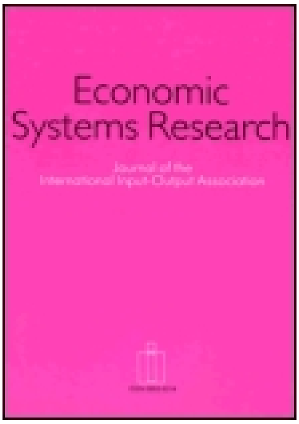

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REGIONAL SHORT-RUN EFFECTS OF TRADE LIBERALIZATION IN BRAZIL

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We use a single-country multi-regional computable general equilibrium model to evaluate regional short-run impacts of reduction in import tariffs resulting from recent free trade area agreements, on poverty and distribution of income in Brazil. Results show that trade can reduce inter-regional income inequality, but poor urban households lose with trade liberalization. Trade policy alone is not sufficient for achieving more equitable income distribution goals in Brazil. Without greater investment in human and physical capital, incomes in most regions of Brazil are likely to lag behind incomes in the South/Southeast, the most developed regions in the country.

Keywords: Trade liberalization; Income distribution; CGE models; Brazil

1. INTRODUCTION

A wave of trade liberalization policies started for many developing countries after the Mexican crisis in the late 1980s. The main belief about such trade policies was that free trade would bring welfare gains and accelerate economic growth. Brazil was one of the last countries in South America to adopt more liberal trade policies. In the early 1990s, under the Asunción Treaty, Brazil established a trade partnership called Mercosur, with Argentina, Paraguay and Uruguay. Recently, the inclusion of Mercosur countries in the Free Trade Area of Americas[1] (FTAA) has been discussed among policymakers across the Mercosur countries.

Trade policy reforms are being debated in Brazil and other South-American countries, and the process of import tariff reduction seems to be irreversible for these countries. According to Winters (2002), developing countries can experience a higher degree of uncertainty as a result of trade liberalization, because they are more vulnerable to trade shocks, such as commodity price booms and slumps or exchange rate changes, undermining policies to alleviate poverty[2] and redistribute income.

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[1] The Free Trade Area of Americas was initially intended to include all South, Central and North-American countries, and the main regulations and agreements in different sectors still in debate and negotiations. However, the FTAA missed the targeted deadline of 2005 as planned. There was a planned summit called the Fifth Summit of the Americas in Trinidad and Tobago in 2009, which once again was not successful in reaching an agreement to the FTAA.

[2] It is true that the analysis of the poverty due to trade liberalization can be more general than the pattern of trade restrictions across countries. See Winters (2002) for more details.

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There are many studies dealing with the macroeconomic impacts of import tariff reduction in Brazil and other Latin American countries, but only a few evaluate the consequences of trade reforms on poverty and income inequality. Almost 12% of Brazil's population lives in poverty and Brazil also has one of the highest levels of income inequality in the world (Barros et al., 2001). Brazil has significant social and economic regional disparities, such as large differences in income and social conditions among the different regions throughout Brazil, which contribute to income concentration and poverty. Because the expected implementation of the FTAA would imply a reduction and harmonization of current tariffs, it is very important not only to analyze the overall economic results from tariff reduction in the Brazilian economy, but also to consider its impacts on income distribution and poverty at the regional level.

The traditional trade theory would emphasize the gains from trade, mainly in the long-run, and it would indicate that a country removing any trade distortion would always gain from opening its economy. In general, trade reforms would bring gains for a country in the long-run, since there would be enough time to have a better allocation and distribution of resources, improving the overall economy. The problem is the uncertainty about short- to medium-run[3] effects of trade reforms, mainly when there are existing regional disparities in poverty and income distribution as in Brazil, resulting in some households winning and others losing from such reforms.

Elimination of import tariffs is one of the main components of structural adjustment policy measures in many developing countries. While the traditional neo-classical theory indicates that a country benefits from free trade, some new arguments about spillover effects, economies of scale, or benefits from technological progress suggest a wider set of impacts. The main argument is that the gains are obtained at the same moment that the trade barriers are removed, as trade controls absorb government resources and cause net welfare losses.

According to Mehlum (2002), the export sector experiences gains in relative prices with trade liberalization, which causes a short-term deficit in the current account balance. Investments increase with higher profits in the export sector, and the following periods show growth and improvement in the current account. Therefore, trade reform brings positive results in the long-run, with a positive investment response.[4]

According to Winters (2002), in the short-run, trade liberalization exerts pressure on some households that, even in the long-run, can leave some others in poverty. Even though there is a strong presumption that the long-run effects from trade liberalization lead to growth that benefits the poor, the true effects differ among households and across countries.

This study is devoted to assessing the regional economic impacts of a reduction in import tariffs at global and sectoral levels on poverty and distribution of income, through a single-country multi-regional computable general equilibrium model (CGE) applied to Brazil,[5] in order to analyze and identify those regional productive sectors that hurt the poor and contribute to increasing the inequality in the distribution of income, accounting for the overall gains and losses from the fall in import tariffs.

[3] Short- to medium-run here refers to the period where some of the factors of production are not fully fixed.

[4] Of course some other factors can affect the long-term responses of investments and the overall success of the trade reform as well, such as the economic and political environment of the country, since the degree of credibility of the reform plays an important role in this process. For more details, see Rodrik (1992) and Mehlum (2002).

[5] Even though Ando and Meng (2009) use a spatial CGE model applied to China, the model also takes into account regional and sectoral production distributions and prices differentials.

The link between trade policy reform and poverty is a major policy concern in Brazil. In particular, we address the following questions in the context of short- to medium-run import tariffs reduction. What are the main consequences of import tariff reduction in the presence of regional disparities, high poverty level and unequally distributed income? What would happen to the rural and urban poor? If there are some sectors in which trade reform hurts the poor, should we exclude such sectors from reform?

People in low-income households[6] represent, respectively, 64% and 79% of the population in the North and Northeast, and 48% in the Southeast. In 1990, Brazil had more than 30 million people living below the poverty line (more than 20% of the population). Although poverty was reduced in Brazil after 1995, its level is still high, with a need to implement actions to reduce it. These figures illustrate some of the regional disparities in Brazil.

In addition to the poverty, the income distribution is another important feature of the Brazilian economy. Although the Gini coefficient has decreased in recent years, from 0.60 in 1995 to 0.56 in 2006,[7] the Brazilian income distribution is still one of the most uneven in the world.[8]

One feature of the policy options to be examined in this study is their potential to affect the welfare of the poor. Because the import tariff reduction in specific sectors can adversely affect the poor, policy makers pursue the important goal to find the best and the worst trade reform alternatives with respect to total sectoral or partial liberalization of the Brazilian economy. As pointed out by Harrison et al. (2003), it can be risky to suggest sector-specific liberalization, as it could induce political lobbying by those sectors that have been protected through high import tariffs. This study can be useful to verify whether the lobbyist's claims for some sectors to be protected are valid in helping the poor.

This study contributes to the debate about the trade policy options available to developing countries through a regional analysis. The model we use is flexible and utilizes overall and sectoral simulations in order to evaluate various trade options. In contrast to other studies, we implement a short- to medium-run CGE model, where there is an intra-regional mobility of labor (skilled and unskilled) and no mobility for capital and land (activity-specific factors of production). Another novel contribution of our work is a disaggregated SAM featuring detailed regional and sectoral disaggregation, including households of different income levels. This allows us to simulate various policy measures aimed at influencing income distribution.

In the following subsection we provide a literature review of CGE studies on trade issues in Brazil. Section 2 provides the methodology and data used. Main results and discussions have been reviewed in the third section. Finally, the paper concludes in the fourth section.

1.1. CGE Studies of Trade Issues in Brazil: A Literature Review

There are many studies that capture the impacts of trade policies and regional integration on the Brazilian economy. Some of them are partial equilibrium studies (Carvalho and

[6] According to the Demographic Census 2000 (IBGE, 2000), low income here represents people whose total monthly earnings are less than twice the minimum wage, approximately US$140.

[7] For more details about the recent changes in the Gini coefficient in Brazil see Hoffman and Ney (2008).

[8] According to information from the World Bank, South Africa and Malawi are the countries with the highest degree of income inequality, with a Gini coefficient respectively of 0.62 and 0.61. Brazil is the third in this list (Barros et al., 2001).

Parente, 1999), which fail to consider the regional integration as a general equilibrium phenomenon. Other studies use a general equilibrium approach to study Mercosur policies, such as Campos-Filho (1998) and Flores (1997); and others, such as Haddad (1999), Haddad and Azzoni (2001), and Carneiro and Arbache (2002), analyze issues related to unilateral liberalization and their implications for resource allocation.

Carneiro and Arbache (2002) use a CGE model to analyze the labor market reactions to trade liberalization. They find that trade liberalization improves economic welfare by means of greater output, lower domestic prices, and higher labor demand, but the benefits of this economic improvement tend be appropriated by the most skilled workers in the most trade-oriented sectors.

Haddad et al. (2002) evaluate three different trade liberalization scenarios through an interregional model integrated to a CGE model and a national CGE model. Results show that the trade strategies tested are likely to increase the regional inequality in Brazil. Although this study evaluates regional short-run effects of trade liberalization, it does not address poverty, which is very heavily affected by the regional distribution of resources, population, and production sectors in the Brazilian economy.

Monteagudo and Watanuki (2001) investigated the impact on Mercosur after two different free trade agreements: Free Trade Area of Americas (FTAA) and free trade with European Union (EU). Their findings suggest that with the removal of tariffs and non-tariff barriers, the FTAA seems to be a better option for Mercosur countries. The integration seems to have a strong effect in Brazil, stimulating the export specialization in manufacturing industries.

Flores (1997) uses a CGE model with imperfect competition to evaluate the gains from Mercosur for Argentina, Brazil, Paraguay, and Uruguay. The results, in general, show that the gains are greater for Uruguay than for the other countries. Outcomes for Brazil and Argentina seem to be closely linked.

The pioneering work of Taylor et al. (1980), and Lysy and Taylor (1980) that evaluate the income distribution in Brazil using a general equilibrium model are the only studies that consider the effects of economic policies and programs on the distribution of income. In Lysy and Taylor (1980), the effect of devaluation is examined and they conclude that trade improves the distribution of income, increasing the income of the poorest households.

Barros et al. (2000) is one of a few studies that address the impact of trade liberalization on poverty in Brazil. They used a CGE model and simulated an increase of protection to the same level as in 1985. They conclude that trade liberalization is beneficial for the whole country, but especially for both urban and rural poor households.

2. METHODOLOGY

The aggregated Brazilian Social Accounting Matrix (SAM) to be used in this study was constructed for 1995–96 by Andrea Cattaneo, of the Economic Research Service's Resource and Environment Policy Branch (USDA) (Cattaneo, 1998).[9] It was generated

[9] More recent data are not available because the Bureau of Brazilian Statistics (IBGE) no longer updates the Brazilian input–output tables. It is not crucial as the main structure of the Brazilian economy has slowly changed in the last few decades. However, the main elasticities used in the CGE model come from recent estimations from different sources.

TABLE 1. Summary of activities, commodities, and factors included in the 1995 Brazilian SAM.

Activity	Commodities produced	Factors used
Annuals production	Corn, rice, beans, manioc, sugar, soy, horticultural goods, and other annuals	Arable land, unskilled rural labor, skilled rural labor, agricultural capital
Perennials production	Coffee, cocoa, other perennials	Arable land, unskilled rural labor, skilled rural labor, agricultural capital
Animal products	Milk, livestock, poultry	Grassland, unskilled rural labor, skilled rural labor, agricultural capital
Forest products	Non-timber tree products, timber, and deforested land for agricultural purposes	Forest land, unskilled rural labor, skilled rural labor, agricultural capital
Other agriculture	Other agriculture	Arable land, unskilled rural labor, skilled rural labor, agricultural capital
Food processing	Food processing	Urban skilled labor, urban unskilled labor, urban capital
Mining and oil	Mining and oil	Urban skilled labor, urban unskilled labor, urban capital
Industry	Industry	Urban skilled labor, urban unskilled labor, urban capital
Construction	Construction	Urban skilled labor, urban unskilled labor, urban capital
Trade and transportation	Trade and transportation	Urban skilled labor, urban unskilled labor, urban capital
Services	Services	Urban skilled labor, urban unskilled labor, urban capital

Source: Cattaneo (1999).

from 1995 input–output tables for Brazil (IBGE, 1997a), National accounts (IBGE, 1997b), as well as Agricultural Census data for 1995–96 (IBGE, 1998). According to Cattaneo (1999), total labor, land and capital value added were allocated across agricultural activities based upon the Agricultural Census. The structure of the SAM is summarized in Table 1.

2.1. Regional Sectoral Disaggregation

A ‘top-down’ approach will be used to perform the disaggregation of national flows to regional levels, since ‘bottom-up’ approaches require a great deal of data that are not fully available for Brazil.[10] It is assumed that each region always produces a fixed share of each sector’s national output (Higgs et al., 1988). The procedure is basically the same as the one performed in the ORANI Regional Equation System (Higgs et al., 1988), and also the one to obtain regional input–output tables described by Leontief (1966).

The industry and services sectors are disaggregated into four regions (North, Northeast, Center-West and Southeast-South) and regional intermediate consumption, regional value added (capital and labor), and regional taxes are calculated by multiplying regional share

[10] See Liew (1984) for a good evaluation of both ‘top-down’ and ‘bottom-up’ approaches. Higgs et al. (1988) give a third procedure that consists of a hybrid of both ‘top-down’ and ‘bottom-up’ approaches.

parameters by national aggregates. The regional disaggregation procedures produce unbalanced regional SAMs. The stochastic cross-entropy (CE) procedure[11] is adopted in order to balance the accounts. The CE procedure allows errors in variables.

2.2. The CGE Model

The CGE model[12] that will be used in this study is a regional adaptation of the so-called 'standard CGE model', developed by the International Food Policy Research Institute (IFPRI).[13] The model follows the neo-classical-structuralist (Chenery, 1975) modeling tradition presented in Dervis et al. (1982). The model has characteristics of importance in developing countries, including household consumption of non-marketed commodities, explicit treatment of transaction costs for commodities that enter the market, and a distinction between producing activities and commodities that permits any activity to produce multiple commodities and any commodity to be produced by multiple activities.

2.2.1. Prices, Activities, Production, and Factor Markets

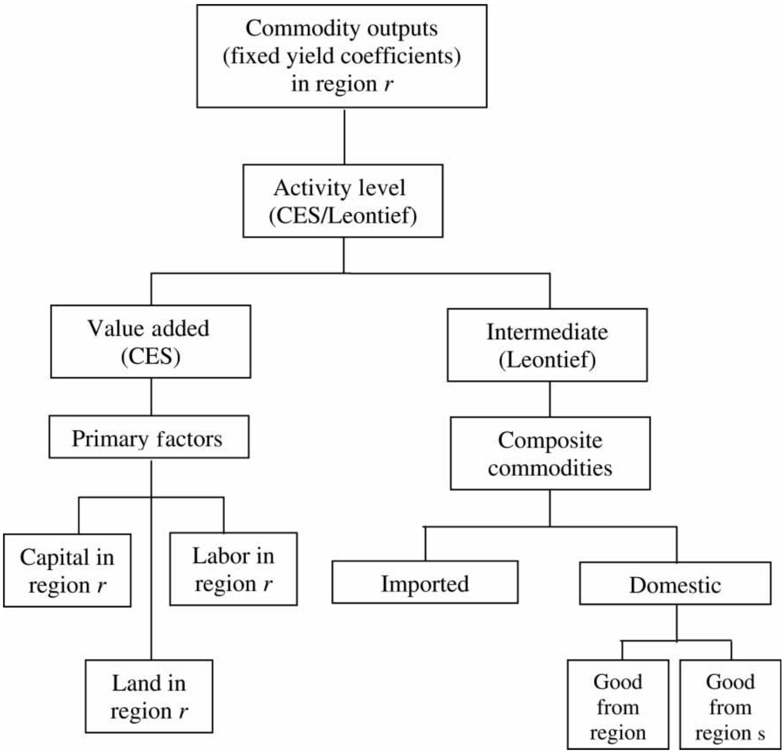
Assuming that producers in each region maximize profits subject to the technology, taking prices as given, Figure 1 shows that this technology is specified by a Constant-Elasticity-of-Substitution (CES) or a Leontief function of the quantities of value added and aggregate intermediate input. Value added is a CES function of primary factors, and the aggregate intermediate input is a Leontief function of disaggregated intermediate inputs. Each regional activity produces one or more commodities, or any commodity can be produced by more than one activity. In factor markets, quantity supplied of each factor is fixed at the initial level (SAM). Labor is considered mobile across sectors. This is a medium-run assumption. Capital and land are considered sector-specific. Labor will be reallocated to more productive uses after a reduction in import tariffs. Regional activities pay an activity-specific wage that is the product of the economy-wide wage and a fixed activity-specific wage term. The main price, production, and commodity equations[14] for each region are given in the Appendix.

2.2.2. Institutions and Commodity Markets

Institutions include households, government, enterprises, and rest of the world. Households receive income from payments for the use of factors of production, and transfers from other institutions. Their consumption is allocated across different commodities according to a Linear Expenditure System (LES) demand function. Enterprises can receive direct payments from households and transfers from other institutions. Since enterprises do not consume, they allocate their income to direct taxes, savings, and transfers to

[11] For more details and explanation about this approach, see, Robinson, Cattaneo and El-Said (1998, 2000).
[12] Lofgren et al. (2002), Thurlow and Van Seventer (2002) and Wobst (2002). Mathematical description of the regional model can be seen in Bittencourt (2004).
[13] For more details about this model, see Lofgren et al. (2001).
[14] Description of parameters and variables can be seen in the Appendix. For a detailed description of the model see Bittencourt (2004).

FIGURE 1. Regional production technology in the standard CGE model for Brazil.



other institutions. Government receives taxes (fixed at *ad valorem* rates) and transfers from other institutions, and uses this income for consumption and for CPI-indexed[15] transfers to other institutions. Transfer payments from the rest of the world, domestic institutions, and factors are all fixed in foreign currency. Foreign savings is the difference between foreign currency spending and receipts.

The first stage in the flows of regional marketed output consists of aggregated domestic output from the regional output of different activities of a given commodity. A Constant-Elasticity-of-Substitution (CES) function is used as the aggregation function. Aggregated domestic output is allocated between exports and regional domestic sales, where suppliers maximize sales revenue for any given aggregate output level, subject to imperfect transformability between exports and regional domestic sales, through a Constant-Elasticity-of-Transformation (CET).

All domestic market demands are for a composite commodity made up of imports and domestic output. It is assumed that domestic buyers minimize cost subject to imperfect substitutability. This is also captured by a CES aggregation function (Armington, 1969). The derived demands for imported commodities are met by international supplies that are infinitely elastic at given world prices. Import tariffs and fixed transaction costs are included in the import prices paid by domestic buyers. The derived demand for domestic

[15] Government transfers indexed to the CPI make the model homogeneous of degree zero in prices.

output is also met by domestic suppliers, and the prices paid by buyers include the cost of transaction services. The values of the elasticity of substitution between imported and domestic commodities are based on Tourinho et al. (2002), which estimated the Armington elasticities for 28 industrial sectors in Brazil for the period 1986–2001. Other elasticities are borrowed from Asano and Fiuza (2001).

The macroeconomic closure used here treats government savings[16] as a flexible residual while all tax rates are fixed. Therefore, government consumption is fixed, either in real terms or as a share of nominal absorption. For external balance, the real exchange rate[17] is flexible while foreign savings is fixed. The savings-investment balance is investment-driven. To generate savings that equal the cost of a fixed investment bundle, the base-year savings rates of selected non-government institutions are adjusted.

2.2.3. Inequality Measures

Following the theorems of Heckscher–Ohlin–Samuelson and Stolper–Samuelson, the relationship between an increase in international trade, wage distribution and level of employment has led several economists to conclude that recent internationalization of economies has contributed to an increase of wage inequality and unemployment (Arbache, 2001). The theorems cited are still the main analytical tools to explain the relationship between international trade and distribution of income, but the case of developing countries has received less attention.

In order to verify the impacts of reduction in import tariffs on poor households and on income inequality, we need to define the tools to quantify such effects. When policy simulations are carried out, factor prices, transfers, or other endogenous variables may change, which modify not only the total households' net income but also the distribution of income (Khan, 1997).

Measures of inequality to be used at the regional level are the Gini coefficient, and several generalized entropy inequality measures developed by Theil, Hirschman-Herfindahl, and Bourguignon. According to Silber (1989), Dagum (1997a), and Mussard et al. (2003), we can decompose the Gini index by factor components when detailed income sources are available. It is possible to break down the inequality into within and between classes inequality when there are groups with different income ranges. Our data show not only different household groups arranged by income, but also by location (urban and rural), or population subgroups, with income sources from activities from different regions.

2.2.4. Trade Policy Simulations

This study investigates two different scenarios that allow us to compare the impact of general trade reform (reduction or elimination of import tariffs) to a reform that is limited to selected sectors.

[16] Government saving is defined as the difference between current government revenues and current government expenditures.

[17] Brazilian exchange rate policy in recent years allows flexible exchange rate fluctuations within a band controlled and determined by the Central Bank.

Scenario 1: Elimination of import tariffs[18] for all sectors. The objective is to verify which sectors bring negative impacts to the poor households after the import tariffs are reduced or eliminated.

Scenario 2: Elimination of import tariffs for specific sectors. The rationale for this set of simulations is to verify what would be the welfare improvements for households after having identified and excluded from the trade policy reform those sectors that bring negative outcomes for the poor.

According to IBGE (1997c), 60% of the working population are unskilled in Brazil, and the share of unskilled workers among the low-income people is around 78%. It is expected that with import tariff reduction, the households providing unskilled labor will gain from reform. This is because, following the Heckscher-Ohlin-Samuelson model (HOS), since Brazil protects the capital-intensive sectors, after import tariff reduction, these sectors should lose and labor-intensive sectors should gain. Almost 20% of low-income workers are employed in agriculture, which should expand, so that trade reform should bring gains for unskilled workers in rural areas.

3. RESULTS AND DISCUSSION[19]

3.1. Overall Trade Liberalization (Scenario 1)

3.1.1. National impacts

Imports increase 12.4% after total elimination of the import tariffs (Table 2). Exports rise 14.4%, which is achieved by a depreciation of 4.4% of the real exchange rate. Lower prices of imported commodities reduce the cost of intermediate goods for domestic producers, which together with increased export demand, induces an increase in production.[20] Reduction in import tariffs causes a decrease in government revenue, leading to a reduction in government savings (–0.9%).

The overall welfare impacts from the import tariff reductions were positive. Welfare increased for all household categories except low-income urban households. The poorest households, rural low- and middle-income households, had their welfare improved after the trade reform. It is therefore not surprising that the Gini coefficient and the Theil index decreased with the removal of the import tariffs. The Gini coefficient decreased from 0.5054 (base) to 0.5045 (total removal of the import tariffs). The Theil index in the base was 0.6344 and, after the complete elimination of the import tariffs, declined to 0.6336.

Given the relatively small changes in the Gini indices, we used calculated standard deviations using bootstrap re-sampling methods,[21] with a refinement of the bias-corrected method (Efron and Tibshirani, 1997). This procedure showed that these Gini index

[18] In general, the average nominal import tariff in Brazil is around 13%, as noted by Estevadeordal et al. (2000), Leipziger et al. (1997), and Monteagudo and Watanuki (2002). Some sectors present, on average, low levels of protection, but there are some specific products with very high import tariffs. For instance, the industry average import tariff is around 10.6%, but the import tariff for vehicles is 39%, and for clothing and shoes is 18.3%.

[19] The results from both scenarios were robust to changes in the Armington elasticities and in the structure of the CGE model. However, they were very sensitive to changes in the macroeconomic closures as expected.

[20] Horticultural, forest, and industrial commodities have large increases in exports after eliminating import tariffs.

[21] We used 2000 repetitions and a 5% significance level.

TABLE 2. National simulation results for overall import tariff reduction (Scenario 1), percent change from benchmark values.

	Percent Change
Absorption	0.1
Private consumption	0.1
Exports	14.4
Imports	12.4
Real exchange rate	4.4
Share of GDP (%)	
Investment	−0.2
Private savings	0.5
Foreign savings	0.1
Government savings	−0.9
Tariff revenue	−0.9
Direct tax revenue	0.1
Equivalent Variation (%)	
Rural low income household	0.7
Rural medium income household	0.7
Urban low income household	−0.7
Urban medium income household	0.0
High income household	0.3
Total welfare	0.1
Gini coefficient	−0.2
Theil index	−0.3

changes were not statistically significant. However, due to the Brazilian income distribution being so skewed, with a large income concentration in the top of the distribution, small changes like these can be a result of important income improvement for the poor. Gini coefficient and Theil indices are not sensitive to changes in the bottom of the distribution, which we are interested in investigating. We attempt to overcome this shortcoming by examining different income distribution measures in our regional analysis. The results here emphasize that a concern about equity is not equivalent to a concern about poverty, since the trade simulation evaluated in this section resulted in greater equity, but with an increase in poverty for urban poor.

The expected results from the first scenario would be that trade liberalization brings gains for all poor households, since there would be a shift of resources from capital intensive manufacturing toward unskilled-labor-intensive agriculture and less capital-intensive manufacturing, increasing the wage of unskilled labor relative to capital returns and skilled labor wages.

The price changes due to trade liberalization affect the incentives to produce particular goods and the technologies they employ. The Stolper-Samuelson Theorem (SST) predicts that, under particular conditions, an increase in the price of the commodity that is intensive in unskilled labor will increase the unskilled real wage and decrease that of skilled labor. Our results for rural households are exactly those predicted by SST. But what can be said about the results for urban poor households? According to Winters (2002), despite its theoretical elegance, SST is not robust enough to totally explain the link between trade and poverty in the real world. One of the problems is the dimensionality problem. SST arrives from a theoretical model that is highly aggregated. Results may differ when there are many sectors, commodities, and also factors of production that are immobile. Another complication is that SST ignores non-traded goods. In our model, the prices of non-traded goods are determined in order to clear the domestic market. Trade shocks then induce changes in the real exchange rate,[22] and if traded and non-traded goods have different factor intensities, the factor market effects may differ greatly from those predicted by SST (Lal, 1986).

Brazil is abundant in unskilled labor, so a reduction in import tariffs should improve workers' welfare. However, within Brazil it is not clear that the least-skilled workers, who are most likely to be poor, are the most intensively used factor in the production of tradable goods, mainly in urban areas. According to Winters (2002), the agricultural sector should be the one to gain from free trade because this sector has a higher proportion of unskilled workers. Results for rural households, in Table 2 are consistent with SST.

The urban poor households are harmed after the removal of the import tariffs, and some possible explanations for this result were previously described. Some studies, such as Robbins (1994, 1995), Beyer et al. (1999), Robbins and Gindling (1999), and Arbache (2001), claim that trade liberalization can increase wage inequality, perhaps as a consequence of higher technological modernization, increasing the demand for skilled labor. Other studies, such as Arbache and Corseuil (2000), Barros et al. (2001), Menezes-Filho and Rodrigues (2001), and Maia (2001), go against the results predicted by the traditional theory of trade, and their conclusions indicate a negative or an uncertain impact of trade liberalization on labor markets in Brazil.

3.1.2. Regional Impacts

The regional effects of trade liberalization on agriculture bring welfare gains for all rural households, with a higher increase in wages for skilled workers. Our results confirm the findings of earlier Brazilian studies that the importation of capital goods at lower prices can increase production, creating a larger demand for skilled labor to gain advantage from the new technologies.

The South/Southeast is the most developed and wealthy region in Brazil. Most of the industry and agriculture is located in this region; it is responsible for more than 90% of national GDP. This region has a larger proportion of households, factor endowment, skilled labor and capital shares than any other region. Although unskilled labor wages increase more than the wages of skilled labors, it is not enough to offset the losses in the industry, which is the main income supplier for urban low-income households. Labor income gains are obtained in the North and Center-West, but mainly for rural households.

Although Table 3 shows that interregional income inequality is slightly reduced after eliminating import tariffs, the question becomes what are the main changes between regions? Table 4 points out some elements to answer this question. In this table, we have the decomposition of four inequality measures. The largest part of the overall inequality seems to come from the inequality in labor income among the four Brazilian

[22] The real exchange rate in our model is represented by the relative prices of traded and non-traded goods.

TABLE 3. Regional income inequality measures before and after an overall elimination of the import tariffs.

	North		Northeast		Center-West		South/ Southeast	
Indexes	Base(*)	Sim(**)	Base	Sim	Base	Sim	Base	Sim
Gini	0.258	0.255	0.353	0.352	0.402	0.400	0.475	0.474
Theil	0.115	0.113	0.229	0.227	0.275	0.272	0.390	0.388
H-H	0.106	0.104	0.201	0.200	0.275	0.273	0.388	0.386
Bourguignon	0.139	0.136	0.310	0.308	0.342	0.337	0.526	0.522

Notes: (*) Base indicates values at the benchmark solution. (**) Sim refers to values after simulation.

TABLE 4. Contribution of the four decompositions to overall labor income inequality after simulation.

Indexes	% of the within-region component	% of the between-regions component	% of transvariation
Gini	16.6	78.6	4.8
Theil	40.2	59.8	–
H-H	58.1	41.9	–
Bourguignon	37.4	62.6	–

regions.[23] According to the Gini index, 78.6% of the total labor income inequality is due to the inequality among regions. Only the Gini coefficient can provide the intensity of transvariation (4.8%), which represents the part of the between-regions disparities issued from the overlap among the distributions.[24] Therefore, the simulation does not modify the structure of the inequality within and among regions in Brazil, and the inequality among regions is more important than within regions.

We can see the relative importance of all four regions for the inequality within a region. Multi-decomposition of the four inequality indexes shows that the North, Northeast, and Center-West regions contribute somewhat to reducing overall inequality among regions (Table 5). The South/Southeast has the largest contribution not only to the increase in the overall inequality among regions, but also within this region. The main contribution to within-region inequality comes from the South/Southeast. For instance, according to the Gini index, around 13% of the overall inequality originates from the inequality within the South/Southeast region.

[23] H-H index was the only index to indicate that the within-region inequality is the most important component to explain the overall inequality. This result reflects how this component is calculated, which includes the product of individual income and the square of a coefficient of variation. That is, if the income is highly concentrated, the within-region inequality tends to be larger than the between inequality, which seems to be the case in Brazil.

[24] The low value for transvariation was not surprising due to the SAM disaggregation, since the labor income comes from activities specified by region, with no overlap from sources of income.

TABLE 5. Regional contribution to overall labor income inequality after simulation.

Indexes	North	Northeast	Center-West	South/Southeast
Gini (%)	0.5	2.1	1.2	12.8
Theil (%)	0.6	4.2	2.6	32.8
H-H (%)	0.07	1.4	0.5	56.2
Bourguignon (%)	3.9	8.8	9.7	15.0

3.2. Sectoral Trade Liberalization (Scenario 2)

In this section, our goal is to verify the possibility of finding a sector for which a reduction in import tariffs does not harm poor households. The simulations performed in scenario 2 consist of a 100% reduction in import tariff for selected sectors. The sectors are divided in five groups: (i) agriculture (AGR), which is composed of corn, rice, soybeans, beans, perennial commodities, annual commodities, horticultural products, forest products, cattle meat, poultry meat, milk, sugar, and other agricultural commodities; (ii) annual (ANN), which is composed of corn, rice, soybeans, beans, annual commodities, horticultural products, and other agricultural commodities; (iii) perennial (PER), which is represented by coffee, cocoa, manioc, perennial commodities, and forest products; (iv) industrial (IND), which is composed of industrial commodities, mining and oil goods, and processed foods; and (v) the last group which is a combination of industry and agriculture (MIX).

Sectoral trade liberalization in the agricultural sector does not bring considerable modifications in the economy in the short- to medium-run. The impacts on trade are small, without any substantial change in the inequality measures. However, the poorest people lose, which is not surprising, as we can see by the decrease in welfare for rural households. In this case, resources from agriculture would be reallocated to the most capital-intensive sectors. However, urban households would experience gains if the import tariffs are totally eliminated in agriculture (Table 6). The elimination of the import tariffs in agriculture does not improve inequality in the distribution of income in any region (Table 7).

Table 6 shows that poor households in rural areas are the main losers from trade liberalization in the agricultural sector. After removing the tariff from labor-intensive sectors, with a fixed capital supply, labor moves to capital-intensive sectors whose output expands. The net result is a lowering of wages in both sectors.

As expected, the industrial sector plays the most important role in the Brazilian attempt to open its economy due to the existence of a high degree of protection in this sector for many decades. Results in Table 6 show a substantial increase in trade, with a devaluation of the real exchange rate.[25] The main negative impact is once again on urban poor households whose welfare declines. As expected, rural poor households experience welfare gains from the reduction or elimination of the protection in the capital-intensive sectors.

Elimination of an import tariff in industry harms urban low and medium income households instead of rural households. Rural households gain from trade reform in the industrial sector, bringing a substantial increase in their wages. Although urban households lose sectoral trade liberalization in industry, the distribution of income within regions improves (Table 8).

[25] An increase in the value of the exchange rate in our model represents a devaluation.

TABLE 6. Simulation results for sectoral elimination of the import tariffs (Scenario 2), percent change from benchmark values.

	100 % reduction import tariff				
	AGR	ANN	PER	IND	MIX
Absorption	–	–	–	0.1	0.1
Private consumption	–	–	–	0.1	0.1
Exports	1.3	0.9	0.4	13.1	14.1
Imports	1.3	0.8	0.5	11.2	12.1
Real exchange rate	0.2	0.2	0.1	4.2	4.3
Share of GDP (%)					
Investment	–	–	–	−0.2	−0.2
Private savings	–	–	–	0.5	0.5
Foreign savings	–	–	–	0.1	0.1
Government savings	–	–	–	−0.8	−0.8
Tariff revenue	−0.1	–	–	−0.9	−0.9
Direct tax revenue	–	–	–	0.1	0.1
Equivalent Variation (%)					
Rural low inc. household	−0.4	−0.4	−0.02	1.1	1.0
Rural medium income household	−0.4	−0.3	−0.03	1.0	0.9
Urban low income household	0.2	0.1	0.02	−0.8	−0.7
Urban medium income household	0.1	0.1	0.03	−0.2	−0.1
High income household	–	–	–	0.3	0.3
Total welfare	0.02	0.01	–	0.1	0.1
Gini coefficient	–	–	–	−0.2	−0.2
Theil index	–	–	–	−0.4	−0.3

TABLE 7. Regional income inequality measures before and after elimination of the import tariffs in agriculture.

	North		Northeast		Center-West		South/ Southeast	
Indexes	Base(*)	Sim(**)	Base	Sim	Base	Sim	Base	Sim
Gini	0.258	0.259	0.353	0.354	0.402	0.403	0.475	0.476
Theil	0.115	0.116	0.229	0.231	0.275	0.276	0.390	0.391
H-H	0.106	0.106	0.201	0.203	0.275	0.276	0.388	0.389
Bourguignon	0.139	0.140	0.310	0.315	0.342	0.344	0.526	0.528

Notes: (*) Base indicates values at the benchmark solution. (**) Sim refers to values after simulation.

Sectoral elimination of the import tariffs in agriculture and industry produced negative welfare outcomes for low and medium income households, in either rural and urban areas.

The elimination of import tariffs as a combination of agricultural and industrial sectors (MIX) brings welfare losses for urban low and medium income households (Table 6). Even though the welfare implications from this combined sectoral trade reform do not bring favorable outcomes for urban households (Table 6), the inequality of the regional distribution of income improves (Table 9). However, the values do not differ significantly from those in Table 6, under industrial removal of the import tariffs.

TABLE 8. Regional income inequality measures before and after elimination of the import tariffs in industry.

	North		Northeast		Center-West		South/ Southeast	
Indexes	Base(*)	Sim(**)	Base	Sim	Base	Sim	Base	Sim
Gini	0.258	0.255	0.353	0.350	0.402	0.400	0.475	0.474
Theil	0.115	0.112	0.229	0.225	0.275	0.272	0.390	0.387
H-H	0.106	0.103	0.201	0.198	0.275	0.272	0.388	0.385
Bourguignon	0.139	0.135	0.310	0.304	0.342	0.336	0.526	0.520

Notes: (*) Base indicates values at the benchmark solution. (**) Sim refers to values after simulation.

TABLE 9. Regional income inequality measures before and after elimination of the import tariffs in a combination of agriculture and industry.

	North		Northeast		Center-West		South/ Southeast	
Indexes	Base(*)	Sim(**)	Base	Sim	Base	Sim	Base	Sim
Gini	0.258	0.256	0.353	0.351	0.402	0.400	0.475	0.474
Theil	0.115	0.113	0.229	0.226	0.275	0.272	0.390	0.387
H-H	0.106	0.104	0.201	0.199	0.275	0.272	0.388	0.386
Bourguignon	0.139	0.136	0.310	0.305	0.342	0.336	0.526	0.521

Notes: (*) Base indicates values at the benchmark solution. (**) Sim refers to values after simulation.

4. CONCLUSIONS

A single country, static, CGE model was used to evaluate trade policy reforms in Brazil under two different scenarios, through a top-down-regionalized social accounting matrix (SAM) with 60 sectors divided into four regions and five household categories. The model experiments were divided into two stages. In the first scenario, the model considered only the global reduction in import tariff. The second scenario consisted of sectoral import tariff reductions.

We determined the main overall and regional consequences for Brazil of a global reduction in import tariffs to be:

(i) An overall welfare gain from trade reform;
(ii) Urban poor households lose, which indicates the presence of a trade-off between aggregate welfare gains and the welfare gains to the urban poor from reduction in import tariffs, as found by Harrison et al. (2003) for Turkey;
(iii) National and regional income inequality is reduced among households, contrary to what was found in Haddad (1999) and Haddad et al. (2002);
(iv) The reduction or elimination of import tariff is not enough to change the structure of inequality in the distribution of regional income;
(v) South/Southeast has the most important weight in determining the inequality of income among the regions in Brazil;

(vi) The main regional impacts from trade reform indicate a similar pattern for the whole country, in which industry suffers a negative impact, with a reduction in income and welfare of poor households employed in this sector.

In the second stage, the main results from the sectoral reduction in import tariff seemed to follow traditional trade theories. Trade reform in the agriculture leads to welfare losses for rural households, with opposite results for urban households from trade reform in the industry. Therefore, a mix of import tariff reduction in agriculture and industry was simulated in an attempt to find a policy that would not hurt the poor. The results from such a policy were similar to those in the simulation in the first stage, which showed that the urban poor are harmed and regional income inequality became worse after trade liberalization.

Trade policy alone is not sufficient for achieving more equitable income distribution goals in Brazil. Without greater investment in human and physical capital, incomes in most regions of Brazil are likely to lag behind incomes in the South/Southeast.

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APPENDIX

Regional Adaptation of Lofgren's Model (Lofgren et al., 2001)

Sets

$a \in A$	Activities	$i \in INS$	Institutions
$c \in C$	Commodities	$i \in INSD(\subset INS)$	Domestic institutions
$c \in CE(\subset C)$	Exported commodities	$i \in INSDNG(\subset INSD)$	Domestic non-government institutions
$c \in CM\ (\subset C)$	Imported commodities	$h \in H\ (\subset INSDNG)$	Households
$c \in CX(\subset C)$	Domestic production	$r \in R$	Regions
$f \in F$	Factors of production		

Parameters

$\alpha_{\mathrm{a}}^{\mathrm{a}}$	Efficiency parameter in the CES activity function	$shif_{if}$	Share for domestic institution i in the income from f
$\alpha_{\mathrm{a}}^{\mathrm{va}}$	Efficiency parameter in the CES value added function	ta_a	Tax rate for activity a
$\alpha_{\mathrm{c}}^{\mathrm{ac}}$	Shift parameter for domestic commodity aggregation function	tf_f	Direct tax rate for factor f
$\delta_{\mathrm{a}}^{\mathrm{a}}$	CES activity function share parameter	$trnsfr_{if,r}$	Transfer from factor f to institution i in region r
$\delta_{\mathrm{fa}}^{\mathrm{va}}$	CES value added function share parameter for factor f in activity a	tva_a	Rate of value added tax for activity a
$\theta_{\mathrm{ac},r}$	Yield of output c per unit of activity a in region r	$ica_{ca}^{,r}$	c used as intermediate input per unit of final output in a in region
$\rho_{\mathrm{a}}^{\mathrm{a}}$	CES production function exponent	$inta_{a,}^{r}$	Amount of aggregate intermediate input per activity unit in region
$\rho_{\mathrm{a}}^{\mathrm{va}}$	CES value added function exponent	$iva_{a,}^{r}$	Amount of aggregate value added input per activity unit in region r
$\rho_{\mathrm{c}}^{\mathrm{ac}}$	Domestic commodity aggregation function exponent		

Variables

$\overline{QFS}_{f,r}$	Quantity supplied of factor in region r	$QF_{fa,r}$	Demand for factor f from activity a in region r
$\overline{WFDIST}_{fa,r}$	Wage distortion factor for factor f in activity a in region r	QHA_{ach}	Household home consumption of c from activity a by household h
EXR	Foreign exchange rate	$QINTA_{a,r}$	Aggregate intermediate input in region r
$PA_{a,r}$	Price of activity a in region r	$QINT_{ca,r}$	Output of commodity c as intermediate input to activity a in region r
$PINTA_{a,r}$	Aggregate intermediate input price for activity a in region r	$QVA_{a,r}$	Aggregate value added in region r
PQ_c	Composite commodity price	QX_c	Aggregate domestic output
PX_c	Producer price	$QXAC_{ac,r}$	Output of commodity c from activity a in region r
$PVA_{a,r}$	Value added price of a in region r	$WF_{f,r}$	Average price of factor f in region r
$PXAC_{ac,r}$	Producer price of commodity c for activity a in region r	$YF_{f,r}$	Income of factor f in region r
$QA_{a,r}$	Level of activity a in region r	$YIF_{if,r}$	Income to domestic institution i from factor f in region r

Equations

Regional Prices

$$PA_{a,r} = \sum_{c \in C} \theta_{ac,r}.PXAC_{ac,r} \qquad \text{(Regional Activity Price)} \tag{1}$$

$$PINTA_{a,r} = \sum_{c \in C} PQ_c.ica^r_{ca} \qquad \text{(Regional Intermediate Input Price)} \tag{2}$$

$$PA_{a,r}.(1 - ta_a).QA_{a,r} = PVA_{a,r}.QVA_{a,r} + PINTA_{a,r}.QINTA_{a,r} \tag{3}$$
(Regional Activity Revenues and Costs)

Production and Commodity Regional Equations

$$QA_{a,r} = \alpha^a_a.\left(\delta^a_a.QVA_{a,r}^{-\rho^a_a} + (1 - \delta^a_a).QINTA_{a,r}^{-\rho^a_a}\right)^{\frac{1}{\rho^a_a}} \tag{4}$$
(Regional CES Activity Production Function)

$$\frac{QVA_{a,r}}{QINTA_{a,r}} = \left(\frac{PINTA_{a,r}}{PVA_{a,r}} \frac{\delta^a_a}{1 - \delta^a_a}\right)^{\frac{1}{1+\rho^a_a}} \tag{5}$$
(Regional CES Value added Intermediate-Input Ratio)

$$QVA_{a,r} = iva^r_a.QA_{a,r} \qquad \text{(Demand for Regional Value added)} \tag{6}$$

$$QINTA_{a,r} = \mathrm{int}a^r_a.QA_{a,r} \qquad \text{(Demand for Regional Intermediate Input)} \tag{7}$$

$$QVA_{a,r} = \alpha^{va}_a.\left(\sum_{f \in F} \delta^{va}_{fa}.QF_{fa,r}^{-\rho^{va}_a}\right)^{\frac{1}{\rho^{vq}_a}} \text{(Regional Value added and Factor Demands)} \tag{8}$$

$$W_{f,r}.\overline{WFDIST_{fa,r}} = PVA_{a,r}.(1 - tva_a).QVA_{a,r}.\left(\sum_{f \in F'} \delta^{va}_{fa}.QF_{fa,r}^{-\rho^{va}_a}\right)^{-1}.\delta^{va}_{fa}.QF_{fa,r}^{-\rho^{va}_a - 1} \tag{9}$$
(Regional Factor Demand)

$$QINT_{ca,r} = ica^r_{ca}.QINTA_{a,r} \qquad \text{(Regional Intermediate Input Demand)} \tag{10}$$

$$QXAC_{ac,r} + \sum_{h \in H} QHA_{ach,r} = \theta^{r}_{ac}.QA_{a,r} \tag{11}$$

(Regional Commodity Production and Allocation)

$$QX_c = \alpha^{ac}_c.\left(\sum_{a \in A} \delta^{ac}_{ac}.QXAC^{-\rho^{ac}_c}_{ac,r}\right)^{\frac{1}{\rho^{ac}_c - 1}} \tag{12}$$

(Regional Output Aggregation Function)

$$PXAC_{ac,r} = PX_c.QX_c.\left(\sum_{a \in A'} \delta^{ac}_{ac}.QXAC^{-\rho^{ac}_c}_{ac,r}\right)^{-1}.\delta^{ac}_{ac}.QXAC^{-\rho^{ac}_c - 1}_{ac,r} \tag{13}$$

(First-order Condition for Regional Output Aggregation Function)

Institutions

$$YF_{f,r} = \sum_{a \in A} WF_{f,r}.\overline{WFDIST}_{fa,r}.QF_{fa,r} \qquad (RegionalFactorIncome) \tag{14}$$

$$YIF_{if,r} = shif_{if,r}.\left[(1 - tf_f).YF_{f,r} - trnsfr_{rowf,r}.EXR\right] \tag{15}$$

(*Regional Institutional Factor Incomes*)

System Constraints

$$\overline{QFS_{f,r}} = \sum_{a \in A} QF_{fa,r} \qquad (Regional\ FactorMarket\ Equilibrium) \tag{16}$$