

**REGIONAL IMPACTS OF TRADE  
REFORM IN BRAZIL UNDER  
ROBERTO CAMPOS LIBERAL  
CONTRIBUTIONS**

Mauricio Vaz Lobo Bittencourt

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# **Regional Impacts of Trade Reform in Brazil under Roberto Campos Liberal Contributions**

**Mauricio Vaz Lobo Bittencourt  
PPGDE/UFPR**

## **ABSTRACT**

This study uses 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 under Roberto Campos liberal ideas. Results show that trade can reduce inter-regional income inequality, but poor urban households lose with trade liberalization. Roberto Campos' 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. Even though the "spider" development regime to be adopted, as suggested by Roberto Campos, will bring an overall improvement in the income distribution, it does not guarantee that the rational market will be able to provide better income distribution across regions, which also may suggest a need for a complementary policy to be implemented along with the trade liberalization one.

**JEL Classification:** C68, F14, O54

**Keywords:** Trade Liberalization, Income Distribution, CGE Models, Brazil, Roberto Campos.

## 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<sup>1</sup> (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<sup>2</sup> and redistribute income.

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, 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

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<sup>1</sup> 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.

<sup>2</sup> 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.

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<sup>3</sup> 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.

This study is devoted to assessing the regional economic impacts of a reduction in import tariffs on poverty and distribution of income, through a single-country multi-regional computable general equilibrium model (CGE) applied to Brazil.

## **2. THE ISSUE**

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

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<sup>3</sup> Short- to medium-run here refers to the period where some of the factors of production are not fully fixed.

periods show growth and improvement in the current account. Therefore, trade reform brings positive results in the long-run, with a positive investment response<sup>4</sup>.

According to Winters (2002), in the short-run, trade liberalization exerts pressure on some economic agents and 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.

A major policy concern is the link between trade policy reform and poverty in Brazil. Therefore, this study attempts to answer some questions seriously when evaluating the consequences of import tariffs reduction in the short- to medium-run, following some of the main liberal ideas proposed by an important and influential Brazilian economist, diplomat and politician, Roberto de Oliveira Campos<sup>5</sup>. 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<sup>6</sup> 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.

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<sup>4</sup> 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).

<sup>5</sup> Roberto de Oliveira Campos had important contributions in the Brazilian government of Getúlio Vargas, Café Filho, Juscelino Kubitschek and Castelo Branco. He was diplomat in Los Angeles, New York and London, and became senator and member of the Brazilian Literature Academy.

<sup>6</sup> According to the Demographic Census 2000 (IBGE, 2000a), low income here represents people whose total monthly earnings are less than twice the minimum wage, approximately US\$ 140.

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<sup>7</sup>, the Brazilian income distribution is still one of the most uneven in the world<sup>8</sup>.

The slow process of import tariff reduction in Brazil in recent years has important consequences for urban and rural households, and also for poverty and income distribution. Due to the diversity of households in Brazil and to the disparities and distributional issues discussed so far, it is likely that any trade reform will bring unequal distribution of gains for households at least in the short-run, since it is possible that the losses from such reform exceed the gains, worsening the overall welfare within the country, increasing income concentration and poverty.

One feature of the policy options to be examined in this study is their potential to mitigate the negative and positive<sup>9</sup> welfare effects on the poor. Because the import tariff reduction in specific sectors can bring negative impacts on the poor, policy makers may have an 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 claims for some sectors to be protected are valid in helping the poor.

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<sup>7</sup> More details about the recent changes in the Gini coefficient in Brazil see Hoffman and Ney (2008).

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

<sup>9</sup> Mitigate positive effects on the poor can be important to point out one or more policy options to be adopted.

### **3. OBJECTIVES OF THE STUDY**

Taking into account the regional characteristics of the production sectors and factor allocation, we can establish the following as the main objectives of the study:

- Evaluate the effects of different levels of reduction of import tariff on poverty and income distribution in rural and urban areas of Brazil, and on the regional production sectors and factor markets, according to the ideas of Roberto Campos.

This study uses a single-country multiregional CGE model for Brazil, and simulates a reduction in import tariffs at global and sectoral levels, in order to analyze and identify those regional productive sectors that hurt the poor and contribute to increase the inequality in the distribution of income, accounting for the overall gains and losses from the fall in import tariffs.

### **4. CGE STUDIES OF EFFECTS OF TRADE IN BRAZIL**

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 Parente, 1999), which fail to consider the regional integration as a general equilibrium phenomenon, producing biased results<sup>10</sup>. 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

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<sup>10</sup> When the study implies important economic variables, the biased results are due to not taking into account the interdependence of the overall economic agents, and market interactions, and to its fixed price nature. More details, see Wobst (2000).

the benefits of this economic improvement tend to 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.

This study contributes to the debate about the trade policy options available to Brazil through a regional analysis. The model makes use of overall and sectoral simulations in order to evaluate such trade options. Differently from other studies, it is implemented here 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 interesting contribution is in the use of a decomposition of different income distribution measures in the simulations and, finally, the disaggregated SAM used has a good regional and sectoral disaggregation, with households with different income levels.

## **5. SOCIAL ACCOUNTING MATRIX (SAM)**

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)<sup>11</sup>. It was generated 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.

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<sup>11</sup> 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 changed slowly in the last 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).

### 5.1 – 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<sup>12</sup>. 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

<sup>12</sup> 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” approach.

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 parameters by national aggregates. The regional disaggregation procedures produce unbalanced regional SAMs. The stochastic cross-entropy (CE) procedure<sup>13</sup> is adopted in order to balance the accounts. The CE procedure allows errors in variables.

## 6. THE STANDARD CGE MODEL<sup>14</sup>

The CGE model 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).<sup>15</sup> The model follows the neo-classical-structuralist (Chenery, 1975) modeling tradition presented in Dervis, de Melo, and Robinson (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.

### a. 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

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<sup>13</sup> For more details and explanation about this approach, see Robinson *et al.* (1998), Robinson and El-Said (2000), and Robinson *et al.* (2000).

<sup>14</sup> Lofgren, Robinson and Thurlow (2002), Thurlow and Van Seventer (2002) and Wobst (2002). Mathematical description of the regional model can be seen in Bittencourt (2004).

<sup>15</sup> For more details about this model, see Lofgren *et al.* (2001).

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<sup>16</sup> for each region are given in the Appendix.

### **b. Institutions and Commodity Markets**

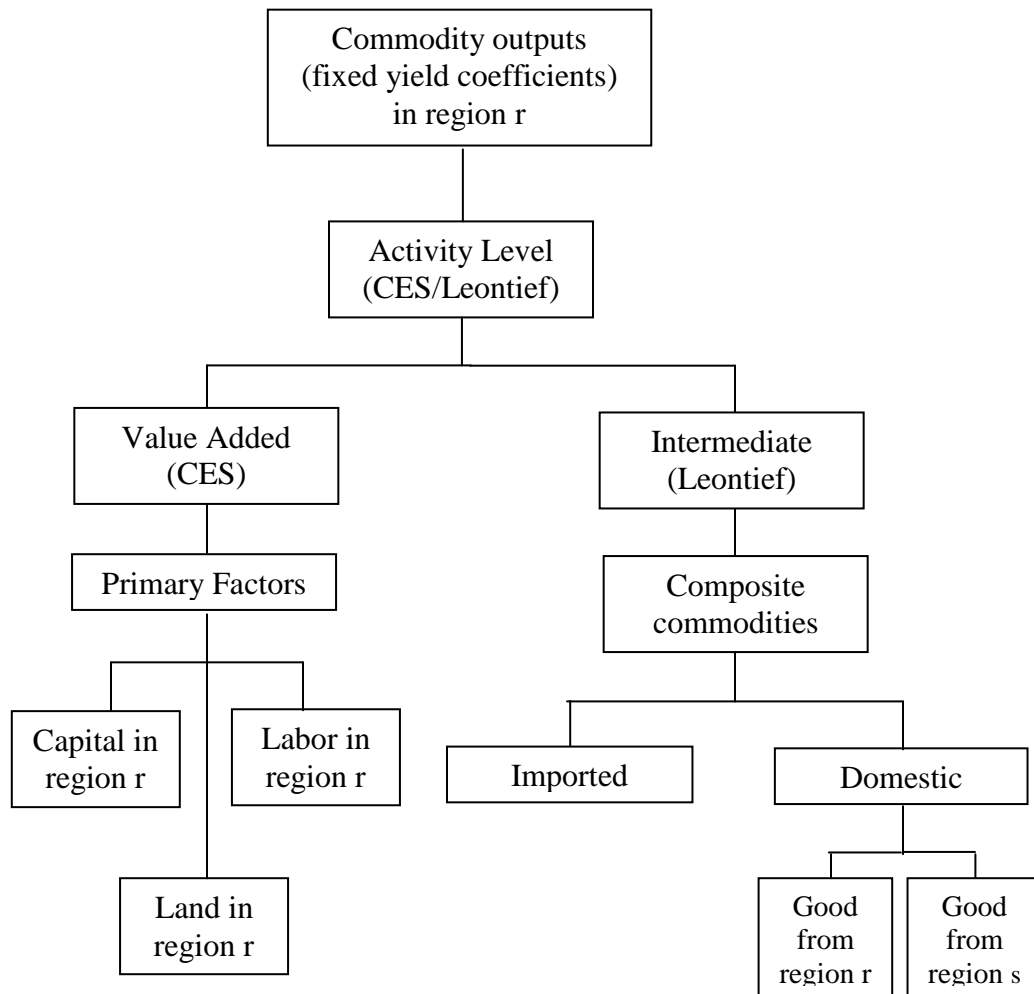
Institutions include households, government, enterprises, and rest of the world. Households receive income from payments for the use of factors of production, and transfers from other institutions. Their consumption is allocated across different commodities according to a Linear Expenditure System (LES) 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 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<sup>17</sup> 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.

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<sup>16</sup> Description of parameters and variables can be seen in the Appendix. For a detailed description of the model see Bittencourt (2004).

<sup>17</sup> Government transfers indexed to the CPI make the model homogeneous of degree zero in prices.

**FIGURE 1**  
**Regional Production Technology in the Standard CGE Model for Brazil**



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 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, Kume and Pedroso (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<sup>18</sup> 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<sup>19</sup> 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.

### **c. Inequality Measures**

Following the theorems of Heckscher-Ohlin-Samuelson and Stolper-Samuelson, the relationship between 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

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<sup>18</sup> Government saving is defined as the difference between current government revenues and current government expenditures.

<sup>19</sup> Brazilian exchange rate policy in recent years allows flexible exchange rate fluctuations within a band controlled and determined by the Central Bank.

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 (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.

## **7. ROBERTO CAMPOS IDEAS AND TRADE POLICY SIMULATIONS**

Roberto Campos is one of the most underrated economists in Brazil. He reached during his life outstanding positions both in the government and in the academy, recognized nationally and internationally. An exponent of the Brazilian Foreign Department as an ambassador, he was minister of state, congressman and senator.

Campos was also a public figure, whose words and speeches influenced many people and due to the way of thinking in different moments of his political career, he collected many enemies from different perspectives. Even today, he is considered a liberal or neo-liberal economist. But when we analyze his important contributions in different moments of his career, it is not so easy to stereotype him as a development or a

liberal economist. As Bielschowsky (1988) points out, Campos should not be considered as a liberal or as a development economist. He was not a structuralist like Celso Furtado neither a liberal like Eugênio Gudin. He was more like a “liberal development” economist, as Campos labeled himself after agreed with Bielschowsky (Campos, 1994).

According to Campos (1963), the industry plays an important role in the Brazilian economic development, but the emphasis should be in the productivity increments, which could bring improvements in the regional inequalities, equity and better income distribution. Since 1950, Campos had some liberal ideas but always defended the State as an important planner and as the “Schumpeter’s Entrepreneur”<sup>20</sup> of the economy, because in his thought the Brazilian economy did not have the “rationality” to promote the private space that would bring the aimed development.

One of the main Campos ideas we will borrow in the trade simulation in this study comes from his way of thinking about State planning specifically to what he called “germination sectors”<sup>21</sup> and also the “silkworm versus spider”<sup>22</sup> debate about how the Brazilian development should be. The “germination sectors” idea comes from Campos suggestion that the State focus should be in the most troublesome sectors of the economy, those where the private market did not have interest or conditions to support. The “silkworm versus spider” debate can be extended to the fact that under the “silkworm” regime, Brazil would protect its economy through many different ways, including trade barriers as the import substitution policy adopted in the past, until the country reaches a development level such as this protectionist behavior can be switched to a called “spider” regime, where the economy can expand its overall market frontiers.

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<sup>20</sup> For Campos, the existence of the “Schumpeter’s entrepreneur” would provide what he called “spontaneous development”. But in the absence of it, the State should play this role and promote what he called “derivate development” (Campos, 1963).

<sup>21</sup> This type of State planning was present in the Kubitschek’s Plano de Metas, which Campos was one of the main contributors.

<sup>22</sup> These terms refer to a Campos lecture in the ESG (War Superior School) in march of 1953.



Summing up, Campos's contributions for this study come from his post-1955 period, where he defends a rational market<sup>23</sup> as the main guide for the economic development, basically due to the “giant” Brazilian State at the time, and to the excess of interventionism and protectionism in the different sectors of the Brazilian economy.

Therefore, this study implements two different scenarios. With these two scenarios, we can compare the impact of general trade reform (reduction or elimination of import tariffs) to a reform that is limited to selected sectors.

Scenario 1: a simulation consisting of elimination of import tariffs<sup>24</sup> 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: a simulation consisting of 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 unskilled labor households 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.

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<sup>23</sup> In this period the rationality should be in the market and not in the State as in his contributions before 1955. The liberty becomes an important part of his thought from this point. (Campos, 1987)

<sup>24</sup> 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 %.

## 8. RESULTS AND DISCUSSION

### a. Overall Trade Liberalization (Scenario 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<sup>25</sup>. 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<sup>26</sup>. These results 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.

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<sup>25</sup> Horticultural, forest, and industrial commodities have large increases in exports after eliminating import tariffs.

<sup>26</sup> Even though the changes are very small, it is important to emphasize that small overall change like these for the Brazilian economy represents a large improvement in the distribution of income.

**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
<i>Share of GDP (%)</i>	
	-0.2
Investment	
Private savings	0.5
Foreign savings	0.1
Government savings	-0.9
Tariff revenue	-0.9
Direct tax revenue	0.1
<i>Equivalent Variation (%)</i>	
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

The expected results from the first scenario would be that trade liberalization would bring 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<sup>27</sup>, 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, Rojas and Vergara (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

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<sup>27</sup> The real exchange rate in our model is represented by the relative prices of traded and non-traded goods.

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.

### **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 regions<sup>28</sup>. 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

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<sup>28</sup> 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 squared 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.

transvariation (4.8 %), which represents the part of the between-regions disparities issued from the overlap among the distributions<sup>29</sup>. 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.

**TABLE 3**  
**Regional Income Inequality Measures Before and After an Overall Elimination of the Import Tariffs**

Indexes	North		Northeast		Center-West		South/Southeast	
	Base <sup>(*)</sup>	Sim <sup>(**)</sup>	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 before and After Simulation**

Indexes	% of the within-region component		% of the between-regions component		% of transvariation	
	Base <sup>(*)</sup>	Sim <sup>(**)</sup>	Base	Sim	Base	Sim
Gini	16.6	16.6	78.6	78.6	4.8	4.8
Theil	40.2	40.2	59.8	59.8	-	-
H-H	58.2	58.1	41.8	41.9	-	-
Bourguignon	37.5	37.4	62.5	62.6	-	-

Notes:

(\*) Base indicates values at the benchmark solution

(\*\*) Sim refers to values after simulation

<sup>29</sup> 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.

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.

**TABLE 5**  
**Regional Contribution to Overall Labor Income Inequality Before and after Simulation**

Indexes	North		Northeast		Center-West		South/Southeast	
	Base <sup>(*)</sup>	Sim <sup>(**)</sup>	Base	Sim	Base	Sim	Base	Sim
Gini (%)	0.5	0.5	2.0	2.1	1.2	1.2	12.9	12.8
Theil (%)	0.7	0.6	4.2	4.2	2.5	2.6	32.8	32.8
H-H (%)	0.07	0.07	1.4	1.4	0.5	0.5	56.2	56.2
Bourguignon (%)	3.9	3.9	8.8	8.8	9.7	9.7	15.0	15.0

Notes:

(\*) Base indicates values at the benchmark solution

(\*\*) Sim refers to values after simulation

### **b. 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.<sup>30</sup> 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.

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<sup>30</sup> 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
<i>Share of GDP (%)</i>					
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
<i>Equivalent Variation (%)</i>					
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**

Indexes	North		Northeast		Center-West		South/Southeast	
	Base <sup>(*)</sup>	Sim <sup>(**)</sup>	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

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 substantial increase in their wages. Although urban households lose sectoral trade liberalization in industry, the distribution of income within regions improves (Table 8).

**TABLE 8**  
**Regional Income Inequality Measures Before and After Elimination of the Import Tariffs in Industry**

Indexes	North		Northeast		Center-West		South/Southeast	
	Base <sup>(*)</sup>	Sim <sup>(**)</sup>	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

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 9**  
**Regional Income Inequality Measures Before and After Elimination of the Import Tariffs in a Combination of Agriculture and Industry**

Indexes	North		Northeast		Center-West		South/Southeast	
	Base <sup>(*)</sup>	Sim <sup>(**)</sup>	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

## 9. CONCLUSIONS

A single country, static, CGE model was used to evaluate trade policy reforms in Brazil under two different scenarios, according to Roberto Campos's contributions, 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 poor. The results from such 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. Therefore, even though the “spider” development regime to be adopted,

as suggested by Roberto Campos, will bring an overall improvement in the income distribution, it does not guarantee that the rational market will be able to provide better income distribution across regions, which also may suggest a need for a complementary policy to be implemented along with the trade liberalization one. Definitely, this can be included in the future research agenda.

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## Appendix – Regional adaptation of the 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

$\alpha_a^a$	efficiency parameter in the CES activity function	$shif_{if}$	share for domestic institution $i$ in the income from $f$
$\alpha_a^{va}$	efficiency parameter in the CES value added function	$ta_a$	tax rate for activity $a$
$\alpha_c^{ac}$	shift parameter for domestic commodity aggregation function	$tf_f$	direct tax rate for factor $f$
$\delta_a^a$	CES activity function share parameter	$trnsfr_{if,r}$	transfer from factor $f$ to institution $i$ in region $r$
$\delta_{fa}^{va}$	CES value added function share parameter for factor $f$ in activity $a$	$tva_a$	rate of value added tax for activity $a$
$\theta_{ac,r}$	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 $r$
$\rho_a^a$	CES production function exponent	$inta_{a,r}^r$	amount of aggregate intermediate input per activity unit in region $r$
$\rho_a^{va}$	CES value added function exponent	$iva_{a,r}^r$	amount of aggregate value added input per activity unit in region $r$
$\rho_c^{ac}$	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 $a$	$QINT_{ca,r}$	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:

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

$$(2) PINTA_{a,r} = \sum_{c \in C} PQ_c \cdot ica_{ca}^r \quad (\text{Regional Intermediate Input Price})$$

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

### Production and commodity regional equations:

$$(4) QA_{a,r} = \alpha_a^a \cdot \left( \delta_a^a \cdot QVA_{a,r}^{-\rho_a^a} + (1 - \delta_a^a) \cdot QINTA_{a,r}^{-\rho_a^a} \right)^{\frac{1}{\rho_a^a}} \quad (\text{Regional CES Activity Production Function})$$

$$(5) \frac{QVA_{a,r}}{QINTA_{a,r}} = \left( \frac{PINTA_{a,r}}{PVA_{a,r}} \cdot \frac{\delta_a^a}{1 - \delta_a^a} \right)^{\frac{1}{1 + \rho_a^a}} \quad (\text{Regional CES Value added-Intermediate-Input Ratio})$$

$$(6) QVA_{a,r} = iva_a^r \cdot QA_{a,r} \quad (\text{Demand for Regional Value added})$$

$$(7) QINTA_{a,r} = inta_a^r \cdot QA_{a,r} \quad (\text{Demand for Regional Intermediate Input})$$

$$(8) QVA_{a,r} = \alpha_a^{va} \cdot \left( \sum_{f \in F} \delta_{fa}^{va} \cdot QF_{fa,r}^{-\rho_a^{va}} \right)^{\frac{1}{\rho_a^{va}}} \quad (\text{Regional Value added and Factor Demands})$$

$$(9) W_{f,r} \cdot \overline{WFDIST}_{fa,r} = PVA_{a,r} \cdot (1 - tva_a) \cdot QVA_{a,r} \cdot \left( \sum_{f \in F} \delta_{fa}^{va} \cdot QF_{fa,r}^{-\rho_a^{va}} \right)^{-1} \cdot \delta_{fa}^{va} \cdot QF_{fa,r}^{-\rho_a^{va} - 1} \quad (\text{Regional Factor Demand})$$

$$(10) QINT_{ca,r} = ica_{ca}^r \cdot QINTA_{a,r} \quad (\text{Regional Intermediate Input Demand})$$

$$(11) \quad QXAC_{ac,r} + \sum_{h \in H} QHA_{ach,r} = \theta_{ac}^r \cdot QA_{a,r}$$

(Regional Commodity Production and Allocation)

$$(12) \quad QX_c = \alpha_c^{ac} \cdot \left( \sum_{a \in A} \delta_{ac}^{ac} \cdot QXAC_{ac,r}^{-\rho_c^{ac}} \right)^{\frac{1}{\rho_c^{ac}-1}} \quad (\text{Regional Output Aggregation Function})$$

$$(13) \quad PXAC_{ac,r} = PX_c \cdot QX_c \cdot \left( \sum_{a \in A} \delta_{ac}^{ac} \cdot QXAC_{ac,r}^{-\rho_c^{ac}} \right)^{-1} \cdot \delta_{ac}^{ac} \cdot QXAC_{ac,r}^{-\rho_c^{ac}-1}$$

(First-order Condition for Regional Output Aggregation Function)

**Institutions:**

$$(14) \quad YF_{f,r} = \sum_{a \in A} WF_{f,r} \cdot \overline{WFDIST}_{fa,r} \cdot QF_{fa,r} \quad (\text{Regional Factor Income})$$

$$(15) \quad YIF_{if,r} = shif_{if,r} \cdot (1 - tf_f) \cdot YF_{f,r} - transfr_{rowf,r} \cdot EXR_{-}$$

(Regional Institutional Factor Incomes)

**System constraints:**

$$(16) \quad \overline{QFS}_{f,r} = \sum_{a \in A} QF_{fa,r} \quad (\text{Regional Factor Market Equilibrium})$$