodities are disaggregated in 24 categories (Table A.2.1). Each activity is the only producer of its respective commodity. Agriculture is disaggregated into subsistence products (mainly grains), traditional, and nontraditional exports. Traditional agriculture exports further separate bananas, coffee, and sugar, which in addition to nonagricultural traditional exports (such as forestry, livestock, and mining) constitute the most relevant traditional exports in Honduras. As for manufactures, textiles—mainly in the form of

[21] The University of Purdue's Center for Global Trade Analysis conducts the Global Trade Analysis Project, which provides among other things information on the composition of domestic production and trade for a large set of commodities and countries in the world.

maquila production—can be singled out from paper, chemical, and other manufactures. Given its importance to consumption, and ultimately, to poverty, the category of food, beverages, and tobacco manufactures is also accounted for separately from other manufactures.

Public and private services are initially separated as well. Government services aggregate defense, administration, and social security into a single category. Private services are disaggregated into hospitality, transportation, financial, personal, social, and community services, and other services. Interestingly, other services refer mainly to housing services, thus distinguishing them from financial services. This is a practice followed by the national accounts, which avoids a misleading perception that a joint financial and housing sector dominates the Honduran economy. Electricity, gas, and water provision constitute another independent activity. Oil, commerce, and construction are also considered as three individual activities. As a result, activities and commodities are disaggregated into the following categories: bananas; coffee; sugar; mining; livestock; forestry; nontraditional exports; subsistence agriculture; oil; food, beverage, and tobacco manufactures; textile manufactures; paper manufactures; chemical manufactures; metal, mineral, and machinery manufactures; other manufactures; electricity, gas, and water; construction; commerce; hotel and restaurant services; transportation services; financial services; personal, social, and community services; and government services.

The intermediate demand total is disaggregated by commodities and activities, using a special tabulation provided by the Central Bank of Honduras. This tabulation provides the proportion of commodities that a given activity requires for its normal production. The disaggregation of commodities and activities for the 1997 micro SAM follows the same categorization of the system provided by the Central Bank except for a minor aggregation of formal and informal commerce into a single category. As for the disaggregation of domestic supply, the available information on the value added of each activity is added to its estimated intermediate demand to come up with a gross domestic supply per activity.

The factorial classification in the 1997 micro SAM distinguishes two production factors, labor and capital (Table A2-2). The capital factor also includes land, given that estimating stocks and value added for land from existing EPH household surveys is a completely unreliable possibility. Labor factors are disaggregated into statistically meaningful categories as much as data permit. Labor is separated according to skill, occupation (wage earners versus self-employed), and gender. An intermediate skill (5–9 schooling years) category is differentiated from low (0–4) and high (10 or more) skill levels. This distinction between unskilled and intermediate skilled labor and by gender could be useful in future policy simulations, but it played no part in the simulations reported in the paper, since we set the wages of the two labor categories for the two genders equal and assumed an excess supply of both factors. The combination of skill, occupation, and gender categories results in 12 labor factor types. Wage earners are defined as those receiving wages and salaries as their primary source of (labor) income. The remaining category brings together employers, self-employed, and unpaid relatives in a single category.

Table B.1

ACTIVITY AND COMMODITY CATEGORIES FOR THE SOCIAL ACCOUNTING MATRIX, HONDURAS, 1997

| Sectors and sub-sectors | | Description |
|---|---|---|
| 1. Agriculture, Mining, Fishing and Livestock | | |
| 1.a) Traditional exports | BAN_A | Banana |
| | COF_A | Coffee |
| | SUG_A | Sugar |
| | MIN_A | Mining |
| | LIV_A | Livestock |
| | WOO_A | Wood |
| 1.b) Non traditional exports | NTA_A | Non traditional exports |
| 1.c) Subsistence agricultural | SUB_A | Subsistence agricultural products |
| 1.d) Oil and derivatives | OIL_A | Oil |
| 2. Manufactures | ALI_A | Food, beverage and tobacco manufactures |
| | TEX_A | Textile manufactures |
| | PAP_A | Paper manufactures |
| | CHE_A | Chemical manufactures |
| | MET_A | Metal, mineral and machinery manufactures |
| | OMA_A | Other manufactures |
| 3. Construction | CON_A | Construction |
| 4. Commerce | COM_A | Commerce |
| 5. Services | HOT_A | Hotel and restaurants |
| | TPT_A | Transport, storage and communication |
| | FIN_A | Financial and insurance services |
| | PER_A | Personal, social and community services |
| | GOV_A | Government services |
| | OTH_A | Other services (real estate services) |

Source: Cuesta (2005).

Table B.2

LABOR CATEGORIES, SOCIAL ACCOUNTING MATRIX, HONDURAS, 1997

| Labor Category | Description | | | |
| --- | --- | --- | --- | --- |
| | Skill | Schooling years | Occupation | Gender |
| TUWM | Unskilled | 0-4 | Wage earner | Male |
| TUNM | Unskilled | 0-4 | Non wage earner | Male |
| TIWM | Semi-skilled | 5-9 | Wage earner | Male |
| TINM | Semi-skilled | 5-9 | Non wage earner | Male |
| TSWM | Skilled | 10+ | Wage earner | Male |
| TSNM | Skilled | 10+ | Non wage earner | Male |
| TUWF | Unskilled | 0-4 | Wage earner | Female |
| TUNF | Unskilled | 0-4 | Non wage earner | Female |
| TIWF | Semi-skilled | 5-9 | Wage earner | Female |
| TINF | Semi-skilled | 5-9 | Non wage earner | Female |
| TSWF | Skilled | 10+ | Wage earner | Female |
| TSNF | Skilled | 10+ | Non wage earner | Female |

Source: Cuesta (2005).
Note: The composition of the labor factor does not add up to 100% due to rounding error. Total labor factor amounts to 2,145,753 individuals.

Formally, factors generate value added in the economy. The aggregated value added of labor is distributed among activities proportionally to their share in the labor income mass reported by EPH 1997. Despite this disaggregation of labor, value added is straightforward, the capital value added generated among activities is more troublesome. Honduras lacks estimates on capital stocks, let alone its distribution by activity. Following the stylization of Wobst (1998) using GTAP worldwide data, capital value added is first assigned among agricultural and nonagricultural activities. It is assumed that capital value added among agricultural activities amounts to 60 percent of total value added in these activities (Wobst 1998). For the remaining activities, capital value added represents only 40 percent of their total value added. Then these two subcategories of capital value added are further disaggregated, using worldwide average estimates on specific activities as reported in Wobst (1998). Although this option does not truly reflect a Honduras-specific distribution of capital value added (but a worldwide average instead), alternative options are regarded as nonsensical. Among such alternatives, one might have pro-rated the distributions of capital and labor value added alike. Also, the number of activities considered causes us to reject an arbitrary allocation of shares of capital value added, based on perceptions of what constitutes a capital intensive sector in the Honduran economy.

As for households, these receive incomes from labor factors, an "operating surplus" from firms and remittances from the rest of the world. EPH 1997 data on labor incomes and the economic sector allow us to estimate the proportion of labor value added generated by each category of labor factor, and its reception among different categories of households. Firms' transfers to households are distributed following the proportion of total interest and dividends of each household category, as reported in EPH 1997. Similarly, remittances are assigned to each category of households according to the proportion of total remittances reported in the EPH 1997 survey.

From an expenditure point of view, households produce goods that are self-consumed, consume other goods and services, pay taxes, and save. The distribution of consumption by household category accrues from the ENIGH 1998/99 survey, assuming that the composition of consumption between 1997 and the period of the survey did not change significantly. Given the low level of individuals reporting self-consumption in the ENIGH survey, the distribution of this category of household consumption is pro-rated according to the share of each household category in final household consumption. Savings are estimated as the average difference between incomes and expenditures reported by each category of household in the ENIGH survey. The relative share of each household category in total savings is then applied to the 1997 macro SAM figure to obtain distribution of savings consistent with the micro SAM.

As for the remaining transactions, taxes on sales are specified proportionally to the relative weight that each commodity represents on total domestic supply. Sales taxes as well as production taxes (except for special production taxes on cigarettes, beer, nonalcoholic drinks, and oil) are subject to balancing adjustments (see the next section). Income taxes are assigned among household categories on a proportional basis with respect to their reported average total income. Similarly, both private and public investments are assigned proportionally to the relative weight that each commodity has on total intermediate demand. Finally, transaction costs are distributed by commodities also in proportion to the share of each commodity in domestic supply, imports, and exports, respectively.

### b) Final adjustments

The entropy approach is used to obtain the final balanced SAM for this project (Robinson and others 2000). However, in 1997 there was a large payment from enterprises to the rest of the world that is not consistent with national accounts data for preceding years and unlikely to represent future behavior. We eliminated this flow by 2005, which is one of the reasons that the model has a different trajectory between 1997 and 2005 from the later growth path to 2020.

The actual SAM is a square 87 x 87 matrix comprised of 24 activity accounts; 24 commodity accounts; 13 factor of production accounts (12 labor and 1 capital); 1 enterprise account; 6 government accounts (5 of which disaggregate tax receipts); 16 different types of households, depending on residence and gender head; a saving–investment account; an external account; and row–column sums. The actual matrix is available on the IFPRI website. www.ifpri.org/data/honduras02.asp

Table B.3

NATIONAL SOCIAL ACCOUNTING MATRIX USED IN THE CGE MODEL

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

Source: Adapted from Lofgren, Harris and Robinson (2001).

Appendix C

# FORMAL STATEMENT OF THE DYNAMIC CGE MODEL

Table C.1

**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 |
| $c \in C$ | Commodities | $f \in F$ | factors |
| $c \in CD(\subset C)$ | commodities with domestic sales of domestic output | $i \in INS$ | institutions (domestic and rest of world) |
| $c \in CDN(\subset C)$ | commodities not in $CD$ | $i \in INSD(\subset INS)$ | domestic institutions |
| $c \in CE(\subset C)$ | exported commodities | $i \in INSDNG(\subset INSD)$ | domestic non-government institutions |
| $c \in CEN(\subset C)$ | commodities not in $CE$ | $h \in H(\subset INSDNG)$ | households |
| $c \in CM(\subset C)$ | imported commodities | $fls \in F$ | factors with supply curve |
| PARAMETERS | | | |
| $cwts_c$ | weight of commodity c in the CPI | $\overline{qg}_c$ | base-year quantity of government demand |
| $dwts_c$ | weight of commodity c in the producer price index | $\overline{qinv}_c$ | base-year quantity of private investment demand |
| $ica_{ca}$ | quantity of c as intermediate input per unit of activity a | $shif_{if}$ | share for domestic institution i in income of factor f |
| $icd_{cc'}$ | quantity of commodity c as trade input per unit of c' produced and sold domestically | $shii_{ii'}$ | share of net income of i' to i (i' ∈ INSDNG'; i ∈ INSDNG) |
| $ice_{cc'}$ | quantity of commodity c as trade input per exported unit of c' | $ta_a$ | Tax rate for activity a |
| $icm_{cc'}$ | quantity of commodity c as trade input per imported unit of c' | $te_c$ | export tax rate |
| $inta_a$ | quantity of aggregate intermediate input per activity unit | $tf_f$ | direct tax rate for factor f |

/Continued

Table C.1 (Continued)

| | | | |
|---|---|---|---|
| $iva_a$ | quantity of aggregate intermediate input per activity unit | $\overline{tins}_i$ | exogenous direct tax rate for domestic institution i |
| $\overline{mps}_i$ | base savings rate for domestic institution i | $tins01_i$ | 0-1 parameter with 1 for institutions with potentially flexed direct tax rates |
| $mps01_i$ | 0-1 parameter with 1 for institutions with potentially flexed direct tax rates | $tm_c$ | import tariff rate |
| $pwe_c$ | export price (foreign currency) | $tq_c$ | rate of sales tax |
| $pwm_c$ | import price (foreign currency) | $trnsfr_{i\,f}$ | 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** | | | |
| $\alpha_a^a$ | efficiency parameter in the CES activity function | $\delta_c^t$ | CET function share parameter |
| $\alpha_a^{va}$ | efficiency parameter in the CES value-added function | $\delta_{fa}^{va}$ | CES value-added function share parameter for factor *f* in activity *a* |
| $\alpha_c^{ac}$ | shift parameter for domestic commodity aggregation function | $\gamma_{ch}^m$ | subsistence consumption of marketed commodity c for household h |
| $\alpha_c^q$ | Armington function shift parameter | $\gamma_{ach}^h$ | subsistence consumption of home commodity c from activity a for household h |
| $\alpha_c^t$ | CET function shift parameter | $\theta_{ac}$ | yield of output c per unit of activity a |
| $\beta_{ach}^h$ | marginal share of consumption spending on home commodity c from activity a for household h | $\rho_a^a$ | CES production function exponent |
| $\beta_{ch}^m$ | marginal share of consumption spending on marketed commodity c for household h | $\rho_a^{va}$ | CES value-added function exponent |
| $\delta_a^a$ | CES activity function share parameter | $\rho_c^{ac}$ | domestic commodity aggregation function exponent |
| $\delta_{ac}^{ac}$ | share parameter for domestic commodity aggregation function | $\rho_c^q$ | Armington function exponent |
| $\delta_c^q$ | Armington function share parameter | $\rho_c^t$ | 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 |

/Continued

Table C.1 (Continued)

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

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Table C.1 (Continued)

EQUATIONS

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

/Continued

Table C.1 (Continued)

| | | | |
|---|---|---|---|
| 7 | $PINTA_a = \sum_{c \in C} PQ_c \cdot ica_{c\,a}$ <br> $\begin{bmatrix} aggregate \\ intermediate \\ input\ price \end{bmatrix} = \begin{bmatrix} intermediate\ input\ cost \\ per\ unit\ of\ aggregate \\ intermediate\ input \end{bmatrix}$ | $a \in A$ | Aggregate intermediate input price |
| 8 | $PA_a \cdot (1 - ta_a) \cdot QA_a = PVA_a \cdot QVA_a + PINTA_a \cdot QINTA_a$ <br> $\begin{bmatrix} activity\ price \\ (net\ of\ taxes) \\ times\ activity\ level \end{bmatrix} = \begin{bmatrix} value\text{-}added \\ price\ times \\ quantity \end{bmatrix} + \begin{bmatrix} aggregate \\ intermediate \\ input\ price\ times \\ quantity \end{bmatrix}$ | $a \in A$ | Activity revenue and costs |
| 9 | $\overline{CPI} = \sum_{c \in C} PQ_c \cdot cwts_c$ <br> $\begin{bmatrix} CPI \end{bmatrix} = \begin{bmatrix} prices\ times \\ weights \end{bmatrix}$ | | Consumer price index |
| 10 | $DPI = \sum_{c \in C} PDS_c \cdot dwts_c$ <br> $\begin{bmatrix} Producer\ price\ index \\ for\ non\text{-}traded\ outputs \end{bmatrix} = \begin{bmatrix} prices\ times \\ weights \end{bmatrix}$ | | Producer price index for non-traded market output |
| Production and commodity block | | | |
| 11 | $QA_a = \alpha_a^a \cdot \left( \delta_a^a \cdot QVA_a^{-\rho_a^a} + (1 - \delta_a^a) \cdot QINTA_a^{-\rho_a^a} \right)^{-\frac{1}{\rho_a^a}}$ <br> $\begin{bmatrix} activity \\ level \end{bmatrix} = CES \begin{bmatrix} quantity\ of\ aggregate\ value\text{-}added, \\ quantity\ aggregate\ intermediate\ input \end{bmatrix}$ | $a \in ACES$ | CES technology: activity production function |
| 12 | $\frac{QVA_a}{QINTA_a} = \left( \frac{PINTA_a}{PVA_a} \cdot \frac{\delta_a^a}{1 - \delta_a^a} \right)^{\frac{1}{1+\rho_a^a}}$ <br> $\begin{bmatrix} value\text{-}added - \\ intermediate\text{-} \\ input\ quantity \\ ratio \end{bmatrix} = f \begin{bmatrix} intermediate\text{-}input \\ -\ value\text{-}added \\ price\ ratio \end{bmatrix}$ | $a \in ACES$ | CES technology: Value—Added—Intermediate—Input ratio |
| 13 | $QVA_a = iva_a \cdot QA_a$ <br> $\begin{bmatrix} demand\ for \\ value\text{-}added \end{bmatrix} = f \begin{bmatrix} activity \\ level \end{bmatrix}$ | $a \in ALEO$ | Leontief technology: Demand for aggregate value-added |

/Continued

Table C.1 (Continued)

| | | | |
|---|---|---|---|
| 14 | $QINTA_a = inta_a \cdot QA_a$ <br> $\begin{bmatrix} \text{demand for aggregate} \\ \text{intermediate input} \end{bmatrix} = f \begin{bmatrix} \text{activity} \\ \text{level} \end{bmatrix}$ | $a \in ALEO$ | Leontief technology: Demand for aggregate intermediate input |
| 15 | $QVA_a = \alpha_a^{va} \cdot \left( \sum_{f \in F} \delta_{f\,a}^{va} \cdot QF_{f\,a}^{-\rho_a^{va}} \right)^{-\frac{1}{\rho_a^{va}}}$ <br> $\begin{bmatrix} \text{quantity of aggregate} \\ \text{value-added} \end{bmatrix} = CES \begin{bmatrix} \text{factor} \\ \text{inputs} \end{bmatrix}$ | $a \in A$ | Value-added and factor demands |
| 16 | $W_f \cdot \overline{WFDIST}_{fa} = PVA_a \cdot (1 - tva_a) \cdot QVA_a \cdot \left( \sum_{f \in F'} \delta_{f\,a}^{va} \cdot QF_{f\,a}^{-\rho_a^{va}} \right)^{-1} \cdot \delta_{f\,a}^{va} \cdot QF_{f\,a}^{-\rho}$ <br> $\begin{bmatrix} \text{marginal cost of} \\ \text{factor } f \text{ in activity } a \end{bmatrix} = \begin{bmatrix} \text{marginal revenue product} \\ \text{of factor } f \text{ in activity } a \end{bmatrix}$ | $a \in A$ <br> $f \in F$ | Factor demand |
| 17 | $WFREAL_f = \frac{YF}{CPI * \sum_a QF_{f,a}}$ <br> $\begin{bmatrix} \text{average real wage} \\ \text{per factor unit} \end{bmatrix} = \begin{bmatrix} \text{average wage corrcected} \\ \text{by consumer index price} \end{bmatrix}$ | $f \in F$ | Real wages |
| 18 | $QFS_f = QFS0 * \left[ \frac{\frac{WF_f * WFDIST_f * QF_f}{QFS_f}}{\frac{CPI}{\frac{WF0_f}{CPI0}}} \right]^{etals_f}$ | $f \in F$ | Labor supply |
| 19 | $QINT_{c\,a} = ica_{ca} \cdot QINTA_a$ <br> $\begin{bmatrix} \text{intermediate demand} \\ \text{for commodity } c \\ \text{from activity } a \end{bmatrix} = f \begin{bmatrix} \text{aggregate intermediate} \\ \text{input quantity} \\ \text{for activity } a \end{bmatrix}$ | $a \in A$ <br> $c \in C$ | Disaggregated intermediate input demand |
| 20 | $QXAC_{a\,c} + \sum_{h \in H} QHA_{ach} = \theta_{a\,c} \cdot QA_a$ <br> $\begin{bmatrix} \text{marketed quantity} \\ \text{of commodity } c \\ \text{from activity } a \end{bmatrix} + \begin{bmatrix} \text{household home} \\ \text{consumption} \\ \text{of commodity } c \\ \text{from activity } a \end{bmatrix} = \begin{bmatrix} \text{production} \\ \text{of commodity } c \\ \text{from activity } a \end{bmatrix}$ | $a \in A$ <br> $c \in CX$ | Commodity production and allocation |

/Continued

Table C.1 (Continued)

| | | | |
|---|---|---|---|
| 21 | $$QX_c = \alpha_c^{ac} \cdot \left( \sum_{a \in A} \delta_{ac}^{ac} \cdot QXAC_{ac}^{-\rho_c^{ac}} \right)^{-\frac{1}{\rho_c^{ac}-1}}$$ $$\begin{bmatrix} aggregate \\ marketed \\ production\ of \\ commodity\ c \end{bmatrix} = CES \begin{bmatrix} activity\text{-}specific \\ marketed \\ production\ of \\ commodity\ c \end{bmatrix}$$ | $c \in CX$ | Output Aggregation Function |
| 22 | $$PXAC_{ac} = PX_c \cdot QX_c \left( \sum_{a \in A'} \delta_{ac}^{ac} \cdot QXAC_{ac}^{-\rho_c^{ac}} \right)^{-1} \cdot \delta_{ac}^{ac} \cdot QXAC_{ac}^{-\rho_c^{ac}-1}$$ $$\begin{bmatrix} marginal\ cost\ of\ com\text{-} \\ modity\ c\ from\ activity\ a \end{bmatrix} = \begin{bmatrix} marginal\ revenue\ product\ of \\ commodity\ c\ from\ activity\ a \end{bmatrix}$$ | $a \in A$ <br> $c \in CX$ | First-Order Condition for Output Aggregation Function |
| 23 | $$QX_c = \alpha_c^t \cdot \left( \delta_c^t \cdot QE_c^{\rho_c^t} + (1-\delta_c^t) \cdot QD_c^{\rho_c^t} \right)^{\frac{1}{\rho_c^t}}$$ $$\begin{bmatrix} aggregate\ marketed \\ domestic\ output \end{bmatrix} = CET \begin{bmatrix} export\ quantity,\ domestic \\ sales\ of\ domestic\ output \end{bmatrix}$$ | $c \in (CE \cap CD)$ | Output Transformation (CET) Function |
| 24 | $$\frac{QE_c}{QD_c} = \left( \frac{PE_c}{PDS_c} \cdot \frac{1-\delta_c^t}{\delta_c^t} \right)^{\frac{1}{\rho_c^t - 1}}$$ $$\begin{bmatrix} export\text{-}domestic \\ supply\ ratio \end{bmatrix} = f \begin{bmatrix} export\text{-}domestic \\ price\ ratio \end{bmatrix}$$ | $c \in (CE \cap CD)$ | Export-Domestic Supply Ratio |
| 25 | $$QX_c = QD_c + QE_c$$ $$\begin{bmatrix} aggregate \\ marketed \\ domestic\ output \end{bmatrix} = \begin{bmatrix} domestic\ market \\ sales\ of\ domestic \\ output\ [for \\ c \in (CD \cap CEN)] \end{bmatrix} + \begin{bmatrix} exports\ [for \\ c \in (CE \cap CDN)] \end{bmatrix}$$ | $c \in$ <br> $(CD \cap CEN)$ <br> $\cup$ <br> $(CE \cup CDN)$ | Output Transformation for Non-Exported Commodities |
| 26 | $$QQ_c = \alpha_c^q \cdot \left( \delta_c^q \cdot QM_c^{-\rho_c^q} + (1-\delta_c^q) \cdot QD_c^{-\rho_c^q} \right)^{-\frac{1}{\rho_c^q}}$$ $$\begin{bmatrix} composite \\ supply \end{bmatrix} = f \begin{bmatrix} import\ quantity,\ domestic \\ use\ of\ domestic\ output \end{bmatrix}$$ | $c \in (CM \cap CD)$ | Composite Supply (Armington) Function |
| 27 | $$\frac{QM_c}{QD_c} = \left( \frac{PDD_c}{PM_c} \cdot \frac{\delta_c^q}{1-\delta_c^q} \right)^{\frac{1}{1+\rho_c^q}}$$ $$\begin{bmatrix} import\text{-}domestic \\ demand\ ratio \end{bmatrix} = f \begin{bmatrix} domestic\text{-}import \\ price\ ratio \end{bmatrix}$$ | $c \in (CM \cap CD)$ | Import-Domestic Demand Ratio |

/Continued

Table C.1 (Continued)

| | | | |
|---|---|---|---|
| 28 | $QQ_c = QD_c + QM_c$ <br> $\begin{bmatrix} \text{composite} \\ \text{supply} \end{bmatrix} = \begin{bmatrix} \text{domestic use of} \\ \text{marketed domestic} \\ \text{output [for} \\ c \in (CD \cap CMN)] \end{bmatrix} + \begin{bmatrix} \text{imports [for} \\ c \in (CM \cap CDN)] \end{bmatrix}$ | $c \in (CD \cap CMN) \cup (CM \cap CDN)$ | Composite Supply for Non-Imported Outputs and Non-Produced Imports |
| 29 | $QT_c = \sum_{c' \in C'} \left( icm_{c\,c'} \cdot QM_{c'} + ice_{c\,c'} \cdot QE_{c'} + icd_{c\,c'} \cdot QD_{c'} \right)$ <br> $\begin{bmatrix} \text{demand for} \\ \text{transactions} \\ \text{services} \end{bmatrix} = \begin{bmatrix} \text{sum of demands} \\ \text{for imports, exports,} \\ \text{and domestic sales} \end{bmatrix}$ | $c \in CT$ | Demand for Transactions Services |
| Institution block | | | |
| 30 | $YF_f = \sum_{a \in A} WF_f \cdot \overline{WFDIST}_{f\,a} \cdot QF_{f\,a}$ <br> $\begin{bmatrix} \text{income of} \\ \text{factor } f \end{bmatrix} = \begin{bmatrix} \text{sum of activity payments} \\ \text{(activity-specific wages} \\ \text{times employment levels)} \end{bmatrix}$ | $f \in F$ | Factor Income |
| 31 | $YIF_{i\,f} = shif_{i\,f} \cdot \left[ \left(1 - tf_f\right) \cdot YF_f - trnsfr_{row\,f} \cdot EXR \right]$ <br> $\begin{bmatrix} \text{income of} \\ \text{institution } i \\ \text{from factor } f \end{bmatrix} = \begin{bmatrix} \text{share of income} \\ \text{of factor } f \text{ to} \\ \text{institution } i \end{bmatrix} \cdot \begin{bmatrix} \text{income of factor } f \\ \text{(net of tax and} \\ \text{transfer to RoW)} \end{bmatrix}$ | $i \in INSD$ <br> $f \in F$ | Institutional factor incomes |
| 32 | $YI_i = \sum_{f \in F} YIF_{i\,f} + \sum_{i' \in INSDNG'} TRII_{i\,i'} + trnsfr_{i\,gov} \cdot \overline{CPI} + trnsfr_{i\,row} \cdot EXR$ <br> $\begin{bmatrix} \text{income of} \\ \text{institution } i \end{bmatrix} = \begin{bmatrix} \text{factor} \\ \text{income} \end{bmatrix} + \begin{bmatrix} \text{transfers} \\ \text{from other domestic} \\ \text{non-government} \\ \text{institutions} \end{bmatrix} + \begin{bmatrix} \text{transfers} \\ \text{from} \\ \text{government} \end{bmatrix} + \begin{bmatrix} \text{transfers} \\ \text{from} \\ \text{RoW} \end{bmatrix}$ | $i \in INSDNG$ | Income of domestic, non-government institutions |
| 33 | $TRII_{i\,i'} = shii_{i\,i'} \cdot (1 - MPS_{i'}) \cdot (1 - TINS_{i'}) \cdot YI_{i'}$ <br> $\begin{bmatrix} \text{transfer from} \\ \text{institution } i' \text{ to } i \end{bmatrix} = \begin{bmatrix} \text{share of net income} \\ \text{of institution } i' \\ \text{transfered to } i \end{bmatrix} \cdot \begin{bmatrix} \text{income of institution} \\ i'\text{, net of savings and} \\ \text{direct taxes} \end{bmatrix}$ | $i \in INSDNG$ <br> $i' \in INSDNG'$ | Intra-Institutional Transfers |
| 34 | $EH_h = \left( 1 - \sum_{i \in INSDNG} shii_{i\,h} \right) \cdot \left(1 - MPS_h\right) \cdot (1 - TINS_h) \cdot YI_h$ <br> $\begin{bmatrix} \text{household income} \\ \text{disposable for} \\ \text{consumption} \end{bmatrix} = \begin{bmatrix} \text{household income, net of direct} \\ \text{taxes, savings, and transfers to} \\ \text{other non-government institutions} \end{bmatrix}$ | $h \in H$ | Household Consumption Expenditure |

/Continued

Table C.1 (Continued)

| | | | |
|---|---|---|---|
| 35 | $$QH_{ch} = \gamma_{ch} + \frac{\beta^{m}_{ch} \cdot \left( EH_h - \sum_{c' \in C} PQ_{c'} \cdot \gamma^{m}_{c'h} - \sum_{a \in A} \sum_{c' \in C} PXAC_{ac'} \cdot \gamma^{h}_{ac'h} \right)}{PQ_c}$$ $$\begin{bmatrix} \textit{quantity of} \\ \textit{household demand} \\ \textit{for commodity } c \end{bmatrix} = f \begin{bmatrix} \textit{household} \\ \textit{consumption} \\ \textit{spending,} \\ \textit{market price} \end{bmatrix}$$ | $c \in C$ <br> $h \in H$ | Household Consumption Demand for Marketed commodities |
| 36 | $$QHA_{ach} = \gamma^{h}_{ach} + \frac{\beta^{h}_{ach} \cdot \left( EH_h - \sum_{c' \in C} PQ_{c'} \cdot \gamma^{m}_{c'h} - \sum_{a \in A} \sum_{c' \in C} PXAC_{ac'} \cdot \gamma^{h}_{ac'h} \right)}{PXAC_{ac}}$$ $$\begin{bmatrix} \textit{quantity of} \\ \textit{household demand} \\ \textit{for home commodity } c \\ \textit{from activity } a \end{bmatrix} = f \begin{bmatrix} \textit{household} \\ \textit{disposable} \\ \textit{income,} \\ \textit{producer price} \end{bmatrix}$$ | $a \in A$ <br> $c \in C$ <br> $h \in H$ | Household Consumption Demand for Home Commodities |
| 37 | $$QINV_c = \overline{IADJ} \cdot \overline{qinv}_c$$ $$\begin{bmatrix} \textit{fixed investment} \\ \textit{demand for} \\ \textit{commodity } c \end{bmatrix} = \begin{bmatrix} \textit{adjustment factor} \\ \textit{times} \\ \textit{base-year fixed} \\ \textit{investment} \end{bmatrix}$$ | $c \in CINV$ | Investment Demand |
| 38 | $$QG_c = \overline{GADJ} \cdot \overline{qg}_c$$ $$\begin{bmatrix} \textit{government} \\ \textit{consumption} \\ \textit{demand for} \\ \textit{commodity } c \end{bmatrix} = \begin{bmatrix} \textit{adjustment factor} \\ \textit{times} \\ \textit{base-year government} \\ \textit{consumption} \end{bmatrix}$$ | $c \in C$ | Government Consumption Demand |
| 39 | $$\begin{aligned} YG = & \sum_{i \in INSDNG} TINS_i \cdot YI_i + \sum_{f \in F} tf_f \cdot YF_f + \sum_{a \in A} tva_a \cdot PVA_a \cdot QVA_a \\ & + \sum_{a \in A} ta_a \cdot PA_a \cdot QA_a + \sum_{c \in CM} tm_c \cdot pwm_c \cdot QM_c \cdot EXR + \sum_{c \in CE} te_c \cdot pwe_c \cdot QE_c \cdot E. \\ & + \sum_{c \in C} tq_c \cdot PQ_c \cdot QQ_c + \sum_{f \in F} YF_{gov\,f} + trnsfr_{gov\,row} \cdot EXR \end{aligned}$$ $$\begin{aligned} \begin{bmatrix} \textit{government} \\ \textit{revenue} \end{bmatrix} = & \begin{bmatrix} \textit{direct taxes} \\ \textit{from} \\ \textit{institutions} \end{bmatrix} + \begin{bmatrix} \textit{direct taxes} \\ \textit{from} \\ \textit{factors} \end{bmatrix} + \begin{bmatrix} \textit{value-} \\ \textit{added} \\ \textit{tax} \end{bmatrix} \\ & + \begin{bmatrix} \textit{activity} \\ \textit{tax} \end{bmatrix} + \begin{bmatrix} \textit{import} \\ \textit{tariffs} \end{bmatrix} + \begin{bmatrix} \textit{export} \\ \textit{taxes} \end{bmatrix} \\ & + \begin{bmatrix} \textit{sales} \\ \textit{tax} \end{bmatrix} + \begin{bmatrix} \textit{factor} \\ \textit{income} \end{bmatrix} + \begin{bmatrix} \textit{transfers} \\ \textit{from} \\ \textit{RoW} \end{bmatrix} \end{aligned}$$ | | Government Revenue |

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Table C.1 (Continued)

| | | | |
|---|---|---|---|
| 40 | $EG = \sum_{c \in C} PQ_c \cdot QG_c + \sum_{i \in INSDNG} trnsfr_{i\,gov} \cdot \overline{CPI}$ <br> $\begin{bmatrix} government \\ spending \end{bmatrix} = \begin{bmatrix} government \\ consumption \end{bmatrix} + \begin{bmatrix} transfers\ to\ domestic \\ non\text{-}government \\ institutions \end{bmatrix}$ | | Government Expenditures |
| System Constraint Block | | | |
| 41 | $\sum_{a \in A} QF_{f\,a} = \overline{QFS}_f$ <br> $\begin{bmatrix} demand\ for \\ factor\ f \end{bmatrix} = \begin{bmatrix} supply\ of \\ factor\ f \end{bmatrix}$ | $f \in F$ | Factor market |
| 42 | $QQ_c = \sum_{a \in A} QINT_{c\,a} + \sum_{h \in H} QH_{c\,h} + QG_c$ $+ QINV_c + qdst_c + QT_c$ <br> $\begin{bmatrix} composite \\ supply \end{bmatrix} = \begin{bmatrix} intermediate \\ use \end{bmatrix} + \begin{bmatrix} household \\ consumption \end{bmatrix} + \begin{bmatrix} government \\ consumption \end{bmatrix}$ $+ \begin{bmatrix} fixed \\ investment \end{bmatrix} + \begin{bmatrix} stock \\ change \end{bmatrix} + \begin{bmatrix} trade \\ input\ use \end{bmatrix}$ | $c \in C$ | Composite Commodity Markets |
| 43 | $\sum_{c \in CM} pwm_c \cdot QM_c + \sum_{f \in F} trnsfr_{row\,f} = \sum_{c \in CE} pwe_c \cdot QE_c + \sum_{i \in INSD} trnsfr_{i\,row} + \overline{FSA}$ <br> $\begin{bmatrix} import \\ spending \end{bmatrix} + \begin{bmatrix} factor \\ transfers \\ to\ RoW \end{bmatrix} = \begin{bmatrix} export \\ revenue \end{bmatrix} + \begin{bmatrix} institutional \\ transfers \\ from\ RoW \end{bmatrix} + \begin{bmatrix} foreign \\ savings \end{bmatrix}$ | | Current Account Balance for RoW (in Foreign Currency) |
| 44 | $YG = EG + GSAV$ <br> $\begin{bmatrix} government \\ revenue \end{bmatrix} = \begin{bmatrix} government \\ expenditures \end{bmatrix} + \begin{bmatrix} government \\ savings \end{bmatrix}$ | | *Government Balance* |
| 45 | $TINS_i = \overline{tins}_i \cdot \left(1 + \overline{TINSADJ} \cdot tins01_i\right) + \overline{DTINS} \cdot tins01_i$ <br> $\begin{bmatrix} direct\ tax \\ rate\ for \\ institution\ i \end{bmatrix} = \begin{bmatrix} base\ rate\ adjusted \\ for\ scaling\ for \\ selected\ institutions \end{bmatrix} + \begin{bmatrix} point\ change \\ for\ selected \\ institutions \end{bmatrix}$ | $i \in INSDNG$ | Direct institutional tax rates |
| 46 | $MPS_i = \overline{mps}_i \cdot \left(1 + \overline{MPSADJ} \cdot mps01_i\right) + DMPS \cdot mps01_i$ <br> $\begin{bmatrix} savings \\ rate\ for \\ institution\ i \end{bmatrix} = \begin{bmatrix} base\ rate\ adjusted \\ for\ scaling\ for \\ selected\ institutions \end{bmatrix} + \begin{bmatrix} point\ change \\ for\ selected \\ institutions \end{bmatrix}$ | $i \in INSDNG$ | Institutional savings rates |

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Table C.1 (Continued)

| | | |
|---|---|---|
| 47 | $$\sum_{i\in INSDNG} MPS_i \cdot (1-TINS_i)\cdot YI_i + GSAV + EXR\cdot \overline{FSAV} = \sum_{c\in C} PQ_c \cdot QINV_c + \sum_{c\in C} PQ_c \cdot qdst_c$$ $$\begin{bmatrix} \textit{non-govern-} \\ \textit{ment savings}\end{bmatrix} + \begin{bmatrix} \textit{government} \\ \textit{savings}\end{bmatrix} + \begin{bmatrix} \textit{foreign} \\ \textit{savings}\end{bmatrix} = \begin{bmatrix} \textit{fixed} \\ \textit{investment}\end{bmatrix} + \begin{bmatrix} \textit{stock} \\ \textit{change}\end{bmatrix}$$ | Savings-Investment Balance |
| 48 | $$TABS = \sum_{h\in H}\sum_{c\in C} PQ_c \cdot QH_{ch} + \sum_{a\in A}\sum_{c\in C}\sum_{h\in H} PXAC_{ac}\cdot QHA_{ach} + \sum_{c\in C} PQ_c \cdot QG_c + \sum_{c\in C} PQ_c\cdot QINV_c + \sum_{c\in C} PQ_c \cdot qdst_c$$ $$\begin{bmatrix} \textit{total} \\ \textit{absorption}\end{bmatrix} = \begin{bmatrix} \textit{household} \\ \textit{market} \\ \textit{consumption}\end{bmatrix} + \begin{bmatrix} \textit{household} \\ \textit{home} \\ \textit{consumption}\end{bmatrix} + \begin{bmatrix} \textit{government} \\ \textit{consumption}\end{bmatrix} + \begin{bmatrix} \textit{fixed} \\ \textit{investment}\end{bmatrix} + \begin{bmatrix} \textit{stock} \\ \textit{change}\end{bmatrix}$$ | Total Absorption |
| 49 | $$INVSHR \cdot TABS = \sum_{c\in C} PQ_c \cdot QINV_c + \sum_{c\in C} PQ_c \cdot qdst_c$$ $$\begin{bmatrix} \textit{investment-} \\ \textit{absorption} \\ \textit{ratio}\end{bmatrix} \cdot \begin{bmatrix} \textit{total} \\ \textit{absorption}\end{bmatrix} = \begin{bmatrix} \textit{fixed} \\ \textit{investment}\end{bmatrix} + \begin{bmatrix} \textit{stock} \\ \textit{change}\end{bmatrix}$$ | Ratio of Investment to Absorption |
| 50 | $$GOVSHR \cdot TABS = \sum_{c\in C} PQ_c \cdot QG_c$$ $$\begin{bmatrix} \textit{government} \\ \textit{consumption-} \\ \textit{absorption} \\ \textit{ratio}\end{bmatrix} \cdot \begin{bmatrix} \textit{total} \\ \textit{absorption}\end{bmatrix} = \begin{bmatrix} \textit{government} \\ \textit{consumption}\end{bmatrix}$$ | Ratio of Government Consumption to Absorption |
| 51 | $$WFKAV^a_{ft} = \sum_a \left[ \left( \frac{QF_{fat}}{\sum_{a'} QF_{fa't}} \right) \cdot WF_{ft} \cdot WFDIST_{fat} \right]$$ $$\begin{bmatrix} \textit{average capital} \\ \textit{rental rate}\end{bmatrix} = \begin{bmatrix} \textit{weighted sum of sectors'} \\ \textit{capital rental rates}\end{bmatrix}$$ | average economy-wide rental rate of capital |

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Table C.1 (Concluded)

| | | |
|---|---|---|
| 52 | $$INVSHR1^{a}_{f\,a\,t} = \left( \frac{QF_{f\,a\,t}}{\sum_{a'} QF_{f\,a'\,t}} \right) \cdot \left( \beta^{a} \cdot \left( \frac{WF_{f,t} \cdot WFDIST_{f\,a\,t}}{WFKAV^{a}_{f\,t}} - 1 \right) + 1 \right)$$ $$\left[ \begin{array}{c} \textit{share of} \\ \textit{new capital} \end{array} \right] = \left[ \begin{array}{c} \textit{share of} \\ \textit{existing capital} \end{array} \right] \cdot \left[ \begin{array}{c} \textit{capital rental} \\ \textit{rate ratio} \end{array} \right]$$ | sector's share of the new capital investment |
| 53 | $$\Delta DKAPS^{a}_{f\,a\,t} = INVSHR1^{a}_{f\,a\,t} \cdot \left( \frac{\sum_{c} PQ_{c\,t} \cdot QINV_{c\,t}}{PK_{f\,t}} \right)$$ $$\left[ \begin{array}{c} \textit{quantity of new} \\ \textit{capital by sector} \end{array} \right] = \left[ \begin{array}{c} \textit{share of} \\ \textit{new capital} \end{array} \right] \cdot \left[ \begin{array}{c} \textit{total quantity of} \\ \textit{new capital} \end{array} \right]$$ | Allocate gross fixed capital formation |
| 54 | $$PK_{f\,t} = \sum_{c} PQ_{c\,t} \cdot \frac{QINV_{c\,t}}{\sum_{c'} QINV_{c'\,t}}$$ $$\left[ \begin{array}{c} \textit{unit price} \\ \textit{of capital} \end{array} \right] = \left[ \begin{array}{c} \textit{weighted market price} \\ \textit{of investment commodities} \end{array} \right]$$ | price of capital |
| 55 | $$QF_{f\,a\,t+1} = QF_{f\,a\,t} \cdot \left( 1 + \frac{\Delta INVSHR1^{a}_{f\,a\,t}}{QF_{f\,a\,t}} - deprate_{f} \right)$$ $$\left[ \begin{array}{c} \textit{average capital} \\ \textit{rental rate} \end{array} \right] = \left[ \begin{array}{c} \textit{weighted sum of sectors'} \\ \textit{capital rental rates} \end{array} \right]$$ | Updating quantity of capital |
| 56 | $$QFS_{f\,t+1} = QFS_{f\,t} \cdot \left( 1 + \frac{\sum_{a} \Delta INVSHR1_{f\,a\,t}}{QFS_{f\,t}} - deprate_{f} \right)$$ $$\left[ \begin{array}{c} \textit{average capital} \\ \textit{rental rate} \end{array} \right] = \left[ \begin{array}{c} \textit{weighted sum of sectors'} \\ \textit{capital rental rates} \end{array} \right]$$ | Updating quantity of capital |

Table C.2

LIST OF EQUATIONS

EQUATIONS

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

/Continued

Table C.2 (Continued)

| | | | |
|---|---|---|---|
| 7 | $$PINTA_a = \sum_{c \in C} PQ_c \cdot ica_{c\,a}$$ $$\begin{bmatrix} aggregate \\ intermediate \\ input\ price \end{bmatrix} = \begin{bmatrix} intermediate\ input\ cost \\ per\ unit\ of\ aggregate \\ intermediate\ input \end{bmatrix}$$ | $a \in A$ | Aggregate intermediate input price |
| 8 | $$PA_a \cdot (1 - ta_a) \cdot QA_a = PVA_a \cdot QVA_a + PINTA_a \cdot QINTA_a$$ $$\begin{bmatrix} activity\ price \\ (net\ of\ taxes) \\ times\ activity\ level \end{bmatrix} = \begin{bmatrix} value\text{-}added \\ price\ times \\ quantity \end{bmatrix} + \begin{bmatrix} aggregate \\ intermediate \\ input\ price\ times \\ quantity \end{bmatrix}$$ | $a \in A$ | Activity revenue and costs |
| 9 | $$\overline{CPI} = \sum_{c \in C} PQ_c \cdot cwts_c$$ $$[CPI] = \begin{bmatrix} prices\ times \\ weights \end{bmatrix}$$ | | Consumer price index |
| 10 | $$DPI = \sum_{c \in C} PDS_c \cdot dwts_c$$ $$\begin{bmatrix} Producer\ price\ index \\ for\ non\text{-}traded\ outputs \end{bmatrix} = \begin{bmatrix} prices\ times \\ weights \end{bmatrix}$$ | | Producer price index for non-traded market output |
| Production and commodity block | | | |
| 11 | $$QA_a = \alpha_a^a \cdot \left( \delta_a^a \cdot QVA_a^{-\rho_a^a} + (1 - \delta_a^a) \cdot QINTA_a^{-\rho_a^a} \right)^{-\frac{1}{\rho_a^a}}$$ $$\begin{bmatrix} activity \\ level \end{bmatrix} = CES \begin{bmatrix} quantity\ of\ aggregate\ value\text{-}added, \\ quantity\ aggregate\ intermediate\ input \end{bmatrix}$$ | $a \in ACES$ | CES technology: activity production function |
| 12 | $$\frac{QVA_a}{QINTA_a} = \left( \frac{PINTA_a}{PVA_a} \cdot \frac{\delta_a^a}{1 - \delta_a^a} \right)^{\frac{1}{1+\rho_a^a}}$$ $$\begin{bmatrix} value\text{-}added - \\ intermediate\text{-} \\ input\ quantity \\ ratio \end{bmatrix} = f \begin{bmatrix} intermediate\text{-}input \\ - value\text{-}added \\ price\ ratio \end{bmatrix}$$ | $a \in ACES$ | CES technology: Value-added intermediate input ratio |
| 13 | $$QVA_a = iva_a \cdot QA_a$$ $$\begin{bmatrix} demand\ for \\ value\text{-}added \end{bmatrix} = f \begin{bmatrix} activity \\ level \end{bmatrix}$$ | $a \in ALEO$ | Leontief technology: Demand for aggregate value-added |

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Table C.2 (Continued)

| | | | |
|---|---|---|---|
| 14 | $QINTA_a = inta_a \cdot QA_a$<br>$\begin{bmatrix} \text{demand for aggregate} \\ \text{intermediate input} \end{bmatrix} = f \begin{bmatrix} \text{activity} \\ \text{level} \end{bmatrix}$ | $a \in ALEO$ | Leontief technology: Demand for aggregate intermediate input |
| 15 | $QVA_a = \alpha_a^{va} \cdot \left( \sum_{f \in F} \delta_{f\,a}^{va} \cdot QF_{f\,a}^{\;-\rho_a^{va}} \right)^{-\frac{1}{\rho_a^{va}}}$<br>$\begin{bmatrix} \text{quantity of aggregate} \\ \text{value-added} \end{bmatrix} = CES \begin{bmatrix} \text{factor} \\ \text{inputs} \end{bmatrix}$ | $a \in A$ | Value-added and factor demands |
| 16 | ${}_{f} \cdot \overline{WFDIST}_{fa} = PVA_a \cdot (1 - tva_a) \cdot QVA_a \cdot \left( \sum_{f \in F'} \delta_{f\,a}^{va} \cdot QF_{f\,a}^{\;-\rho_a^{va}} \right)^{-1} \cdot \delta_{f\,a}^{va} \cdot QF_{f\,a}^{\;-\rho_a^{va}-1}$<br>$\begin{bmatrix} \text{marginal cost of} \\ \text{factor } f \text{ in activity } a \end{bmatrix} = \begin{bmatrix} \text{marginal revenue product} \\ \text{of factor } f \text{ in activity } a \end{bmatrix}$ | $a \in A$<br>$f \in F$ | Factor demand |
| 17 | $WFREAL_f = \frac{YF}{CPI * \sum_a QF_{f,a}}$<br>$\begin{bmatrix} \text{average real wage} \\ \text{per factor unit} \end{bmatrix} = \begin{bmatrix} \text{average wage corrcected} \\ \text{by consumer index price} \end{bmatrix}$ | $f \in F$ | Real wages |
| 18 | $QFS_f = QFS0 * \left[ \frac{\frac{WF_f * WFDIST_f * QF_f}{QFS_f}}{\frac{CPI}{\frac{WF0_f}{CPI0}}} \right]^{etals_f}$ | $f \in F$ | Labor supply |
| 19 | $QINT_{c\,a} = ica_{ca} \cdot QINTA_a$<br>$\begin{bmatrix} \text{intermediate demand} \\ \text{for commodity } c \\ \text{from activity } a \end{bmatrix} = f \begin{bmatrix} \text{aggregate intermediate} \\ \text{input quantity} \\ \text{for activity } a \end{bmatrix}$ | $a \in A$<br>$c \in C$ | Disaggregated intermediate input demand |
| 20 | $QXAC_{a\,c} + \sum_{h \in H} QHA_{ach} = \theta_{a\,c} \cdot QA_a$<br>$\begin{bmatrix} \text{marketed quantity} \\ \text{of commodity } c \\ \text{from activity } a \end{bmatrix} + \begin{bmatrix} \text{household home} \\ \text{consumption} \\ \text{of commodity } c \\ \text{from activity } a \end{bmatrix} = \begin{bmatrix} \text{production} \\ \text{of commodity } c \\ \text{from activity } a \end{bmatrix}$ | $a \in A$<br>$c \in CX$ | Commodity production and allocation |

/Continued

Table C.2 (Continued)

| | | | |
|---|---|---|---|
| 21 | $$QX_c = \alpha_c^{ac} \cdot \left( \sum_{a \in A} \delta_{ac}^{ac} \cdot QXAC_{ac}^{-\rho_c^{ac}} \right)^{-\frac{1}{\rho_c^{ac}-1}}$$ $$\begin{bmatrix} \text{aggregate marketed production of commodity } c \end{bmatrix} = CES \begin{bmatrix} \text{activity-specific marketed production of commodity } c \end{bmatrix}$$ | $c \in CX$ | Output aggregation function |
| 22 | $$PXAC_{ac} = PX_c \cdot QX_c \left( \sum_{a \in A'} \delta_{ac}^{ac} \cdot QXAC_{ac}^{-\rho_c^{ac}} \right)^{-1} \cdot \delta_{ac}^{ac} \cdot QXAC_{ac}^{-\rho_c^{ac}-1}$$ $$\begin{bmatrix} \text{marginal cost of commodity } c \text{ from activity } a \end{bmatrix} = \begin{bmatrix} \text{marginal revenue product of commodity } c \text{ from activity } a \end{bmatrix}$$ | $a \in A$ <br> $c \in CX$ | First-order condition for output aggregation function |
| 23 | $$QX_c = \alpha_c^t \cdot \left( \delta_c^t \cdot QE_c^{\rho_c^t} + (1-\delta_c^t) \cdot QD_c^{\rho_c^t} \right)^{\frac{1}{\rho_c^t}}$$ $$\begin{bmatrix} \text{aggregate marketed domestic output} \end{bmatrix} = CET \begin{bmatrix} \text{export quantity, domestic sales of domestic output} \end{bmatrix}$$ | $c \in (CE \cap CD)$ | Output transformation (CET) function |
| 24 | $$\frac{QE_c}{QD_c} = \left( \frac{PE_c}{PDS_c} \cdot \frac{1-\delta_c^t}{\delta_c^t} \right)^{\frac{1}{\rho_c^t - 1}}$$ $$\begin{bmatrix} \text{export-domestic supply ratio} \end{bmatrix} = f \begin{bmatrix} \text{export-domestic price ratio} \end{bmatrix}$$ | $c \in (CE \cap CD)$ | Export-domestic supply ratio |
| 25 | $$QX_c = QD_c + QE_c$$ $$\begin{bmatrix} \text{aggregate marketed domestic output} \end{bmatrix} = \begin{bmatrix} \text{domestic market sales of domestic output [for } c \in (CD \cap CEN)] \end{bmatrix} + \begin{bmatrix} \text{exports [for } c \in (CE \cap CDN)] \end{bmatrix}$$ | $c \in$ <br> $(CD \cap CEN)$ <br> $\cup$ <br> $(CE \cup CDN)$ | Output transformation for non-exported commodities |
| 26 | $$QQ_c = \alpha_c^q \cdot \left( \delta_c^q \cdot QM_c^{-\rho_c^q} + (1-\delta_c^q) \cdot QD_c^{-\rho_c^q} \right)^{-\frac{1}{\rho_c^q}}$$ $$\begin{bmatrix} \text{composite supply} \end{bmatrix} = f \begin{bmatrix} \text{import quantity, domestic use of domestic output} \end{bmatrix}$$ | $c \in (CM \cap CD)$ | Composite supply (Armington) function |
| 27 | $$\frac{QM_c}{QD_c} = \left( \frac{PDD_c}{PM_c} \cdot \frac{\delta_c^q}{1-\delta_c^q} \right)^{\frac{1}{1+\rho_c^q}}$$ $$\begin{bmatrix} \text{import-domestic demand ratio} \end{bmatrix} = f \begin{bmatrix} \text{domestic-import price ratio} \end{bmatrix}$$ | $c \in (CM \cap CD)$ | Import-domestic demand ratio |

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Table C.2 (Continued)

| | | | |
|---|---|---|---|
| 28 | $QQ_c = QD_c + QM_c$ <br> $\begin{bmatrix} composite \\ supply \end{bmatrix} = \begin{bmatrix} domestic\ use\ of \\ marketed\ domestic \\ output\ [for \\ c \in (CD \cap CMN)] \end{bmatrix} + \begin{bmatrix} imports\ [for \\ c \in (CM \cap CDN)] \end{bmatrix}$ | $c \in (CD \cap CMN) \cup (CM \cap CDN)$ | Composite supply for non-imported outputs and non-produced imports |
| 29 | $QT_c = \sum_{c' \in C'} \left( icm_{c\,c'} \cdot QM_{c'} + ice_{c\,c'} \cdot QE_{c'} + icd_{c\,c'} \cdot QD_{c'} \right)$ <br> $\begin{bmatrix} demand\ for \\ transactions \\ services \end{bmatrix} = \begin{bmatrix} sum\ of\ demands \\ for\ imports,\ exports, \\ and\ domestic\ sales \end{bmatrix}$ | $c \in CT$ | Demand for transactions services |
| Institution block | | | |
| 30 | $YF_f = \sum_{a \in A} WF_f \cdot \overline{WFDIST}_{f\,a} \cdot QF_{f\,a}$ <br> $\begin{bmatrix} income\ of \\ factor\ f \end{bmatrix} = \begin{bmatrix} sum\ of\ activity\ payments \\ (activity\text{-}specific\ wages \\ times\ employment\ levels) \end{bmatrix}$ | $f \in F$ | Factor income |
| 31 | $YIF_{i\,f} = shif_{i\,f} \cdot \left[ \left(1 - tf_f\right) \cdot YF_f - trnsfr_{row\,f} \cdot EXR \right]$ <br> $\begin{bmatrix} income\ of \\ institution\ i \\ from\ factor\ f \end{bmatrix} = \begin{bmatrix} share\ of\ income \\ of\ factor\ f\ to \\ institution\ i \end{bmatrix} \cdot \begin{bmatrix} income\ of\ factor\ f \\ (net\ of\ tax\ and \\ transfer\ to\ RoW) \end{bmatrix}$ | $i \in INSD$ <br> $f \in F$ | Institutional factor incomes |
| 32 | $YI_i = \sum_{f \in F} YIF_{i\,f} + \sum_{i' \in INSDNG'} TRII_{i\,i'} + trnsfr_{i\,gov} \cdot \overline{CPI} + trnsfr_{i\,row} \cdot EXR$ <br> $\begin{bmatrix} income\ of \\ institution\ i \end{bmatrix} = \begin{bmatrix} factor \\ income \end{bmatrix} + \begin{bmatrix} transfers \\ from\ other\ domestic \\ non\text{-}government \\ institutions \end{bmatrix} + \begin{bmatrix} transfers \\ from \\ government \end{bmatrix} + \begin{bmatrix} transfers \\ from \\ RoW \end{bmatrix}$ | $i \in INSDNG$ | Income of domestic, non-government institutions |
| 33 | $TRII_{i\,i'} = shii_{i\,i'} \cdot (1\text{-}MPS_{i'}) \cdot (1\text{-}TINS_{i'}) \cdot YI_{i'}$ <br> $\begin{bmatrix} transfer\ from \\ institution\ i'\ to\ i \end{bmatrix} = \begin{bmatrix} share\ of\ net\ income \\ of\ institution\ i' \\ transfered\ to\ i \end{bmatrix} \cdot \begin{bmatrix} income\ of\ institution \\ i',\ net\ of\ savings\ and \\ direct\ taxes \end{bmatrix}$ | $i \in INSDNG$ <br> $i' \in INSDNG'$ | Intra-institutional transfers |
| 34 | $EH_h = \left( 1 - \sum_{i \in INSDNG} shii_{i\,h} \right) \cdot \left(1 - MPS_h\right) \cdot (1\text{-}TINS_h) \cdot YI_h$ <br> $\begin{bmatrix} household\ income \\ disposable\ for \\ consumption \end{bmatrix} = \begin{bmatrix} household\ income,\ net\ of\ direct \\ taxes,\ savings,\ and\ transfers\ to \\ other\ non\text{-}government\ institutions \end{bmatrix}$ | $h \in H$ | Household consumption expenditure |

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Table C.2 (Continued)

| | | | |
|---|---|---|---|
| 35 | $QH_{ch} = \gamma_{ch} + \dfrac{\beta^m_{ch} \cdot \left( EH_h - \sum_{c' \in C} PQ_{c'} \cdot \gamma^m_{c'h} - \sum_{a \in A} \sum_{c' \in C} PXAC_{ac'} \cdot \gamma^h_{ac'h} \right)}{PQ_c}$ <br> $\begin{bmatrix} \text{quantity of} \\ \text{household demand} \\ \text{for commodity } c \end{bmatrix} = f \begin{bmatrix} \text{household} \\ \text{consumption} \\ \text{spending,} \\ \text{market price} \end{bmatrix}$ | $c \in C$ <br> $h \in H$ | Household consumption demand for marketed commodities |
| 36 | $QHA_{ach} = \gamma^h_{ach} + \dfrac{\beta^h_{ach} \cdot \left( EH_h - \sum_{c' \in C} PQ_{c'} \cdot \gamma^m_{c'h} - \sum_{a \in A} \sum_{c' \in C} PXAC_{ac'} \cdot \gamma^h_{ac'h} \right)}{PXAC_{ac}}$ <br> $\begin{bmatrix} \text{quantity of} \\ \text{household demand} \\ \text{for home commodity } c \\ \text{from activity } a \end{bmatrix} = f \begin{bmatrix} \text{household} \\ \text{disposable} \\ \text{income,} \\ \text{producer price} \end{bmatrix}$ | $a \in A$ <br> $c \in C$ <br> $h \in H$ | Household Consumption Demand for Home Commodities |
| 37 | $QINV_c = \overline{IADJ} \cdot \overline{qinv}_c$ <br> $\begin{bmatrix} \text{fixed investment} \\ \text{demand for} \\ \text{commodity } c \end{bmatrix} = \begin{bmatrix} \text{adjustment factor} \\ \text{times} \\ \text{base-year fixed} \\ \text{investment} \end{bmatrix}$ | $c \in CINV$ | Investment demand |
| 38 | $QG_c = \overline{GADJ} \cdot \overline{qg}_c$ <br> $\begin{bmatrix} \text{government} \\ \text{consumption} \\ \text{demand for} \\ \text{commodity } c \end{bmatrix} = \begin{bmatrix} \text{adjustment factor} \\ \text{times} \\ \text{base-year government} \\ \text{consumption} \end{bmatrix}$ | $c \in C$ | Government consumption demand |
| 39 | $YG = \sum_{i \in INSDNG} TINS_i \cdot YI_i + \sum_{f \in F} tf_f \cdot YF_f + \sum_{a \in A} tva_a \cdot PVA_a \cdot QVA_a$ <br> $+ \sum_{a \in A} ta_a \cdot PA_a \cdot QA_a + \sum_{c \in CM} tm_c \cdot pwm_c \cdot QM_c \cdot EXR + \sum_{c \in CE} te_c \cdot pwe_c \cdot QE_c \cdot EXR$ <br> $+ \sum_{c \in C} tq_c \cdot PQ_c \cdot QQ_c + \sum_{f \in F} YF_{gov\,f} + trnsfr_{gov\,row} \cdot EXR$ <br> $\begin{bmatrix} \text{government} \\ \text{revenue} \end{bmatrix} = \begin{bmatrix} \text{direct taxes} \\ \text{from} \\ \text{institutions} \end{bmatrix} + \begin{bmatrix} \text{direct taxes} \\ \text{from} \\ \text{factors} \end{bmatrix} + \begin{bmatrix} \text{value-} \\ \text{added} \\ \text{tax} \end{bmatrix}$ <br> $+ \begin{bmatrix} \text{activity} \\ \text{tax} \end{bmatrix} + \begin{bmatrix} \text{import} \\ \text{tariffs} \end{bmatrix} + \begin{bmatrix} \text{export} \\ \text{taxes} \end{bmatrix}$ <br> $+ \begin{bmatrix} \text{sales} \\ \text{tax} \end{bmatrix} + \begin{bmatrix} \text{factor} \\ \text{income} \end{bmatrix} + \begin{bmatrix} \text{transfers} \\ \text{from} \\ \text{RoW} \end{bmatrix}$ | | Government revenue |

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Table C.2 (Continued)

| | | | |
|---|---|---|---|
| 40 | $$EG = \sum_{c \in C} PQ_c \cdot QG_c + \sum_{i \in INSDNG} trnsfr_{i\,gov} \cdot \overline{CPI}$$ $$\begin{bmatrix} government \\ spending \end{bmatrix} = \begin{bmatrix} government \\ consumption \end{bmatrix} + \begin{bmatrix} transfers\ to\ domestic \\ non\text{-}government \\ institutions \end{bmatrix}$$ | | Government expenditures |
| System Constraint Block | | | |
| 41 | $$\sum_{a \in A} QF_{f\,a} = \overline{QFS}_f$$ $$\begin{bmatrix} demand\ for \\ factor\ f \end{bmatrix} = \begin{bmatrix} supply\ of \\ factor\ f \end{bmatrix}$$ | $f \in F$ | Factor market |
| 42 | $$QQ_c = \sum_{a \in A} QINT_{c\,a} + \sum_{h \in H} QH_{c\,h} + QG_c + QINV_c + qdst_c + QT_c$$ $$\begin{bmatrix} composite \\ supply \end{bmatrix} = \begin{bmatrix} intermediate \\ use \end{bmatrix} + \begin{bmatrix} household \\ consumption \end{bmatrix} + \begin{bmatrix} government \\ consumption \end{bmatrix} + \begin{bmatrix} fixed \\ investment \end{bmatrix} + \begin{bmatrix} stock \\ change \end{bmatrix} + \begin{bmatrix} trade \\ input\ use \end{bmatrix}$$ | $c \in C$ | Composite commodity markets |
| 43 | $$\sum_{c \in CM} pwm_c \cdot QM_c + \sum_{f \in F} trnsfr_{row\,f} = \sum_{c \in CE} pwe_c \cdot QE_c + \sum_{i \in INSD} trnsfr_{i\,row} + \overline{FSAV}$$ $$\begin{bmatrix} import \\ spending \end{bmatrix} + \begin{bmatrix} factor \\ transfers \\ to\ RoW \end{bmatrix} = \begin{bmatrix} export \\ revenue \end{bmatrix} + \begin{bmatrix} institutional \\ transfers \\ from\ RoW \end{bmatrix} + \begin{bmatrix} foreign \\ savings \end{bmatrix}$$ | | Current account balance for RoW (in foreign currency) |
| 44 | $$YG = EG + GSAV$$ $$\begin{bmatrix} government \\ revenue \end{bmatrix} = \begin{bmatrix} government \\ expenditures \end{bmatrix} + \begin{bmatrix} government \\ savings \end{bmatrix}$$ | | Government balance |
| 45 | $$TINS_i = \overline{tins}_i \cdot \left(1 + \overline{TINSADJ} \cdot tins01_i\right) + \overline{DTINS} \cdot tins01_i$$ $$\begin{bmatrix} direct\ tax \\ rate\ for \\ institution\ i \end{bmatrix} = \begin{bmatrix} base\ rate\ adjusted \\ for\ scaling\ for \\ selected\ institutions \end{bmatrix} + \begin{bmatrix} point\ change \\ for\ selected \\ institutions \end{bmatrix}$$ | $i \in INSDNG$ | Direct institutional tax rates |
| 46 | $$MPS_i = \overline{mps}_i \cdot \left(1 + \overline{MPSADJ} \cdot mps01_i\right) + DMPS \cdot mps01_i$$ $$\begin{bmatrix} savings \\ rate\ for \\ institution\ i \end{bmatrix} = \begin{bmatrix} base\ rate\ adjusted \\ for\ scaling\ for \\ selected\ institutions \end{bmatrix} + \begin{bmatrix} point\ change \\ for\ selected \\ institutions \end{bmatrix}$$ | $i \in INSDNG$ | Institutional savings rates |

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Table C.2 (Continued)

| | | |
|---|---|---|
| 47 | $$\sum_{i \in INSDNG} MPS_i \cdot (1 - TINS_i) \cdot YI_i + GSAV + EXR \cdot \overline{FSAV} = \sum_{c \in C} PQ_c \cdot QINV_c + \sum_{c \in C} PQ_c \cdot qdst_c$$ $$\begin{bmatrix} non\text{-}govern\text{-} \\ ment\ savings \end{bmatrix} + \begin{bmatrix} government \\ savings \end{bmatrix} + \begin{bmatrix} foreign \\ savings \end{bmatrix} = \begin{bmatrix} fixed \\ investment \end{bmatrix} + \begin{bmatrix} stock \\ change \end{bmatrix}$$ | Savings-investment balance |
| 48 | $$TABS = \sum_{h \in H} \sum_{c \in C} PQ_c \cdot QH_{ch} + \sum_{a \in A} \sum_{c \in C} \sum_{h \in H} PXAC_{ac} \cdot QHA_{ach} + \sum_{c \in C} PQ_c \cdot QG_c + \sum_{c \in C} PQ_c \cdot QINV_c + \sum_{c \in C} PQ_c \cdot qdst_c$$ $$\begin{bmatrix} total \\ absorption \end{bmatrix} = \begin{bmatrix} household \\ market \\ consumption \end{bmatrix} + \begin{bmatrix} household \\ home \\ consumption \end{bmatrix} + \begin{bmatrix} government \\ consumption \end{bmatrix} + \begin{bmatrix} fixed \\ investment \end{bmatrix} + \begin{bmatrix} stock \\ change \end{bmatrix}$$ | Total absorption |
| 49 | $$INVSHR \cdot TABS = \sum_{c \in C} PQ_c \cdot QINV_c + \sum_{c \in C} PQ_c \cdot qdst_c$$ $$\begin{bmatrix} investment\text{-} \\ absorption \\ ratio \end{bmatrix} \cdot \begin{bmatrix} total \\ absorption \end{bmatrix} = \begin{bmatrix} fixed \\ investment \end{bmatrix} + \begin{bmatrix} stock \\ change \end{bmatrix}$$ | Ratio of Investment to Absorption |
| 50 | $$GOVSHR \cdot TABS = \sum_{c \in C} PQ_c \cdot QG_c$$ $$\begin{bmatrix} government \\ consumption\text{-} \\ absorption \\ ratio \end{bmatrix} \cdot \begin{bmatrix} total \\ absorption \end{bmatrix} = \begin{bmatrix} government \\ consumption \end{bmatrix}$$ | Ratio of government consumption to absorption |
| 51 | $$WFKAV_{ft}^{a} = \sum_{a} \left[ \left( \frac{QF_{fat}}{\sum_{a'} QF_{fa't}} \right) \cdot WF_{ft} \cdot WFDIST_{fat} \right]$$ $$\begin{bmatrix} average\ capital \\ rental\ rate \end{bmatrix} = \begin{bmatrix} weighted\ sum\ of\ sectors' \\ capital\ rental\ rates \end{bmatrix}$$ | Average economy-wide rental rate of capital |

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Table C.2 (Concluded)

52
$$INVSHR1^{a}_{f\,a\,t} = \left( \frac{QF_{f\,a\,t}}{\sum_{a'} QF_{f\,a'\,t}} \right) \cdot \left( \beta^{a} \cdot \left( \frac{WF_{f,t} \cdot WFDIST_{f\,a\,t}}{WFKAV^{a}_{f\,t}} - 1 \right) + 1 \right)$$
$$\begin{bmatrix} share\ of \\ new\ capital \end{bmatrix} = \begin{bmatrix} share\ of \\ existing\ capital \end{bmatrix} \cdot \begin{bmatrix} capital\ rental \\ rate\ ratio \end{bmatrix}$$
Sector's share of the new capital investment

53
$$\Delta DKAPS^{a}_{f\,a\,t} = INVSHR1^{a}_{f\,a\,t} \cdot \left( \frac{\sum_{c} PQ_{c\,t} \cdot QINV_{c\,t}}{PK_{f\,t}} \right)$$
$$\begin{bmatrix} quantity\ of\ new \\ capital\ by\ sector \end{bmatrix} = \begin{bmatrix} share\ of \\ new\ capital \end{bmatrix} \cdot \begin{bmatrix} total\ quantity\ of \\ new\ capital \end{bmatrix}$$
Allocate gross fixed capital formation

54
$$PK_{f\,t} = \sum_{c} PQ_{c\,t} \cdot \frac{QINV_{c\,t}}{\sum_{c'} QINV_{c'\,t}}$$
$$\begin{bmatrix} unit\ price \\ of\ capital \end{bmatrix} = \begin{bmatrix} weighted\ market\ price \\ of\ investment\ commodities \end{bmatrix}$$
Price of capital

55
$$QF_{f\,a\,t+1} = QF_{f\,a\,t} \cdot \left( 1 + \frac{\Delta INVSHR1^{a}_{f\,a\,t}}{QF_{f\,a\,t}} - deprate_{f} \right)$$
$$\begin{bmatrix} average\ capital \\ rental\ rate \end{bmatrix} = \begin{bmatrix} weighted\ sum\ of\ sectors' \\ capital\ rental\ rates \end{bmatrix}$$
Updating quantity of capital

56
$$QFS_{f\,t+1} = QFS_{f\,t} \cdot \left( 1 + \frac{\sum_{a} \Delta INVSHR1_{f\,a\,t}}{QFS_{f\,t}} - deprate_{f} \right)$$
$$\begin{bmatrix} average\ capital \\ rental\ rate \end{bmatrix} = \begin{bmatrix} weighted\ sum\ of\ sectors' \\ capital\ rental\ rates \end{bmatrix}$$
Updating total quantity of capital

Appendix D

## THE MICROSIMULATION MODULE

The basic input for the microsimulations of the poverty and distribution impact of the CAFTA scenarios is the 2004 national household survey entitled Encuesta Nacional de Condiciones de Vida (MECOVI) [22] It comprises a national sample of 8,175 households. We use the solution of the CGE for 2005 to get the base-period distribution of the labor force across the households represented in the survey. We then use the random procedure described in Vos, Taylor and Paes de Barros, 2002 and in more detail in Appendix J of Sanchez (2004) to get an estimate of the hypothetical level of poverty and distribution of income that would be observed in each of the CAFTA scenarios. Each microsimulation is repeated 100 times to get a mean estimate and a standard error, enabling us to make statements regarding the significance of the changes we found. The procedure is done sequentially, first for the change coming from the total growth in employment, holding skill structure and relative wages constant, and then sequentially allowing for changes in skill structure and relative wages.

The poverty lines are taken from CEPAL (2005), adjusted from 2002 to 2004 by changes in inflation. The moderate line is adjusted by the change in the CPI, while the extreme poverty line is adjusted by the change in the price of food. The lines for the urban sector are 1,604 lempiras per month per person for the upper line and 772 for the lower. For the rural sector, the lines are 988 for the moderate line and 544 for extreme poverty. In 2004 US dollars, those lines translate to $88 per month for moderate urban poverty and $54 for extreme urban poverty, and $42 and $28, respectively, for rural poverty. We note that relative to other countries these poverty lines are quite high, particularly given that Honduras is a relatively poor country, which is one of the reasons that the level of poverty in all of our microsimulations is so high.

[22] Program for the Improvement of Surveys and the Measurement of Living Conditions in Latin America and the Caribbean (MECOVI).