Poverty Impacts of Trade Integration with the EU: lessons for Ecuador

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Abstract

This research proposes to measure the effects of a trade agreement with the European Union on poverty in Ecuador. Both poverty and the signing of a trade agreement with the EU are issues under discussion in Ecuador. Ecuador is seeking to sign a trade agreement with the EU due to their complementary trade: the EU is a major market for Ecuadorian agricultural and fish products, and Ecuador imports mainly manufacturing goods from the EU. In particular, the EU is the main market for the main agricultural export product of Ecuador: bananas. The transmission mechanisms to study these issues include changes in commodity prices, wages and earnings, and labor market demands. This research combines a reduced-form micro household income and occupational choice model with a standard single-country computable general equilibrium model (CGE) for Ecuador. This study highlights that a trade agreement with the EU may have a different impact on poverty depending on the degree of initial tariff reduction, on labor market considerations, and on whether better access to Ecuadorian bananas is granted by the negotiations or not. Through trade liberalization there is a significant increase in imports from the EU, particularly in protected sectors. With better access for bananas to the EU market, investment constraints may imply that increasing banana export and production can be achieved by pulling resources (namely production and labor) out of other sectors. Nearly every scenario of a trade agreement leads to a decline in extreme poverty in rural regions. In contrast, extreme poverty in urban regions may increase.

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1. Introduction

Ecuador is currently negotiating a trade agreement with the European Union, one of Ecuador's main trade partners. In 2007, Ecuadorian exports to the EU represented 12.7 % of the value of its total exports –the average in the last five years (2003-2007) was 13.6 %. In the same year, the share of Ecuador's imports from the EU in total imports reached 9 %. Almost half of Ecuadorian exports to the EU consist of agricultural products such as banana (35 %), and other fruit, vegetables and flowers (10 %). In contrast, most of Ecuador's imports from the EU are manufactures such as machinery (38 %), or chemicals, rubber and plastic (26 %).

Under the Generalized System of Preferences Plus (GSP+) the EU provides tariff preferences to around 6,600 products of which 6,370 enter the EU with zero tariffs. A few products that are of special importance to Ecuador do not have free access to the EU market such as bananas, which pay 176 euros per Metric Ton to enter the EU market. According to the EU, GSP+ aims to contribute to poverty reduction, good governance, and sustainable development. These tariff preferences are unilaterally provided by the EU, because Ecuador applies tariffs to European products.

Agricultural export activities are an important economic activity for Ecuador and banana exports alone represent two thirds of total tropical exports. Furthermore, according to the Central Bank of Ecuador, depending on the degree of technological advancement, the banana sector directly employs 1 to 3 workers per hectare and indirectly generates 1.5 to 10 jobs per hectare in production (Chang, 2000, as cited in Central Bank of Ecuador, 2004).

Therefore Ecuador expects to gain better access to the European banana market by signing a free trade agreement with the EU. The official negotiations started in July 2007, with the Andean Community (Colombia, Peru, and Bolivia) negotiating as a block, but recent developments have led to each country holding bilateral negotiations with the EU.[1] According to Ecuador's Minister of Trade, Ecuador is interested in signing the agreement because it has complementary trade with the EU (Ecuador exports mostly agricultural products to the EU and imports manufactures from the EU). (El Comercio, November 8, 2008, p.8).

Given the importance of the banana sector, where labor is an important factor of production, it may be the case that the expected changes in banana prices due to better access to the EU market have a key social impact on Ecuador (for better or worse, depending on the outcome of the trade negotiations).

However, to the extent of our knowledge, there is no study that investigates impacts on the Ecuadorian economy of a potential preferential trade agreement with the EU, in particular,

[1] Colombia and Peru finish negotiating the trade agreement with the EU on March 2010. The agreement is to be signed in May 2010 and, according to sources from Peru it will enter into effect on 2012.

impacts on urban and rural sectors, employment, and poverty. The aim of the present study is to fill this gap.

This study is part of a growing branch of empirical economics literature that tries to examine the effects on poverty in countries that have opened their markets to global competition (see literature reviews in, for example, Winters, McCulloch, and McKay 2004, Hertel 2006). The impact analysis of changes in trade policies on poverty in urban and rural (farming) sectors is a very important issue for a country such as Ecuador where rural poverty rates are high.

The channels for the poverty impacts of changes in trade policy (tariffs) addressed in this paper include the impact on prices, employment, and macroeconomic performance, differentiated by urban and rural sectors, and industry.

To perform such impact analyses, we apply a CGE model and micro-simulations. This study is based on research by Wong and Arguello (2009) that links trade and fiscal policy changes to poverty and income distribution effects, using a single-country CGE model *and* a micro simulation model. As opposed to Wong and Arguello, the present study focuses on the impacts that a trade agreement with the EU may have on Ecuador's economy, with special regard to agricultural sectors and the urban/rural effects on poverty. These are key aspects for Ecuador, given that the majority of Ecuadorian exports to the EU are bananas.

The CGE and micro models permit the documentation of changes regarding these prices and labor market effects, within different labor types according to education, region and employment and by mayor type of commodity produced in Ecuador.

The main research questions the present study tackles are: (i) What would the effects of a free trade agreement with the EU be on the main macroeconomic indicators in Ecuador?; (ii) What would the effects of this trade agreement be on poverty (headcount) in Ecuador?; and (iii) How do alternative economic and policy scenarios that seek to stimulate key features of the Ecuadorian economy (unemployment, dollarization, concentration on bananas for the exports to the EU) influence the results of the previous questions?

The trade agreement with the EU is simulated with 3 different scenarios:

- Free trade for all EU products (100 % tariff reduction), and Ecuador keeps the GSP+ preferences
- Free trade for all EU products, Ecuador keeps the GSP+ preferences, and receives better access for bananas to the EU market
- Preferential trade, similar as the first scenario but with a 50 % (instead of 100 %) tariff reduction

The main results suggest that a trade agreement with the EU may have a different poverty impact depending on the degree of initial tariff reduction, and on whether better access to Ecuadorian bananas is granted by the negotiations. The adjustments to a trade agreement with the EU come through changes in prices (goods, services) and factor returns. For the scenarios

that assume unemployment in the unskilled urban and rural labor, adjustments also come through changes in labor demand for these categories of wage workers. How fast trade liberalization is implemented has an impact on factor returns and prices that are reflected in poverty results and macro aggregates. For the macro aggregates, the impacts of preferential trade (50% tariff reduction) are half of those of the scenario of zero tariffs. For poverty results, the 50% tariff reduction determines that –under the assumption of unemployment in the unskilled wage worker segment– poverty reduction may not be as fast as in the zero tariff case and it may be mainly because the reduction in consumption prices is not as big as in the free trade case.

When one important sector of the economy -such as bananas- gets better access to the EU markets (given that almost all of the others are already entering the EU with zero tariffs), investment constraints may imply that increasing export and production of bananas can be achieved by pulling resources (namely labor) out of other sectors. Lower production and higher consumer prices in those sectors may preclude gains from poverty reduction, even if free trade is adopted. This result highlights the need for investment when increasing trade opportunities arise.

The remainder of this paper is organized as follows. Section 2 presents an overview of the Ecuadorian economy. Section 3 discusses relevant work on CGE modeling and micro-simulation models related to trade policies and poverty. Section 4 lays out the methodology and data. Section 5 summarizes the scenarios applied. Section 6 discusses the results and policy implications, and Section 7 presents concluding remarks. The Annex present^s further details on the CGE model structure.

2. Overview of the Ecuadorian Economy

As part of a policy to gain or increase access for Ecuadorian products, the current Government of Ecuador is seeking a trade agreement with the EU. The European Union is a key market for Ecuador, in particular for Ecuadorian bananas. Bananas are a key export product of Ecuador. Ecuador's exports to the EU represent around 12 to 16 % of total exports. According to the Central Bank of Ecuador, banana exports represent 42 % of total non-oil and non-manufacturing exports in Ecuador (Central Bank of Ecuador, 2008). The EU purchases half of Ecuador's total banana exports (49% in 2007) and banana exports to the EU represent more than one third of Ecuador's total exports to the EU (35% in 2007). While Ecuador exports mostly agricultural products to the EU, the majority of Ecuador's imports from the EU are manufacturing products. Ecuador is seeking to consolidate and improve the trade preferences it already receives from the EU through the Generalized System of Preferences Plus (GSP+). As mentioned above, the GSP+ allows most Ecuadorian products to enter the EU free of tariffs. There are a few exceptions, which include some key agricultural products of Ecuador. The most sig-

nificant case is bananas, the main Ecuadorian export to the EU, which are subjected to a specific tariff of 176 euros per metric ton (MT).

Although Ecuador receives zero-tariff entry on almost all products under GSP+, these preferences are subject to revision every period (of about three years, and this has been the case since the EU first implemented GSP for developing countries in 1971). One of the objectives for Ecuador of a trade agreement with the EU is to make this zero-tariff entry permanent, and to extend preferences to those key Ecuadorian products that do not receive preferential treatment.

Ecuadorian producers and exporters are concerned about the market access for Ecuadorian bananas to the EU due to the EU tariff policy on bananas from Latin American countries. Ecuador hopes to obtain no less than was nearly accepted by the EU in the last negotiations between banana country producers and exporters and the EU in Geneva, July 2008. This meeting failed when the EU made the success of the Doha round a condition for its implementation; and, in turn, the Doha round failed. The 2008 Doha round failed because of lack of agreement on the implementation of a mechanism of special safeguards that would allow developing countries to raise tariffs on farm imports when they reach a certain level and begin to threaten the livelihoods of poor farmers. The aforementioned agreement between the EU and banana country producers and exporters called for a slow reduction of the EU specific banana tariff from 176 euros per MT in 2008 to 114 euros per MT by 2016.[2]

The ultimate purpose of the Ecuadorian Government in setting up these agriculture and trade policies is to reduce poverty and redistribute income in favor of the poor. However, despite the importance of the analysis of poverty impacts in Ecuador, there has been little research on the impact on poverty of agricultural trade policies in this country.

As shown in Table 1, poverty is widespread in Ecuador, particularly in rural areas where –measuring poverty using aggregate income[3]– 22.7 % of individuals are under the one-dollar-a-day poverty line (extreme poverty) and 49.6 % are under the two-dollar-a-day poverty line (poverty). In urban areas, 10.8 % are under extreme poverty and 27.8 % live in poverty. Extreme-poverty and poverty rates, measured using aggregate consumption, are lower than poverty results obtained using aggregate income, but poverty rates in rural areas still present high and similar rates under both aggregate measures.[4] In rural areas, 11.6 % of households are extremely poor and 47.1 % are poor. In urban areas, 1.3 % of households are extremely poor and

[2] This tariff may be reduced to 114 Euros per metric ton (over a seven-year period) under an agreement reached between the EU and the Latin American countries at the end of 2009. If and when the agreement is ratified, it would end a sixteen-year WTO dispute between Ecuador (and other Latin American banana exporter countries) and the EU.

[3] Aggregate income includes: wages and salaries, income from agricultural activities, income from self-employment, remittances, and aid.

[4] Aggregate consumption includes food, non-food items, durables, utilities, and rent. Expenditure on durables was calculated as the flow of services from durable goods. It was calculated using data on durable spending and age of the durable goods, as reported in the Ecuadorian household survey.

15 % are poor. There are differences in poverty incidence when households are headed by males or females, and they tend to be wider under the two-dollar-a-day poverty line: when measuring poverty using aggregate income, households headed by women tend to experience a higher incidence rate.

Table 1. Ecuador: Poverty indices (headcount) at the base year 2005 [1,2,3]

Households	a. Measured by Aggregate Consumption		b. Measured by Aggregate Income	
	Below one dollar a day (extreme poverty)	Below two dollars a day (poverty)	Below one dollar a day (extreme poverty)	Below two dollars a day (poverty)
Total	4.85%	26.05%	14.87%	35.28%
Rural	11.57%	47.09%	22.72%	49.55%
Urban	1.33%	15.05%	10.78%	27.82%
Headed by male	5.19%	27.41%	13.64%	33.91%
Headed by female	3.54%	20.88%	19.57%	40.46%

Source: Ecuador's Household Survey 2005-2006, and own calculations.
Notes: 1.-Excludes households that do not show any data on income. 2.-This study uses the customary poverty measure of poverty incidence or FGT(0), which is the percentage of individuals whose consumption (or income) fall under the poverty line. 3.-The poverty lines adopted are also the customary one dollar and two dollar a day poverty lines because the study wants the reader to be able to establish comparisons between the poverty situation in Ecuador and the poverty situation in other developing countries.

Considering that one out of three households in Ecuador live in rural areas, these high poverty incidence rates are significant. According to the 2005-6 household survey data, there are 3,264,866 households in Ecuador (approximately 13 million inhabitants), 34 % of which live in rural areas. Eighty one percent of rural households have some agricultural activity. In contrast (and as expected), fewer urban households work on agricultural related activities, but there is still a considerable share of urban households whose activities include agriculture (18%).

Therefore agricultural activities are an important part of a household income. Households derive income also from wages, self-employment (in non-agricultural activities), remittances, and transfers. The distribution of household income among these sources of income varies by income quintile and by type of household: urban and rural (see Table 2). Agricultural income is a key income component for rural households, in particular for households in the lowest quintile of income, for which agricultural activities make up 33 % of their income. Wages are an important income source for both rural and urban households, but more so for urban households, where wages represent between 42 to 60 % of total income (for rural households between 22 to 48 %), with the higher shares for households in higher income quintiles.

Transfers are an important source of income for the poor, representing 15 % and 10 % of income in households in the lowest income quintile of urban and rural areas, respectively. Similarly, although with lower shares, remittances contribute more to the income of urban households (3 to 7% of their total income) than to the rural households' income (3 to 4% of

their total income), and more to the income of the urban households in the lowest income quintile (7%).

Table 2. Income shares by area and income quintile [1]

Total						**Total**
Quintiles	Remittances	Transfers	Self-employment	Wages	Agricultural	Millions of US$
1	5%	11%	32%	30%	22%	350
2	5%	6%	29%	45%	15%	1,057
3	4%	4%	28%	52%	11%	2,044
4	4%	3%	30%	56%	7%	3,875
5	3%	2%	35%	53%	6%	13,541
Urban						
Quintiles	Remittances	Transfers	Self-employment	Wages	Agricultural	Millions of US$
1	7%	15%	34%	42%	2%	309
2	6%	7%	32%	54%	2%	925
3	5%	4%	31%	58%	1%	1,730
4	4%	4%	31%	60%	1%	3,120
5	3%	2%	37%	55%	4%	9,868
Rural						
Quintiles	Remittances	Transfers	Self-employment	Wages	Agricultural	Millions of US$
1	3%	10%	32%	22%	33%	110
2	4%	4%	27%	37%	28%	309
3	4%	3%	24%	46%	23%	570
4	3%	3%	26%	48%	20%	985
5	3%	1%	31%	41%	23%	2,942

Source: Own construction using data from Ecuador's Household Survey 2005-2006.
Note: 1.-Some households also obtain income from small businesses, but this source of income is not included due to measurement issues.

Income from self-employment represents a similar share of total income for households in the lowest income quintile in both urban (34 %) and rural areas (32 %).

Clearly, wages and agricultural income –two sources of income likely to be affected by policies of trade liberalization– add with varying degrees of importance to the income of urban and rural households in the lowest income quintile. Poor households in rural areas depend on both wages (22 %) and agricultural revenues (33 %), and poor households in urban areas rely heavily on wages (42 %).

Finally, to understand the potential impacts of a free trade agreement with the EU, it is necessary to take into account the composition of households' expenditures, as these expenditures will be affected directly by changes in prices and indirectly by other channels (ripple effects coming from changes in employment and production) during trade liberalization.

Table 3 shows that food expenditures are an important component of households' expenditures: more for rural households than for urban households, and more for households in the lowest income quintile than for households in the higher income quintiles. Thus, for rural households 54 % of expenditures in households in the lowest quintile of income goes towards food items, while 42 % of household expenditures for rural households in the highest income

quintile are on food. In urban areas, the lowest income quintile spends 40 % of their total expenditure on food, and the highest income quintile just 25 %.

Table 3. Expenditure shares by type of household and income quintile

Total								**Total**
Quintiles	Food	Non food	Health	Education	Rent	Services	Durables	Millions of US$
1	46%	16%	6%	3%	16%	6%	6%	1,162
2	46%	16%	6%	3%	14%	5%	9%	1,667
3	44%	18%	6%	4%	14%	5%	8%	2,506
4	41%	19%	6%	5%	14%	5%	10%	3,938
5	28%	25%	6%	7%	14%	5%	14%	9,313
Urban								
Quintiles	Food	Non food	Health	Education	Rent	Services	Durables	Millions of US$
1	40%	16%	6%	3%	18%	6%	10%	1,140
2	40%	19%	6%	4%	16%	6%	9%	1,508
3	39%	19%	6%	5%	15%	6%	10%	2,101
4	36%	20%	6%	6%	15%	6%	12%	3,161
5	25%	27%	6%	7%	15%	6%	15%	6,541
Rural								
Quintiles	Food	Non food	Health	Education	Rent	Services	Durables	Millions of US$
1	54%	14%	7%	2%	14%	5%	4%	292
2	54%	15%	6%	3%	12%	5%	5%	451
3	53%	16%	7%	3%	11%	5%	6%	615
4	51%	17%	6%	4%	11%	5%	7%	917
5	42%	21%	7%	5%	11%	4%	10%	1,837

Source: Own construction using data from Ecuador's Household Survey 2005-2006.

For rural households, consumption of home produced goods is an important component of consumption expenditures. According to Table 4, the consumption of home produced banana, coffee, and cocoa represents 24 % of the total consumption expenditure of rural households; the consumption of cereals, other crops, and meat and meat products represents 13, 11, and 22 % respectively.

Table 4. Consumption expenditure of home produced goods

Products	**Urban**					**Total Urban**	**Rural**					**Total Rural**
	q1	q2	q3	q4	q5		q1	q2	q3	q4	q5	
Banana, coffee, and cocoa	0.47%	1.02%	0.79%	0.53%	2.22%	**1.17%**	15.1%	17.8%	18.5%	19.3%	33.9%	**23.9%**
Cereals	0.47%	1.05%	0.54%	0.50%	0.81%	**0.68%**	7.8%	9.9%	10.2%	11.8%	16.2%	**12.5%**
Other crops	0.44%	0.38%	0.41%	0.24%	0.28%	**0.32%**	10.9%	10.7%	10.5%	8.0%	13.6%	**11.2%**
Meat and meat products	1.31%	1.51%	1.68%	1.32%	1.21%	**1.36%**	20.0%	25.0%	23.5%	22.7%	19.3%	**21.5%**
Dairy	0.03%	0.02%	0.03%	0.01%	0.01%	**0.02%**	0.9%	1.6%	1.3%	0.8%	0.8%	**1.0%**
Other food products, tobacco and chocolate	3.8%	3.1%	3.7%	5.5%	4.3%	**4.2%**	14.4%	17.9%	19.6%	21.8%	33.3%	**23.7%**

Source: Own construction using home produced data from Ecuador's Household Survey 2005, and total consumption expenditures from the Social Accounting Matrix data 2004.

3. Literature Review

Studies on the link between trade and poverty stress that while in the long run it is likely that trade leads to poverty reduction, in the short term there may be some different outcomes (Winters 2000a, Matusz and Tarr 1999). The positive long-run impact of trade on poverty

comes from the positive impact that trade may have on growth and the poverty reduction effects of sustained growth (that is, the effect of trade on poverty is usually analyzed in a two-step fashion, USAID 2006). In the short run, however, positive or negative poverty results from trade liberalization may arise depending on several factors such as the initial distortions in goods and service markets, the speed of trade liberalization and price transmission, and the structure and flexibility of factor markets, in particular labor markets. This section highlights these short-term adjustment channels and the empirical research on this topic for Latin American countries.

It has been mentioned in the literature that ultimately the question of what are, or have been, the poverty impacts of trade openness is an empirical one. To ascertain these impacts Winters et al. (2004) review the empirical evidence on four channels: growth, goods and services prices, wages and employment, and government revenue and spending. The authors consider that these four channels are the key aspects in the transmission of the poverty effects of trade.[5] Winters et al. (2004) differentiate between the short-term mechanisms (shocks and adjustment processes) and the long-term ones (economic growth). The main conclusion of these authors from their empirical literature review is that "…In the long run, economic growth is the key to the alleviation of absolute poverty." (Winters et al 2004, p. 76), mainly because economic growth would raise households' income.[6] The literature also stresses that the channels that link trade and poverty are case-specific (Winters 2000b). Therefore, the best approach is to examine separate country episodes of trade liberalization and learn from their experience with trade openness, growth and poverty.

Ideally, the studies should conduct *ex-post* analysis of a particular episode of trade openness, growth, and poverty, but data limitations may hinder the possibility of undertaking this approach. Just a few studies have been able to perform this type of ex-post analysis, such as Friedman (2003) for Indonesia, which finds that this economy obtained poverty reduction effects from economic growth at the national level, but with significant differences across the regions.

Studies on the poverty impacts of trade liberalization should also account for short-term adjustments, that is, what happens on impact with markets and prices and how these effects get transmitted to households. For goods markets, empirical models usually assume flexible markets, and the perfect transmission of prices. Winters (2001) stresses that this may not be the case in developing countries, particularly in rural areas where prices may not get transmitted because poor infrastructure, missing markets, and marketing practices may keep rural markets isolated, thus preventing any effect on poverty from trade liberalization (see examples in Winters 2000a, pp. 16-21).

[5] A similar structure and emphasis on these transmission channels is found in earlier works by Winters (Winters 2000a.b.c, and Winters 2001).

Assuming price changes are effectively transmitted to households, the empirical literature usually uses a measure of aggregate income or aggregate consumption, and an assessment of the households' net position –as buyers or sellers of the goods and services whose prices have changed– to ascertain how these price changes affect households. The literature stresses that the impact of price changes will affect households differently depending on their income and spending patterns: the households that gain from trade liberalization are net sellers of products whose prices rise and the households that lose out are net purchasers of such goods (Winters 2000b, Hertel 2006). For the poorest rural households, consumption should take into account home production, as it may represent a sizable portion of their overall consumption profile, which in turn would allow the poor to feel only modest impacts of any changes in relative prices.

As for factor markets, the effects on labor markets (employment and wages) provide another key channel for the analysis of the poverty effects of trade liberalization (in both the short and long term). According to the Heckscher-Olin assumption, countries should specialize in the production and export of goods and services that use the relatively more abundant factor, which in the case of developing countries is expected to be unskilled labor. Aside from frictional effects, as production responds to changes in relative prices and firms hire unskilled labor, wages of this labor market segment may reflect an upward pressure. This in turn should have a poverty reducing effect, if the former wages are below the poverty line or if the newly hired workers were unemployed. However, this scenario assumes a fixed supply of labor and wage flexibility which may not be the case in some developing countries. As Winters (2000b) points out, labor supply may be infinitely elastic at the prevailing wage rate (which may be set by minimum wage laws) so that an increase in labor demand increases employment, but not wages. In this case, depending on what the former unemployed were doing (e.g. subsistence activities that earned them less than or the same amount as the minimum wage), the results may or may not have a poverty reducing impact.

Given the data difficulties faced when trying to undertake ex-post analysis, the empirical evidence on the poverty impacts of trade liberalization using ex-ante analysis (simulations) has flourished. However, for Latin America there are not many studies, and only a few of these studies distinguish poverty results by urban and rural areas see Gurgel (2007), Taylor (2002), Morley and Diaz-Bonilla (2003), Wong and Arguello (forthcoming) and Ganuza et al. (2004).

Gurgel (2007) studies different trade agreements in Brazil and analysis the impacts for different household categories (urban, rural, and small and commercial farmers). This author finds that while the income differential between urban and rural households diminishes, the income differential between rural households deteriorates. Taylor (2002) uses a macro-micro

[6] Note that Winters et al (2004) –a nd the empirical literature in general – use an absolute income or con-

econometric approach to study the impacts of several policies of increased trade openness and market shock scenarios on rural production, income and poverty in Mexico and Central America. His main findings with respect to rural poverty are that the effect on rural income depends upon the type of crop affected (cash or staple). If for instances trade reduces staple prices, the impact on rural income may be small, as rural households have a high level of product diversification. Morley and Diaz-Bonilla (2003) develop a computable general equilibrium and micro model to study the poverty impacts of several scenarios of greater trade openness in Mexico. These authors find that although overall poverty falls after trade liberalization, rural poverty and extreme poverty increase. As Morley and Diaz-Bonilla (2003), Wong and Arguello (forthcoming) find similar results for Ecuador, in terms of the differentiated impact on rural and urban poverty. By applying a CGE and micro models to simulate a combined policy of a free trade agreement with the US and a VAT rate increase to compensate for tariff revenue losses they found out that national poverty falls, but rural poverty increases (although the effects are small). Ganuza et al. (2004), applying a CGE-micro simulation framework for several Latin American countries, also find that different scenarios of trade liberalization lead to poverty reduction effects.

Most of the studies mentioned above apply CGE models and micro models to study the poverty impacts of trade liberalization because these studies try to capture the direct (price effects on commodity markets from lower tariffs) and indirect channels (for instance, factor market effects arising from higher/lower production resulting from trade liberalization) through which trade can impact poverty. A general equilibrium model, unlike a partial equilibrium model, should capture such direct and indirect effects.

There are several ways to approach the analysis of the impact on poverty and income distribution of changes in economic policies within a combined CGE-micro-simulation framework. These approaches can be classified according to the interrelation between the CGE and the micro model or data they apply: top-down, bottom-up, both top-down and bottom-up; layered, fully integrated; representative, extended representative or real household data. Bourguignon et al. (2002), and Davies (2004) highlight the main characteristics, applications, and advantages and disadvantages of these approaches. Lofgren et al. (2003) explain the representative household approach.

Cockburn (2005) is an example of a fully integrated CGE-micro-simulation model. Fully integrated CGE micro simulation models have as many households in the CGE model as in the micro model with the aim to account for the full distributional changes in household data (inter- and intra-household) as a result of policy changes. The gain in income variation comes at the cost of high computational demands and a highly complex model set up. Savard (2003) de-

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sumption measure of poverty.

signed a top-down/bottom-up approach, where the CGE and the micro model connect in a two-way fashion to capture household responses to policy changes (given in the CGE model) as well as responses in the economy to feedback from the household reactions to policies. Bourguignon et al. (2003) follow a top-down layered or sequential approach.[7]

The top-down approach has been widely applied as it makes it easy to follow the chain of events from changes in commodity and factor prices, and employment –stemming from the CGE model– to the effects in households' real income and consumption, and poverty –obtained in the micro model (once the CGE price and employment changes are passed into the micro model). The main criticism against the top-down approach is that this approach ignores feed-back mechanisms from households' responses in the micro-model simulations to the CGE economy-wide model.

The present study adopts a top-down sequential approach with a CGE and a micro model along the lines of Bourguignon et al. (2003), connecting a CGE model and a micro model of earnings and occupational choice by households through changes in wages, earnings, prices, and employment. A key contribution of the present study is the modeling of agricultural trade policies and the analysis of impacts on Ecuadorian urban and rural poverty with *real* household data of a free trade agreement between Ecuador and the EU.

4. Methodology[8] and Data

The method applied includes four main stages, and has a sequential approach, given that the macro and the micro-modelling part are developed separately. A key step is to ensure consistency between the CGE and the micro model data. This is an insightful approach as it allows us to transmit to the household level, domestic price and resource reallocation changes expected from trade liberalization and agricultural trade policies that may have a key influence on household poverty and income distribution. It also allows us to analyze the full distribution of real household income *within* households and not just *between* households, which is the traditional weakness of models which use a representative household approach.

As mentioned above, the top-down approach using a CGE and micro models is not free of criticism either. Main criticisms against this approach are the lack of feedback from households' results to the CGE model, and the ad-hoc nature of the micro-model equations.

The four main modelling stages are:

1) Linking, in a consistent way, the micro and the CGE models (see Section 4.4 below). This study follows the *consistency rules* provided by Bourguignon et al. (2003), by which

[7] See also Robilliard, Bourguignon and Robinson (2005), Robilliard, Bourguignon and Robinson (2008), and Bussolo and Lay (2005).
[8] This section relies on Wong and Arguello, forthcoming.

changes in the variables (aggregate employment, wages, earnings, and prices) of the micro-model data equations are set to be equal to changes in similar variables of the CGE model.

2) Solving the trade policy changes in the CGE country model for Ecuador, and getting a new set of variables (a vector of appropriate prices, aggregate wages and earnings, and aggregate employment variables) that are used to communicate with the micro-simulation model. An overview of the CGE model is presented below.
3) Estimating the coefficients in the occupational choice, and wages and earnings regressions.
4) Evaluating the impacts of the policy changes on poverty using the changes in employment, wages and earnings from the CGE into the micro model estimations so that the results are consistent with the post-policy-change macro variables generated by the CGE model.

An issue, addressed prior to the macro-micro links issue, is the modelling of both the single-country CGE model for Ecuador and the micro model so that the models take into account key features of the Ecuadorian economy and households (such as the agricultural sector, household characteristics, and labor market). To deal with unemployment, this study adopts a proper closure that keeps wages fixed and allows for adjustment in labor quantities. Whether or not unemployment in Ecuador (9 to 11% on average annually in the last 5 years) is really a problem (of rationing) worth dealing with in a more detailed fashion, within the framework proposed, is an issue that remains to be discussed.

This research utilizes an input-output table and a social accounting matrix (SAM) for Ecuador for the year 2004, both developed by the Central Bank of Ecuador. This SAM was modified to suit the needs of the present study. The study also uses the 2005-2006 survey of urban and rural households' life conditions, collected by the National Institute of Statistics and Censuses (INEC). This survey follows the same methodology and format as the World Bank's Living Standards Measurement Study (LSMS) household surveys. The survey includes data on income and occupational choices at the individual level, as well as income on agricultural and business activities and expenditure at the household level. The unit of study of the household survey is the household and its members. That is, besides household level data, the survey also contains data for variables at the individual level.

4.1. The Micro Model

The micro model is based on a set of reduced form equations that describe individual wages, individual and household self-employment income, and the occupational choices of individuals in the household survey, as in Bourguignon et al.(2003).[9]

The wage equation is a semi-logarithmic equation of the logarithm of the wages of individual *i* in household *m* with independent variables: a constant, age, years of schooling, years of

[9] For details on the micro model see Wong and Arguello, forthcoming.

schooling squared (to account for non-linearity in income generation), number of children under 18 years of age, and dummies for gender, marital status, and head of household. There are four labor market segments: urban skilled, urban unskilled, rural skilled and rural unskilled.

The earnings or self-employment income equation is a semi-logarithmic equation of the logarithm of self-employment income of household *m*, with independent variables: a constant, age of head of household, years of schooling and years of schooling squared of the head of household, land size of the farm field of those households that have farm income, and dummies for gender and marital status of the head of the household. This self-employment income equation includes also a variable for the number of household members actually involved in self-employment.

Both total wages and earnings equations are estimated by OLS and by Heckman two-stage, the latter to control for sample selection bias. Sample selection bias may arise given that the wage and income is observed by those who actually participate in the labor market, although this is less of a problem with large samples such as the data used here. The regressions for wages and earnings show, in general, expected signs and significant effects. Working-age male household members command higher wages than female ones. Age has a positive and significant effect on wages and earnings (except in the equation for urban self-employment income, where age is not significant). Married members show higher wages than unmarried members (except in the equation for rural unskilled wage workers, and the urban self-employed, where marital status is not significant). The heads of household have a higher wage than the rest of working-age household members. Education leads to a higher wage for urban-skilled, urban-unskilled, and rural unskilled wage workers. The effect of formal education on wages of rural-skilled workers is negative, although not significant.

For self-employed individuals, higher education also has a positive and significant effect on earnings.

The Heckman two-step estimates present similar effects to those in the OLS regressions, for both the wage and earnings equations. That is, it appears that the household samples are large enough, so we can use the OLS estimates. The OLS estimates for the wages and earnings regressions will later be used in the micro simulation that links the survey data (from the micro model) with the SAM data (from the CGE model).

The occupational choice equation is a multinomial logit of three occupational alternatives for individual *i*: (i) inactive or unemployed (benchmark, not estimated), (ii) wage earner, and (iii) self-employed (farm and non-farm activities for the household).

Table 5 shows data on the number of workers and their wages and earnings. There are fewer self-employed (41 %) than wage earners (59 %), and the latter have a bigger share of total wages and earnings (55 %) than the self-employed people. These differences hold for urban and

rural areas, although in rural areas the wage-worker earnings' share (44 %) is lower than the self-employed earnings' share (56 %) in total wages and earnings.[10]

In the occupational choice model, individuals decide whether to be inactive, self-employed, or wage worker, based on the utility associated to each choice. This equation states that an individual will be wage-employed if the utility associated with wage employment is higher than the utility of being self-employed or inactive. The base category is "inactive", and its associated utility is zero. For the wage-worker category, the occupational choice equation applies the set of independent variables: years of schooling, years of schooling squared, number of children under 18 years of age in the household, exogenous income (such as aid and remittances), and dummies for gender, marital status, and for somebody in the household who owns a family business. There is, of course, an error term (u^w_{mi} if wage worker, and u^s_{mi} if self-employed). The coefficient estimates and their correspondent residuals will later be applied to the micro simulation that connects the micro model with the CGE model results when simulating changes in employment status (under the scenarios that assume unemployment).

Table 5. Number of workers, wages, and earnings, 2005

	Total		Urban		Rural	
Description	**Value**	**%**	**Value**	**%**	**Value**	**%**
Number of wage workers	3,270,907	59%	2,254,662	62%	1,016,245	54%
Number of self-employed	2,279,231	41%	1,401,028	38%	878,203	46%
Total	5,550,138	100%	3,655,690	100%	1,894,448	100%
Wages, Annual Millions US$	10,800	55%	8,750	52%	2,050	44%
Earnings, Annual Millions US$*	8,830	45%	6,260	48%	2,570	56%
Total	19,630	100%	15,010	100%	4,620	100%

Source: Own calculations using Ecuador's Household Survey 2005-2006.

For the category self-employed, the choice equation has as the dependent variable the number of household members working in self-employment activities, and as the set of independent variables the same set defined above. This equation states that an individual *i* of household *m* will prefer self-employment if its associated utility is higher than the utility of inactivity or wage employment.

An income accounting equation complements the earnings and occupational choice model. The total household income will be adjusted using the consumer price index resulting from the CGE simulations.

4.2. Overview of the CGE Model

The Ecuador CGE model is a standard neoclassical static CGE model based on Lofgren et al. 2002. The basic structure of the model is the following. Technology is modeled at the top

[10] Data on total wages and earnings should be regarded with care as these data may be subject to problems of under-reporting and omission.

by a Leontieff function of value added and aggregate intermediate input. The value added equation is a CES function of primary factors (labor, capital, and land) and the aggregate intermediate input is a Leontieff function of disaggregated intermediate inputs. Each activity can produce more than one commodity following fixed yield coefficients. A commodity can also be produced by more than one activity. There are 27 sectors: nine primary or extractive (six agricultural, two fisheries, and mining and oil), eight food industries, seven non-food manufacturing industries, and three service sectors. These sectors or industries produce 27 goods or services, 17 of which are produced by more than one industry.

Households, split between rural and urban, receive income from factors and transfers from other institutions (government, the rest of the world, and other households). Their consumption is the residual after paying taxes, savings, and transfers to other institutions, and is spent according to LES demand functions derived from a Stone-Geary utility function. Self-employment also generates income for households, but no attempt is made to distinguish between labor and capital from self-employment income due to the lack of reliable data to do so. Commodities may be marketed or consumed directly by the household producer, valued at producer prices.

Enterprises may receive factor income (only from capital) and transfers from other institutions. Their activities are assumed to maximize profits, subject to technology and taking prices as given. Their total income can be allocated between direct taxes, savings, and transfers to other institutions.

The government collects taxes and gets transfers from other institutions and spends this income on purchases (basically services), transfers to households, payments to other regions, and savings. Government consumption is fixed in real terms while transfers to domestic institutions are CPI-indexed, and savings is a residual

As for factor markets, there are six labor types: four wage-labor types and two self-employed types. Wage workers are organized by educational level and area of residence. Educational levels comprise of (i) unskilled such as no formal education and primary, and (ii) skilled such as secondary (whether complete or not) and higher. Each of these wage-worker types is split into rural and urban, according to their area of residence. Self-employed labor is divided into urban and rural, according to the location of the household's residence. The other factors included are capital and land. There is no distinction as to land or capital types.

To incorporate land in this model, part of the return to capital (included in the mixed income or self-employment income) was apportioned to land using return-to-land shares from the GTAP-AGR database 6.2 (base year 2001). This procedure affects only the six agricultural sectors in the Ecuador SAM.

As this study looks at impact effects, capital is assumed to be sector specific or immobile (although an alternative closure allows for capital mobility). Land is also assumed to be immobile.

Marketed outputs are imperfectly substitutable under a CES function. Aggregated domestic output is allocated between domestic consumption and export through a CET function. Domestic demand comes from households and government consumption, investment, and intermediate input consumption. Export demands and supplies are infinitely elastic.

There are four foreign regions in the model: the US, the EU, the Andean Community, and the Rest of the World. The export data are incorporated in a nested structure that includes the regions mentioned above.

Aggregate composite imported commodities and domestic output are imperfect substitutes in demand using a CES function (Armington assumption). Imports are differentiated by region of origin using a single nest structure that includes the four import markets.

Household direct taxes are defined as fixed shares of household income. The rest of taxes are at fixed ad valorem rates, as are tariff rates. The treatment of taxes varies according to the closure rule adopted.

4.3. Calibration of CGE model and Closures

The Ecuador CGE model is calibrated to a modified SAM that includes the European Union as a trade region, while the original SAM from the Central Bank of Ecuador includes only the US, Andean Communities and Rest of the World as trade regions. A new SAM with the EU as a fourth trade region was built by using trade data from the Central Bank of Ecuador. Export and Import data by sector for the EU was taken out of the corresponding data of the Rest of the World.

The CGE model is calibrated in such a way that its data is consistent with data coming from the household survey employed. In particular, total household income is consistent in the SAM and in the micro model database, the sectoral division of income comes from the original SAM, and the split between urban and rural households, both in terms of factor income and from self-employment, is consistent with that in the household survey.

This study follows standard procedures for calibrating parameters and elasticities of a CGE model. To the extent that they are available, this study uses econometric estimates of elasticities for Ecuador. The calibration procedures include checks such as tests for data replication, tests for parameter weights, Walras' Law, etc.

The following closures reflect both the relevant conditions in the Ecuadorian economy before the shocks and the expected mechanisms by which trade may have an impact on poverty. First, and concerning the external balance, as the Ecuadorian economy uses the US dollar as its official currency, the nominal exchange rate is fixed. The current account is assumed fixed too,

so as to avoid the "free lunch" effect that arises (in a static model) if the foreign savings were allowed to adjust to fill the current account gap. The nominal exchange rate is used as the numeraire and the consumer price index is allowed to vary so that the real exchange rate can adjust too.

Secondly, for the government closure, all the tax rates (for households and enterprises) are fixed and given that this study is not focused on compensating for government revenue losses that may arise due to tariff changes, government savings are flexible. Government consumption is fixed in real terms (or as a share of total absorption).[11]

Regarding the savings-investment closure, this study assumes that it is investment driven and balanced. In this closure, both nominal absorption shares of investment and government consumption are fixed at base levels (flexible quantities). The residual share for household consumption is also fixed at base levels (flexible quantities). There is a uniform marginal propensity to save (MPS) point change for selected institutions.[12]

As for factors markets, this study assumes that land is not mobile to capture the notion that crops can only be cultivated in land with some agro-ecological requirements, unique for each type of crop (for instance, land that is used to cultivate bananas cannot be used to cultivate flowers). There are two scenarios for capital mobility: (i) sector-specific capital, to highlight the notion that in Ecuador there are capital rigidities or restrictions, and (ii) capital mobility between sectors. To simplify the analysis for the reader and because the results of capital mobility and sector-specific capital do not show many differences in most scenarios, we analyze predominantly the case of capital being mobile. In the case that striking differences occur, we highlight the results of capital being sector specific too.

The closure rules vary according to the two types of additional assumptions regarding factor markets: (i) full employment of all factors and factor returns adjust to clear the markets (the classical trade model closure), and (ii) unemployment in the unskilled salaried labor market segment, both rural and urban, a feature expected to be common in most of the Latin American economies (the classical development theory closure, pointed out by Winters 2000), while the rest of factor markets clear through changes in returns.

[11] "With regard to government consumption, the (single-period) model does not capture its direct and indirect welfare contributions; to avoid misleading results, it is also preferable in welfare analysis to keep this variable fixed." Lofgren et al (2002), p.16.

[12] Alternatively, the assumption for the change in MPS could be that this is done as a scaled (not point) change for selected institutions. This is just to highlight the point made by Lofgren et al (2002) by which the impacts may vary according to the way the MPS adjusts, either as a point change or in a scale fashion. This comparison could be interesting if there were changes in taxes, for instance, if the study were focused on exploring the effects of a tax replacement policy.

4.4. Linking micro model and CGE model

In order to analyze whether consistency between the aggregate income and consumption data in the micro model and the data in the CGE model at the benchmark equilibrium exists or not, we compare these two sets of data. These two data sets are said to be consistent if discrepancies between the survey and SAM data for each of the two aggregates are equal or lower than 10 %. According to the data comparison between the 2005 household survey data and the 2004 Social Accounting Matrix of Ecuador, there are no significant differences between aggregate total incomes in the two data sets (the difference between aggregate income data amounts to 2 %). Differences in aggregate consumption are higher (15 %), so we keep income data fixed and re-balance consumption data in the SAM.

To ensure consistency in the model simulations, percentage changes in household data should match percentage changes in the CGE model data after performing changes in policy in the CGE. In particular, the percentage changes in aggregate wages, earnings, and employment that link the CGE model with the micro model should be equal in both data sets. The changes in some or all of these aggregates are triggered by a policy change or shock that hits the economy (in the CGE model). These changes are then incorporated into the household behavior through the micro-simulation for wages, income, and employment, so that consistency requirements are met.

To ensure consistency with income data in the baseline from the Ecuadorian household survey, this study follows recent literature and it adds back estimated residuals into the estimated household behavior equations. This study simulates changes in wages and earnings via changes in intercepts. That is, it does not re-estimate micro equations behavior. Consistency checks are performed in each simulation result.

5. Scenarios

This section summarizes the alternative scenarios applied to analyze the poverty effects of the free trade agreement with the EU in Ecuador.

(i) Free trade for all EU products (100 % tariff reduction), and Ecuador keeps the GSP+ preferences

(ii) Free trade for all EU products, Ecuador keeps the GSP+ preferences, and receives better access for bananas to the EU market

(iii) Preferential trade, similar as the first scenario but with a 50 % (instead of 100 %) tariff reduction

Tariff elimination implies zero tariffs after the trade agreement is in place for all goods and services imported from the EU, starting from the original effective tariffs. The total range of the applied tariffs lies between 0.1% and 23%. Most tariffs are in the range of 13% to 17%. Com-

modities of the sectors' transportation equipment, alcoholic and non alcoholic beverages and telecommunication and small services are subjected to the highest effective tariffs.

6. Results

6.1. Macroeconomic Results

Preliminary results from the CGE model show that imports from the EU would increase after a trade agreement with this region (see Table 6). Sectors with the highest increase in import quantities in all three scenarios are beverages, wood and wooden products, canned fish and other seafood products, textiles and apparel, meat and meat products, and cereals. However, total imports increase modestly, as imports from the EU currently represent around 9 to 10 % of total imports.

Table 6. Percentage changes in the quantity of imports from the EU

Description	Base Millions of US$	Free Trade		50% tariff reduction		Free trade and banana access	
		Full employment	Unemployment	Full employment	Unemployment	Full employment	Unemployment
Cereals	0.0	14.6	14.6	6.8	6.8	16.1	16.5
Flowers	3.1	0.3	0.3	0.1	0.1	8.2	7.3
Other agricultural	8.1	3.1	3.1	1.5	1.5	3.6	4.3
Livestock	0.5	11.6	11.6	5.5	5.5	13.7	14.8
Forestry	3.3	10.7	10.7	5.0	5.0	12.7	13.9
Raw fish	0.7	-0.1	-0.1	-0.1	-0.1	0.7	1.4
Fuel oils and other oil prod.	66.9	0.6	0.6	0.3	0.3	0.6	1.0
Meat, meat prods. and sub-prod.	0.4	16.9	16.9	7.8	7.8	18.6	19.6
Canned fish and other aquatic	0.1	18.6	18.6	8.5	8.5	21.5	22.7
Oil and fats	2.9	13.1	13.1	6.1	6.1	14.0	14.6
Dairy	1.4	13.6	13.6	6.3	6.3	15.0	15.7
Milling and bakery	6.0	10.8	10.8	5.1	5.1	12.9	13.6
Sugar	0.4	0.2	0.2	0.1	0.1	1.5	2.1
Alcoholic and non-alcoh. beverages	25.0	25.5	25.5	11.5	11.5	27.2	28.2
Other miscellaneous food	11.7	11.2	11.2	5.3	5.3	11.2	11.6
Textiles, apparel and leather	23.0	17.0	17.0	7.8	7.8	18.3	19.3
Wood and wooden products	6.3	13.1	13.1	6.3	6.3	19.6	23.6
Paper and paper products	37.9	8.8	8.8	4.2	4.2	9.3	10.1
Chemicals, rubber and plastic	218.2	3.0	3.0	1.5	1.5	5.0	6.0
Metallic and non-met. mineral prod.	93.5	6.4	6.4	3.1	3.1	6.9	7.5
Transportation equipment	41.1	6.0	6.0	2.9	2.9	6.2	6.9
Machinery and equipment	396.2	4.2	4.2	2.0	2.0	4.8	5.6
Telecom. and mail services	0.0	-0.2	-0.2	-0.1	-0.1	0.4	1.3

Source: Own calculation
Note: For all the scenarios the closures include: capital mobility, sector-specific land, and balanced investment point share adjustment.

In terms of exports, no noticeable impacts occur in the scenarios of free trade liberalization and preferential trade because most of Ecuador's exports are already free and these two scenarios do not include a better access to any export products, just the permanence of SGP+. Nonetheless, in the third scenario, when in exchange for zero tariffs to EU products Ecuador not

only keeps current trade preferences from the EU, but also obtains better access for its banana exports to the EU, banana exports show a considerable increase, both under the full employment (21 %) and the unemployment (25 %) assumptions (Table 7). In both cases, the increase in banana exports is higher when capital is mobile than when capital is assumed sector specific. In other words, capital restrictions imply that not all export opportunities can be fully materialized.

Table 7. Percentage changes in the quantity of exports to the EU

		Free trade and + banana access			
		Full employment		Unemployment	
Description	Base Millions of US$	Capital mobility	Capital sector specific	Capital mobility	Capital sector specific
Banana, coffee, and cocoa	435,0	21,0	16,4	25,4	20,6
Cereals	0,0	-3,2	-3,1	-2,2	-2,2
Flowers	62,0	-13,2	-10,7	-10,0	-7,6
Other agricultural products	30,8	-2,3	-2,6	-1,9	-2,2
Livestock	0,0	-1,1	-2,1	-1,0	-2,0
Forestry products	7,6	-2,3	-2,8	-2,7	-3,4
Shrimps		-	-	-	-
Raw fish	0,7	-0,8	-0,9	-0,6	-0,7
Fuel oils and other oil products	0,0	-1,7	-0,2	-1,8	-0,3
Meat, meat products and sub products		-	-	-	-
Canned fish and other aquatic products	122,7	-1,8	-1,9	-1,8	-1,8
Oil and fats	0,8	-2,0	-2,6	-1,9	-2,9
Dairy products		-	-	-	-
Milling and bakery products	0,1	-2,7	-2,7	-2,2	-2,2
Sugar products	0,2	-0,7	-2,2	0,1	-1,7
Alcoholic and non-alcoholic beverages	0,1	-1,0	-1,6	-0,7	-1,8
Other miscellaneous food products	147,9	1,8	-0,5	2,9	0,3
Textiles, apparel and leather products	12,5	-1,0	-1,7	-0,5	-1,4
Wood and wooden products	0,2	-1,9	-2,0	-2,4	-2,4
Paper and paper products	0,3	-0,6	-1,2	-0,3	-1,1
Chemicals, rubber and plastic	1,0	1,2	-0,7	2,0	-0,5
Metallic and non-metallic mineral products	10,3	-0,5	-0,9	0,1	-0,4
Transportation equipment	0,0	-0,2	-0,6	0,3	-0,3
Machinery and equipment	7,1	-1,1	-2,0	-0,7	-1,9
Transportation services and storage	78,5	-0,8	-1,8	-0,7	-1,7
Telecommunication and mail services	23,1	-0,2	-1,7	0,5	-2,6
Other services	134,2	-0,1	-0,6	0,2	-0,4

Source: Own calculations.
Note: For all the scenarios the closures include capital mobility, sector-specific land, and balanced investment point share adjustment.

Better access to the EU banana market gives the incentive for an increase in banana production that in the model (with no intertemporal growth) implies a reduction in production in other sectors, particularly agricultural sectors, such as flowers (-11 %) and cereals (-2 %), as well as shrimps (-8 %).. As expected, this decrease in production is higher under the full employment assumption (for instance, 13 % reduction in flower production) than it is under the

unemployment scenario (10 % reduction in flower production, to continue with the same example).

Lower production in real terms brings with it an increase in the consumer price index, unlike in the previous two trade agreement scenarios in which the CPI falls (see Table 8). The increase in the CPI will in turn have an impact on poverty, as we will see later on. Table 8 shows that real impacts on GDP are negligible (given that the model is static), in particular under the full employment assumption.

Regarding preferential trade, the results go in the same directions as those of free trade, but with half the magnitude. Therefore we concentrate our interpretation of the model results on free trade and free trade with better banana access to the EU.

Table 8. Percentage change (nominal and real) in GDP and components (including CPI[1,2])

		Free Trade				50% tariff reduction				Free trade and better banana access			
		Nominal		Real		Nominal		Real		Nominal		Real	
Variable	**Labor market**	Capital mobility	Capital sector specific	Capital mobility	Capital sector specific	Capital mobility	Capital sector specific	Capital mobility	Capital sector specific	Capital mobility	Capital sector specific	Capital mobility	Capital sector specific
Absorption	FE	-0.30	-0.47	0.01	0.00	-0.15	-0.23	0.00	0.00	1.06	2.07	0.22	0.23
	UE	-0.29	-0.48	0.01	0.00	-0.14	-0.23	0.00	0.00	1.90	2.86	0.73	0.62
Private	FE	-0.30	-0.47	0.00	0.00	-0.15	-0.23	0.00	0.00	1.06	2.07	0.22	0.29
consumption	UE	-0.29	-0.48	0.00	-0.01	-0.14	-0.23	0.00	0.00	1.90	2.86	0.76	0.69
Fixed	FE	-0.27	-0.45	0.14	0.11	-0.13	-0.22	0.07	0.05	1.17	2.19	0.47	0.49
Investment	UE	-0.26	-0.46	0.14	0.09	-0.13	-0.22	0.07	0.05	2.09	3.03	1.04	0.96
Stock change	FE	-0.68	-0.72	-	-	-0.34	-0.36	-	-	-0.36	0.66	-	-
	UE	-0.68	-0.71	-	-	-0.34	-0.35	-	-	-0.36	0.84	-	-
Exports	FE	0.30	0.23	0.30	0.23	0.15	0.11	0.15	0.11	1.13	1.41	0.28	0.59
	UE	0.31	0.23	0.31	0.23	0.15	0.11	0.15	0.11	1.89	2.06	1.01	1.21
Imports	FE	0.28	0.22	0.28	0.22	0.14	0.11	0.14	0.11	1.05	1.31	1.05	1.31
	UE	0.29	0.21	0.29	0.21	0.14	0.10	0.14	0.10	1.75	1.91	1.75	1.91
GDP	FE	-0.31	-0.48	0.01	0.00	-0.15	-0.23	0.00	0.00	1.08	2.12	-0.01	0.01
(value added)	UE	-0.30	-0.49	0.01	0.00	-0.14	-0.23	0.00	0.00	1.94	2.92	0.51	0.40
GDP	FE	-0.05	-0.23	0.00	0.00	-0.02	-0.11	0.00	0.00	1.40	2.47	0.00	0.00
(value added)	UE	-0.04	-0.23	0.00	-0.01	-0.02	-0.11	0.00	0.00	2.27	3.29	0.51	0.39
CPI change	FE	-0.30	-0.48			-0.15	-0.23			0.83	1.77		
	UE	-0.30	-0.47			-0.14	-0.23			1.12	2.15		

Source: Own calculations.
Notes: 1.- For all the scenarios the closures include: sector-specific land, and balanced investment, point share adjustment. **2.-** FE = full employment. UE = unemployment in unskilled wage workers.

Next, we analyze the effects of a trade agreement with the EU on factor returns. Under the assumption of full employment, a zero-tariff agreement with the EU results in a fall in nominal wages and earnings, except in the case of wages for rural unskilled wage workers (see Table 9). Land and capital show a small increase in returns. Real returns to factors go up – although modestly– for all factors of production, given that cheaper access to imports from the EU would bring about a fall in the consumer price index. Under full employment and a 50 % tariff reduction, results for factor returns go in the same direction, but with a lower magnitude.

Table 9 shows the percentage changes in factor returns. Land and rural unskilled wages experience the highest increase in real terms in all scenarios.

Table 9. Percentage change (Nominal and real) in factor returns [1,2]

Labor market	Factor type	Free Trade		50% tariff reduction		Free trade and + banana access	
		Nominal	Real	Nominal	Real	Nominal	Real
LABOR							
	Urban						
FE	Unskilled wage labor	-0,05	0,25	-0,02	0,12	1,89	1,06
	Skilled wage labor	-0,09	0,21	-0,04	0,10	1,49	0,66
	Self-employment	-0,11	0,19	-0,05	0,09	1,66	0,83
UE	Unskilled wage labor	-	0,30	-	0,14	-	-1,12
	Skilled wage labor	-0,08	0,22	-0,04	0,11	2,52	1,39
	Self-employment	-0,10	0,19	-0,05	0,09	2,68	1,56
	Rural						
FE	Unskilled wage labor	0,17	0,47	0,08	0,23	5,63	4,81
	Skilled wage labor	-0,06	0,24	-0,03	0,12	2,25	1,43
	Self-employment	-0,09	0,21	-0,04	0,11	2,01	1,18
UE	Unskilled wage labor	-	0,30	-	0,14	-	-1,12
	Skilled wage labor	-0,05	0,25	-0,02	0,12	3,44	2,32
	Self-employment	-0,07	0,22	-0,04	0,11	3,13	2,01
CAPITAL							
FE	-	0,02	0,32	0,02	0,16	-0,01	-0,84
UE	-	0,03	0,32	0,01	0,16	0,53	-0,60
LAND							
FE	-	0,23	0,53	0,11	0,26	7,10	6,27
UE	-	0,27	0,56	0,13	0,28	9,80	8,68

Source: Own calculations.
Notes: **1.-** For all the scenarios the closures include capital mobility, sector-specific land, and balanced investment point share adjustment. **2.-** FE = full employment. UE = unemployment in unskilled wage workers.

The fact that both unskilled rural labor and land receive higher returns may not be surprising as neoclassical theory of trade predicts that a country will specialize in the production (and export) of products that use more intensively the abundant factor, and that this factor will experience an increase in returns. Most of Ecuadorian exports to the EU consist of agricultural products, so it is expected that permanent free access to the European market would consolidate market access to this type of products. Agricultural export products to the EU in Ecuador are banana, flowers, and other vegetables and fruits, which are labor intensive. Thus, the results show that consolidation of access to the EU market brings a higher return to unskilled rural workers, which in turn may have a positive implication for poverty reduction, as we will see later on.

Compared to the previous two scenarios, *full employment* and *free trade with better access to the EU banana market* implies a higher increase in real wages and earnings. Rural wages increase more than urban wages (see Table 10). Unskilled wage workers experience a higher wage increase than skilled wage workers (in both rural and urban areas). If capital is

assumed sector specific, increments in nominal wages are higher than in the case of capital mobility (except for the increment in wages of rural unskilled wage workers –not shown in the table). Income from self-employment also increases and so do returns for land. In fact, land experiences the highest nominal and real percentage increase of all factor returns (6 % in real terms). Capital returns decline slightly (0.84 %).

The increase in urban wages, and the even bigger increase in rural wages (particularly for the unskilled wage workers) can be explained by the increase in banana exports which comes hand in hand with an increase in banana production –a sector that, as mentioned in the introduction, employs 1 to 3 workers per hectare and indirectly generates 1.5 to 10 jobs per hectare in production. As the assumptions also include full employment and a static model, an increase in banana production implies a reduction in the production of the other sectors, in particular other agricultural sectors. . Given the assumption of full employment, higher banana production can be reached with an increase in real wages for the factor used intensively in this sector: unskilled labor, in particular rural unskilled labor.

In a similar way to the full employment scenario, under *unemployment* in the unskilled wage labor (urban and rural), both zero-tariff and 50-% tariff reduction scenarios lead to an increase in real factor returns, in particular for the unskilled wage workers. Under the assumption of unemployment, the adjustment in this labor market segment comes through changes in quantities (number of workers) and not through changes in nominal wages. Thus, an increase in real wages in turn implies decreased employment in the *urban* unskilled wage worker segment (-0.03 and -0.19 % for the cases of capital mobility and sector-specific capital, respectively). On the contrary, for *rural* unskilled wage workers employment would increase in these two scenarios as well as their real wages –more so in the case of a zero-tariff agreement with the EU. For further details see Tables 9 and 10. Both an increase in employment and real wages for the *rural* unskilled workers should have an important poverty reducing effect.

Table 10.- Percentage changes in employment for unskilled wage workers

	Base		Free Trade		50% tariff reduction		Free trade and + banana access	
Labor type	Numbers of workers	Percent	Capital mobility	Capital sector specific	Capital mobility	Capital sector specific	Capital mobility	Capital sector specific
Urban								
Unskilled wage worker	1,108,361	20%	-0.03	-0.19	-0.01	-0.09	2.69	3.46
Rural								
Unskilled wage worker	842,572	15%	0.15	0.07	0.08	0.04	5.86	5.67
Total	5,550,134	100%	-	-	-	-	-	-

Source: Own calculations.
Note: For all the scenarios the closures include sector-specific land and balanced investment point share adjustment.

A different situation may arise in terms of real return to factors under the scenario of *free trade with the EU and better access for bananas to the EU market* if there is *unemployment*

in unskilled wage workers. In this case, an increase in banana production, implies an increase in unskilled labor demand (that reduces unemployment) met with lower real wages for unskilled wage workers both in rural and urban areas (1.12 %, see Table 9).

The next section shows the poverty effects of the price increases, and both a fall in real wages and the increased labor demand of a free trade agreement with the EU with better market access to Ecuadorian bananas.

6.2. Poverty Impacts

Under the assumption of *full employment*, a *free trade agreement with the EU* shows small and mixed impacts on poverty, and results at the national level mask the different direction of impacts in rural and urban areas (see Table 11). While there is a small decrease in indigence[13] in rural areas (0.11 %), in urban areas indigence increases (0.14 %). On the other hand, rural poverty headcount increases (0.18 %) while urban poverty falls (0.08 %). In the end, both extreme poverty and poverty rates increase slightly at the national level. In summary, the results suggest that in the case of full employment a free trade agreement with the EU leads to a redistribution of income to the benefit of the rural indigent and the urban poor.

With full employment and a 50 % tariff reduction agreement reductions in indigence and poverty are of smaller magnitude, while increases in poverty are bigger. It seems that the smaller fall in consumer prices and the smaller real wage raise produce lesser poverty impacts in this scenario.

Under full employment, an FTA with the EU that includes better access to Ecuadorian banana exports also shows mixed results on poverty. Both indigence and poverty rates fall at the national level if capital is assumed fully mobile (0.17 % and -0.06 %, respectively), but they increase if capital is assumed sector specific (0.04 % and 0.32 %, respectively).

So far a trade agreement with the EU has little, if any, poverty impact –given the small fall in goods' prices and factor returns. Nevertheless, if *unemployment* amongst unskilled wage workers is allowed, which may be a reasonable assumption in the Ecuadorian labor market, a *free trade scenario* leads to strong poverty reduction effects (Table 11). This reduction in poverty may be explained by the increase in employment that rural unskilled wage worker experience (Table 10), the increase in real wages and earnings for the urban and rural workers and self-employed as well as the fall in the consumer price index (Table 9).

Rural unskilled wage labor accounts for about 15 % of total employment and these workers belong to households that are amongst the poorest, so the gain in employment (amongst those currently unemployed –with the assumption that the newly employed will receive the average wage of the rural unskilled wage workers currently employed) may lead to a positive

effect in poverty reduction. Urban unskilled wage workers represent 20 % of total employment, and they also belong to households that are amongst the poorest. The increase in the real wage of this type of worker (an increase that is bigger than the one observed in the simulations under full employment) may also contribute to poverty reduction.

Regardless the closures (capital mobility and sector-specific capital) and with free trade and unemployment indigence rates as well as poverty rates fall (-4 % and -9 %, respectively). That is, there is a significant decline in poverty rates. As Table 11 reports, urban households show a higher decline of indigence and poverty rate than rural households. In contrast to free trade and full employment, with free trade and unemployment rural and urban households are both winners, poverty and indigence decline in both areas.

Table 11.- Percentage Change in poverty indices (headcount)[1]

Free Trade (Capital Mobility)	**Full employment**		**Unemployment**	
	Below one dollar a day	Below two dollars a day	Below one dollar a day	Below two dollars a day
Total Households	0.06%	0.01%	-4.30%	-9.22%
Rural Households	-0.11%	0.18%	-3.39%	-6.17%
Urban Households	0.14%	-0.08%	-4.79%	-10.81%
Hhd. headed by male	0.02%	0.03%	-3.55%	-7.94%
Hhd. headed by female	0.18%	-0.04%	-7.19%	-14.06%
50 % tariff reduction (Capital Mobility)	**Full employment**		**Unemployment**	
	Below one dollar a day	Below two dollars a day	Below one dollar a day	Below two dollars a day
Total Households	0.08%	0.09%	0.08%	0.11%
Rural Households	-0.07%	0.23%	-0.06%	0.26%
Urban Households	0.15%	0.03%	0.15%	0.03%
Hhd. headed by male	0.04%	0.11%	0.04%	0.12%
Hhd. headed by female	0.21%	0.09%	0.21%	0.09%
Free Trade Banana (Capital Mobility)	**Full employment**		**Unemployment**	
	Below one dollar a day	Below two dollars a day	Below one dollar a day	Below two dollars a day
Total Households	-0.16%	-0.07%	0.08%	0.32%
Rural Households	-0.87%	-0.37%	-0.43%	0.13%
Urban Households	0.20%	0.09%	0.33%	0.42%
Hhd. headed by male	-0.22%	-0.04%	-0.07%	0.14%
Hhd. headed by female	0.04%	-0.13%	0.61%	1.01%

Source: Own calculations.
[1]For the case of Capital Mobility in every scenario

A trade agreement with the EU that implies only a 50 % tariff reduction to imports from the EU, again under the assumption of unemployment, shows modest, if any, poverty reduction effects. At the national level, indigence increases around 0.8 %, while rural indigence falls by -0.06 %, and urban indigence increases by 0.15 % (under the assumption of capital mobility, but similar results are obtained if capital is assumed to be sector specific). Poverty rates increase

[13] The poverty lines for extreme poverty (or indigence) and poverty, 1-dollar-a-day and 2-dollar-a-day,

0.11 %, which comes about from an increase in poverty of 0.26 % in rural areas and of 0.03 % in urban areas. If capital is sector specific, poverty is slightly reduced in urban areas (-0.03 %). These results are in striking contrast with the bigger magnitude in poverty reduction obtained with a free trade (zero tariffs) trade agreement with the EU. It seems that the bigger reduction in prices obtained with a zero-tariff trade agreement (as opposed to only a 50 % tariff reduction) has a greater impact on the poor's income (and thus their spending). A zero tariff agreement also creates more job opportunities for unskilled wage workers in both urban and rural areas and has a bigger poverty reduction impact than a 50 % tariff agreement (see Table 10).

If the assumption of unemployment in unskilled wage workers is in place, and a free trade agreement with the EU with improved access to the EU banana market is reached, both indigence and poverty increase at the national level, with or without capital mobility (Table 11). Interestingly, in this scenario, there is the biggest increase in indigence and poverty rates of all the scenarios, and this happens in the households headed by females. In this type of household, indigence and poverty rates increase by 0.61 % and 1 % if capital is assumed fully mobile, and they increase by 1 % and 1.5 % if capital is assumed sector specific.

The increase in poverty rates with a free trade agreement and better access to Ecuadorian banana, if there is unemployment, can be explained by the developments in the banana sector and their impacts on production and wages in other sectors. As the economy is being affected by the lack of increasing capital accumulation and labor supply (the model is static), the increase in banana production can only be met by pulling resources out of other (agricultural) sectors which reduces production in those sectors where resources are being drained and increases prices for consumers. Price increases have a poverty increase effect. This result highlights the need for more investment as an economy opens up for increasing trade. It also highlights the impacts on poverty of consumer price increases.

7. Concluding remarks

Ecuador expects to sign a trade agreement with the EU to make permanent the trade preferences it receives from the EU (zero tariffs for most of Ecuadorian products) and to open the EU market for the main agricultural export product of Ecuador: bananas (which currently enter the EU market paying 176 euros per MT). The agreement is expected to have positive impacts on the Ecuadorian economy given the complementarities of these two economies in trade –Ecuador exports mostly agricultural goods to the EU and imports manufactures from the EU. This study highlights that a trade agreement with the EU may have different poverty impact depending on the degree of initial tariff reduction, and on whether better access to Ecuadorian bananas is granted by the negotiations. These scenarios try to take into account key characteris-

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respectively, have been adjusted for the change in consumer prices resulting in the simulations.

tics of the Ecuadorian economy such as dollarization, capital restrictions (modeled as sector-specific capital), and unemployment (expected to be in the unskilled wage labor).

The adjustments to a trade agreement with the EU come through changes in prices and factor returns. For the scenarios that assume unemployment in the unskilled urban and rural labor, adjustments also come through changes in labor demand for these categories of wage workers.

The results show that impacts on Ecuadorian imports from the EU are significant, particularly in the sectors that are currently the most protected (meat and meat products, cereals, beverages, textiles and apparel, wood and wood products, machinery and equipment). These impacts become even more significant as Ecuador also gets better access to the EU market for its bananas (Ecuador can finance more purchases from the EU –given the assumptions of no free lunch and that the model is static).

In the scenarios of free trade, real wages for unskilled labor increase (as the consumer price index decrease). If unemployment in this labor market segment is taken into account, there is an increase in employment for unskilled wage workers in rural areas –as expected if Ecuador consolidates its EU trade preferences. However, there would be a fall in employment for the unskilled in urban areas. Nevertheless, in this scenario there is a considerable poverty reduction. Poverty reduction seems to come about by increases in real wages and employment in the labor market segments where households are among the poorest and where poverty rates are the highest: rural and agricultural households. It is estimated that 50 % of households are poor in rural areas (measured using aggregate income). For poor households food represents the majority share of the households' expenditure (54 % in rural areas, and 40 % in urban areas), and the main source of income is through agricultural activity (33 % of total income comes from these activities in rural areas) and wages (42 % of total income in urban areas and 22 % of total income in rural areas).

How fast trade liberalization is implemented has an impact on factor returns and prices that are reflected in poverty results and macro aggregates. For the macro aggregates, the impacts of preferential trade (50% tariff reduction) are half of those in the scenario of zero tariffs. For poverty results, the 50% tariff reduction determines that –under the assumption of unemployment in the unskilled wage worker segment– poverty reduction may not be as fast as in the zero tariff case, and it may be mainly because reduction in consumption prices are not as big as in the latter case.

When one important sector for the economy -such as bananas- gets better access to the EU markets (given that almost all of the others are already entering the EU with zero tariffs), investment constraints (given that the model is static) may imply that increasing export and production of bananas can be achieved by pulling resources (namely production) out of other sectors. Lower production and higher consumer prices in those sectors may preclude gains from

poverty reduction, even if free trade is adopted. This result highlights the need for investment when increasing trade opportunities arise.

Capital restrictions may imply that increasing production opportunities cannot be materialized or that they are, but in an inefficient way. When capital is assumed to be sector specific, impacts on production and trade are not as big as when capital is assumed freely mobile.

There are several limitations and caveats of the present study. Consumption of own agricultural production in rural households can be very important (in terms of the share of the household's total consumption), but could not be included as part of the analysis for the lack of data. Another interesting aspect that could not be analyzed is the regional impact of the trade scenarios.

Among the caveats, it is important to recall that the model is static –no investment (like FDI, expected from an FTA) can be analyzed. Unemployment is assumed, focusing only on unskilled wage workers.

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ANNEX

CGE Model: Key Equations

1) Price block

- **Import Prices**

$$PMUSA_C = pwmusa_C * (1 + TIMPUSA_C) * EXR$$
$$PMCAN_C = pwmcan_C * (1 + TIMPCAN_C) * EXR$$
$$PMEU_C = pwmeu_C * (1 + TIMPEU_C) * EXR$$
$$PMROW_C = pwrow_C * (1 + TIMPROW_C) * EXR$$

- **Export Prices**

$$PE = \left[\frac{QEUSA_C}{QE_C} * PEUSA_C + \frac{QECAN_C}{QE_C} * PECAN_C + \frac{QEEU_C}{QE_C} * PEEU_C + \frac{QEROW_C}{QE_C} * PEROW_C \right] - \Sigma_C PQ_C * ice_C$$
$$PEUSA_C = pweusa_C * (1 - TEXP_C) * EXR$$
$$PECAN_C = pwecan_C * (1 - TEXP_C) * EXR$$
$$PEEU_C = pweeu_C * (1 - TEXP_C) * EXR$$
$$PEROW_C = pwerow_C * (1 - TEXP_C) * EXR$$

2) Production and trade block

- **Output transformation and export supply**

$$QE_C = QD_C * \left[\frac{PE_C}{PDS_C} * \frac{(1-\delta_c^t)}{\delta_c^t} \right]^{\frac{1}{\rho_c^t - 1}}$$

$$QEUSA_C = \alpha_{USA_C}^t * (\delta_{USA_C}^t) * \left[\frac{PEUSA_C}{PE_C} \right]^{\frac{1}{\rho_c^t - 1}}$$

$$QECAN_C = \alpha_{CAN_C}^t * (\delta_{CAN_C}^t) * \left[\frac{PECAN_C}{PE_C} \right]^{\frac{1}{\rho_c^t - 1}}$$

$$QEEU_C = \alpha_{EU_C}^t * (\delta_{EU_C}^t) * \left[\frac{PEEU_C}{PE_C} \right]^{\frac{1}{\rho_c^t - 1}}$$

$$QEROW_C = \alpha_{ROW_C}^t * (\delta_{ROW_C}^t) * \left[\frac{PEROW_C}{PE_C} \right]^{\frac{1}{\rho_c^t - 1}}$$

- **Armington and cost minimization**

$$QM_C = QD_C * \left[\frac{PDD_C}{PM_C} * \frac{\delta_c^q}{1-\delta_c^q} \right]^{\frac{1}{1+\rho_c^q}}$$

$$QMUSA_C = \alpha^q_{USA_C} * \delta^q_{USA_C} * \left[\frac{PM_C}{PMUSA_C}\right]^{\frac{1}{1+\rho^q_c}}$$

$$QMCAN_C = \alpha^q_{CAN_C} * \delta^q_{CAN_C} * \left[\frac{PM_C}{PMCAN_C}\right]^{\frac{1}{1+\rho^q_c}}$$

$$QMEU_C = \alpha^q_{EU_C} * \delta^q_{EU_C} * \left[\frac{PM_C}{PMEU_C}\right]^{\frac{1}{1+\rho^q_c}}$$

$$QMROW_C = \alpha^q_{ROW_C} * \delta^q_{ROW_C} * \left[\frac{PM_C}{PMROW_C}\right]^{\frac{1}{1+\rho^q_c}}$$

3) Institution block

- **Institutional factor incomes**

$$YIF_{i,f} = shif_{i,f} * \left[(1 - TFAC_f) * YF_f - (trnsf_{USA,f} + trnsf_{CAN,f} + trnsf_{EU,f} + trnsf_{ROW,f}) * EXR\right] + (trnsf_{f,USA} + trnsf_{f,CAN} + trnsf_{f,EU} + trnsf_{f,ROW}) * EXR$$

- **Income of domestic non-governmental institutions**

$$YI_{i,f} = \sum_f YIF_{i,f} + \sum_i TRII_{i,f} + trnsf_{i,gov} * CPI + (trnsf_{i,USA} + trnsf_{i,CAN} + trnsf_{i,EU} + trnsf_{i,ROW}) * EXR$$

- **Government revenue**

$$YG = YGINSDNG + YGFACT + YGVADD + YGACT + YGTIMP + YGTEXP + YGCOM + YGIF + YGTRNS$$

$$YGINSDNG = \sum_i TINS_i * YI_i$$
$$YGFACT = \sum_f TFAC_f * YF_f$$
$$YGVADD = \sum_a TVAD_a * PVA_a * QVA_a$$
$$YGACT = \sum_a TAC_a * PA_a * QA_a$$
$$YGTIMP = \sum_C (TIMPUSA_C * PWMUSA_C * QMUSA_C + TIMPCAN_C * PWMCAN_C * QMCAN_C + TIMPEU_C * PWMEU_C * QMEU_C + TIMPROW_C * PWMROW_C * QMROW_C) * EXR$$
$$YGTEXP = \sum_C TEXP_C * pwe_C * QE_C * EXR$$
$$YGCOM = \sum_C TCOM_C * PQ_C * QQ_C$$
$$YGIF = \sum_f YIF_{gov,f}$$
$$YGTRNS = (trnsf_{gov,USA} + trnsf_{gov,CAN} + trnsf_{gov,EU} + trnsf_{gov,ROW}) * EXR$$

4) System constraint block

- **Current account balance of foreign regions**

$$\sum_C pwm_C * QM_C + \sum_f (trnsf_{USA,f} + trnsf_{CAN,f} + trnsf_{EU,f} + trnsf_{ROW,f})$$

$$- \sum_i (trnsf_{i,USA} + trnsf_{i,CAN} + trnsf_{i,EU} + trnsf_{i,ROW})$$

5) Variables and parameters in equations

- **VARIABLES**

EXR	exchange rate
PE(C)	price of exports
PM(C)	price of imports
PQ(C)	price of composite good C
PWEUSA(C)	USA price of exports
PWECAN(C)	CAN price of exports
PWEEU(C)	EU price of exports
PWEROW(C)	ROW price of export
PWMUSA(C)	world price of imports from USA
PWMCAN(C)	world price of imports from CAN
PWMEU(C)	world price of imports from EU
PWMROW(C)	world price of imports from ROW
PDD(C)	demand price for com'y c produced & sold domestically
PDS(C)	supply price for com'y c produced & sold domestically
QE(C)	quantity of exports
QM(C)	quantity of imports
TEXP(C)	Effective export tax rate for commodity C
TIMPUSA(C)	Effective USA import tax rate for commodity C
TIMPCAN(C)	Effective CAN import tax rate for commodity C
TIMPEU(C)	Effective EU import tax rate for commodity C
TIMPROW(C)	Effective ROW import tax rate for commodity C
CPI	consumer price index (PQ-based)
QQ(C)	quantity of composite goods supply
QVA(A)	quantity of aggregate value added
TCOM(C)	Effective excise tax rate for commodity C
TEXP(C)	Effective export tax rate for commodity C
TFAC(F)	Effective factor tax rate for factor F
TINS(INS)	rate of direct tax on domestic institutions ins
TRII(INS,INSP)	transfers to dom. inst. insdng from insdngp
TVAD(A)	Effective value - added tax rate for activity A
YF(F)	factor income
YG	total current government income
YGACT	total current government income from activity taxes
YGCOM	total current government income from commodity taxes
YGFACT	total current government income from factor income taxes
YGIF	total current government income from government's factor income
YGINSDNG	total current government income from direct taxes to institutions
YGTEXP	total current government income from export tariffs
YGTIMP	total current government income form import tariffs
YGTRNS	total current government income from transfers

YGVADD	total current government income from value added taxes
YI(INS)	income of (domestic non-governmental) institution ins
YIF(INS,F)	income of institution ins from factor F
YF(F)	factor income

- **PARAMETERS**

ice(C,CP)	trade input of c per unit of comm'y cp exported
icm(C,CP)	trade input of c per unit of comm'y cp imported
alphat (C)	shift parameter for every region in CET function
alphaq(C)	shift parameter for Armington function
deltaq(C)	share parameter for Armington function
deltat(C)	share parameter for CET function
rhoq(C)	Armington function exponent
rhot(C)	CET function exponent
shif(INS,F)	share of dom. institution i in income of factor F
trnsf	transfers from i.e. factors, region, institution to i.e. factors, region or institution