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Alexandre B. Cunha

Arilton Teixeira

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Alexandre Cunha and Arilton Teixeira

Ibmec Business School

Av Rio Branco 108/5o. andar

Rio de Janeiro, RJ

Brazil 20040-001

e-mail: abcunha@ibmecrj.br and arilton@ibmecrj.br

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Abstract

This paper uses a computable general equilibrium model to evaluate the implications of trade agreements and a tax reform for the Brazilian economy. The model predicts that welfare gains will happen whether the Free Trade Area of the Americas (FTAA henceforth) is implemented or Argentina simply reduces the tariffs it still placed on Brazilian products in 1997. However, the welfare gains are much larger when the FTAA is implemented. If the FTAA is implemented simultaneously to a reduction on domestic consumption taxes, the Brazilian gains will be even larger. The model also suggests that most of the Brazilian welfare gains arise from the reduction of Brazilian tax and tariffs. Reductions of tariffs that destination countries place on Brazilian exports have small welfare effects.

Keywords: trade blocks, tax reform, welfare.

JEL: D58, F11, D69

1 Introduction

In the post World War II the commerce of good and services has increased steadily. At the same time, the world has seeing the formation of trade blocks where a group of countries agree to adopt free trade policies among themselves. Bergoeing and Kehoe [1] provide some evidence on these facts.

A debate has surrounded the formation of each block. Is it better for a country to join a trade union or not? This debate is of particularly interest in a region like

Latin America where the countries have generally followed what is known in the literature as Import Substitution Policies. In short, these policies consist of closing the internal market, protecting it against external competition and, simultaneously, giving subsidies for firms to produce for the internal market.

In a moment where the countries of the whole American continent are getting ready to start discussing the formation of FTAA (Free Trade Area of the Americas) the importance of studying the consequences of the formation of these blocks on the Brazilian economy speaks for itself. What are the gains to join the FTAA? What are the consequences?

Brazilian entrepreneurs pointed out some problems to join the FTAA. They claim that is difficult to compete with the US economy in a free trade zone, among other things, because the Brazilian tax system. Brazil taxes heavily labor input using a cascade taxation system that increases the cost and the prices of Brazilian goods. Since the other countries do not use these taxes, the Brazilian entrepreneurs claim that Brazil should reform its tax system before joining the FTAA.

In this paper we try to assess these issues quantitatively. Given the size of the US, to study the consequences of joining the FTAA is basically to study the consequences of joining the US economy. Therefore, we adopt a four-country (Argentina, Brazil, US and rest of the world) model to evaluate the impacts of trade blocks and taxation policies on the Brazilian economy.

The use of general equilibrium model to evaluate alternative policies is today a common practice. Kehoe and Kehoe [12] and Kehoe and Kehoe [13] provide a survey on the subject. Some authors, as Gonzaga, Terra e Cavalcante [8] and Cavalcante and Mercenier [4], have used general equilibrium models to evaluate the impact of the Mercosur on the Brazilian economy.

We specified our model at a very basic level. Family units were described by preference relations and budget sets. Firms are described by their production set and profit functions. The advantage of specifying the model at this structural level, instead of describing just a set of demand and supply functions, is that this procedure allowed us to carry out welfare implications in an unambiguous way.

We should stress some limitations of our model. First, we are using a static model. In this case, we are not allowed to say anything about the transition path from one stead state to another. Second, we are problem underestimating the impacts of the FTAA. As pointed out by several authors (for instance, Kim [14] and Tybout and Westbrook [22]), trade liberalization is often followed by with an increment in the total factor productivity (TFP). Since our model is static, we cannot capture this increment. This change in the TFP would increase productivity, reduce price and increase trade and the welfare effects of the formation of trade blocks.

We carried out three experiments. In the first one we set the bilateral tariffs for the pair Brazil/Argentina equal to zero. We call this experiment Mercosur. The idea behind this experiment is to quantify the impacts of a reduction of the trade barriers that were raised by the Argentinian government in the last three years. In

the second experiment we set all import tariffs between Argentina, Brazil and the US equal to zero. This experiment we call FTAA. As we said before, the reason to call this experiment FTAA is that the impacts on the Brazilian economy of joining the FTAA (all American countries) should be very close to the impact of joining a free trade zone with the US. In the last experiment, we combine the previous policy change with a reduction in the Brazilian domestic taxes on domestic consumption.

All these experiments point toward welfare gains for the Brazilian economy. These gains are very modest in the first and in the second experiment but it is sizable in the last one. This results pointed for a small impact of the FTAA in the Brazilian economy in the static environment used here.

Besides the three experiments described above, we considered also the case in which the US import tariffs on Brazilian goods were initially higher than the US weighted average tariff that we computed. The reason to carry on this experiment is motivated by the fact that the US has non tariff barriers (NTBs) in many sector as steel, sugar and orange juice (besides the huge volume of subsidies paid by the US government to the agriculture sector). Therefore, the effective average tariff of the US economy on Brazilian goods is higher than the one that we computed. Since we could not compute a tariff adjusted for the NTBs, we redid the three experiments explained above using for the US the same average tariff placed by the EU on Brazilian goods. We then performed exactly the same three experiments. The impacts over the Brazilian economy were roughly the same. In particular, the welfare gains were virtually unchanged.

The computational experiments we performed suggest that most of welfare gains for the Brazilian people arise from the reduction the Brazilian tariffs and domestic taxes rate. This finding has a striking policy implication. Brazil should open to trade and carry out a tax reform regardless its trade partners proceed in the same way or not.

This paper is organized as follows. In section 2 we described the model economy. In section 3 we define competitive equilibrium. In section 4 we explained our calibration procedure. In section 5 we report and analyze the results of the experiments. Section 6 concludes. A balance-of-payments issue is discussed in the appendix (section 7).

2 The economy

There exist four countries: Brazil (b), Argentina (a), US (u), and the Rest of the World (r). The set of countries is represented by $\mathcal{I} = \{a, b, r, u\}$. Each country produces a tradable and a non-tradable good. These goods are country specific.

Each nation i has a representative agent endowed with $\bar{k}_i$ units of capital and one unit of time that she can allocate to market and non market activities (call it leisure). Capital is mobile across countries but labor is not.

Let c_{ij} denote the amount of the tradable good produced by country i and consumed in country j; c_i denotes the non tradable good of country i. The commodity space is $L = I\!R^{13}$. A generic point in L is denoted by x,

$$x = (c_{aj}, c_{bj}, c_{rj}, c_{uj}, c_a, c_b, c_r, c_u, l_a, l_b, l_r, l_u, k)$$

where $j \in \mathcal{I}$, c_{ij} is the good produced in country i and exported to country j; c_i is the nontradable good produced by country i, l_i is amount of labor input in country i and k is the capital stock.

The consumption set of a consumer in country $i \in \mathcal{I}$ is

$$X_i = \{x \in L_+ : l_i \leq 1;\ k_i \leq \bar{k}_i;\ c_j = l_j = 0 for j \neq i\} \tag{1}$$

where l_i is the amount that a consumer from country $i \in \mathcal{I}$ allocates to work. k_i is the amount of capital services that a consumer rent to firms, given that this consumer has $\bar{k}_i$ units of capital services to be rented.

2.1 Preferences

Preferences of a consumer of country $i \in \mathcal{I}$ are represented by the utility function

$$u_i(x) = \left[c_i^{\alpha_i} \left(c_{ai}^{\alpha_{ai}} c_{bi}^{\alpha_{bi}} c_{ri}^{\alpha_{ri}} c_{ui}^{\alpha_{ui}}\right)^{1-\alpha_i}\right]^{\gamma} (1 - l_i)^{1-\gamma},$$

where $\alpha_{ai} + \alpha_{bi} + \alpha_{ri} + \alpha_{ui} = 1$, c_{ij} is the good consumed by the representative consumer in country i produced in country j; c_i is the nontradable good of country i, l_i is the amount of the consumer time allocated to work.

2.2 Technologies

In each country firms operate two technologies. One that produces the non tradable good and one that produces the country specific tradable good.

The production set of the non tradable good of country $i \in \mathcal{I}$ is

$$Y_i(n) = \{y \in L_+ : y_i \leq k^{\theta} l_i^{1-\theta}; y_j = l_j = 0,\ \text{for}\ j \neq i; y_{ij} = 0\}$$

The production set of the tradable good of country $i \in \mathcal{I}$ is

$$Y_i(t) = \{y \in L_+ : y_{ii} \leq k^{\varphi} l_i^{1-\varphi}; y_{ij} = y_j = l_j = 0,\ \text{for}\ j \neq i\}.$$

The technological parameters satisfy $\theta, \eta \in (0, 1)$.

2.3 Government Consumption and Taxes

Government i levies proportional taxes at rate τ_{ji} on the imports from country $j \neq i$, at rate τ_{ii} on the consumption of the domestic goods and at rate τ_{li} on labor income. The government uses the fiscal revenue to purchase some amount g_i of its country non-tradable good.

3 Competitive Equilibrium

A tax system for country $j \in \mathcal{I}$ is a vector $\tau_j = (\tau_{aj}, \tau_{bj}, \tau_{rj}, \tau_{uj}, \tau_{lj})$. An international tax system is an object $\tau = (\tau_a, \tau_b, \tau_r, \tau_u)$. Each component of τ is a tax system for a country. A price system for this economy is a vector

$$P = (p_{at}, p_{bt}, p_{rt}, p_{ut}, p_a, p_b, p_r, p_u, -w_a, -w_b, -w_r, -w_u, -r).$$

We are abusing notation, since prices of a non tradable good from other countries are infinity. But this abuse make our notation easier and homogeneous across countries. The coordinates of P are before tax prices. An after tax price system for a country i is a vector

$$P_i = (p_{ai}, p_{bi}, p_{ri}, p_{ui}, p_{an}, p_{bn}, p_{rn}, p_{un}, -p_{al}, -p_{bl}, -p_{ul}, -p_{rl}, -r).$$

The typical consumer from county $i \in \mathcal{I}$ solves the following problem

$$\max_{x \in X_i} \quad u(x) \quad s.t. \;\; P_i \cdot x \leq 0$$

The problem of a firm that produces the non tradable good in country $i \in \mathcal{I}$ is

$$\max_{y \in Y_i(n)} \quad P \cdot y$$

The problem of a firm that produces the tradable good in country $i \in \mathcal{I}$ is

$$\max_{y \in Y_i(t)} \quad P \cdot y$$

Definition 1 *A* competitive equilibrium *for an international tax system τ is an array $\left[P, (P_i, x_i, y_{in}, y_{it})_{i \in \mathcal{I}}\right]$ such that:*

1. *given P, y_{in} and y_{it} solve the problem of the respective firm;*
2. *given P_i, x_i solves the maximization problem of consumer i;*
3. *P, P_i and τ_i satisfy $(1 + \tau_{ai})p_{at} = p_{ai}$, $(1 + \tau_{bi})p_{bt} = p_{bi}$, $(1 + \tau_{ri})p_{rt} = p_{ri}$, $(1 + \tau_{ui})p_{ut} = p_{ui}$, $(1 + \tau_{ii})p_i = p_{in}$, and $(1 - \tau_{li})w_i = p_{il}$.*
4. *each government balances its budget, that is,*

$$p_j g_j = \tau_{lj} w_j l_j + \sum_{i \in \mathcal{I}} \tau_{ij} p_{it} c_{ij};$$

5. *$(x_i, y_{in}, y_{it})_{i \in \mathcal{I}}$ is feasible, that is,*

$$\begin{aligned} c_i + g_i &= k_{in}^{\theta} l_{in}^{1-\theta}, \\ \sum_{j \in \mathcal{I}} c_{ij} &= k_{it}^{\varphi} l_{it}^{1-\varphi}, \\ l_{in} + l_{it} &= l_i, \\ \sum_{i \in \mathcal{I}} (k_{in} + k_{it}) &= \sum_{i \in \mathcal{I}} \bar{k}_i. \end{aligned}$$

One may wonder why a balance-of-payment constraint was not considered in the above definition. It is shown that the conditions spelled out in definition 1 imply that each country satisfies its balance-of-payment constraint.

4 Calibration

The following list of parameters have to be calibrated: α_j, α_{aj}, α_{bj}, α_{rj}, α_{uj}, γ, $\bar{k}_j$, θ, φ, τ_{aj}, τ_{bj}, τ_{rj}, τ_{uj}, τ_{lj}. We calibrated the model to match some features of US, Brazil, Argentina and the rest of the world economy in 1997. Our procedure is detailed below.

Following Kydland and Prescott [16], we set $\gamma = 2/3$. We borrow from Rebelo [19] and Rebelo and Vegh [20] the shares $\theta = 0.37$ and $\varphi = 0.52$.

To calibrate the trade tariffs we proceeded as follows.

1. US:

   We used the data provided by the US International Trade Commission to calculate the weighted average tariff imposed on Brazilian, Argentinian and an Rest of the World. Weights were by given the participation of each good in the total trade with the respective country. The values we obtained are $\tau_{au} = 1.94\%$, $\tau_{bu} = 2.52\%$ and $\tau_{ru} = 2.01\%$.

2. Brazil and Argentina:

   We took simple average of Mercosur tariff information provided in Gonzaga, Terra e Cavalcante [8]. The values we obtained are $\tau_{ba} = 9.3\%$, $\tau_{ra} = \tau_{ua} = 18.4\%$, $\tau_{ab} = 0$ and $\tau_{rb} = \tau_{ub} = 23\%$.

3. Rest of the world:

   We took simple average of the European Union tariffs provided in Lejour, Mooiji and Nahuis [17] to set $\tau_{ur} = 4.32\%$. We picked an weighted average tariff provided by Castilho [6] to set $\tau_{ar} = \tau_{br} = 8.1\%$.

To calibrate the tax rates on labor income and domestic consumption, we took the steps detailed below.

1. US:

   Mendonza, Razin and Tesar [18] estimated tax rates on labor income and consumption for several OECD countries. In an updated version of their work (which is available at www.econ.duke.edu/~mendonzae), they provided estimates for these variables for 1996. We used their figures to set $\tau_{lu} = 5.467\%$ and $\tau_{uu} = 27.733\%$.

2. Brazil:

   We used the calibration carried out by Rosal and Ferreira [21] to set $\tau_{lb} = 18\%$. The paper on tax incidence of Siqueira, Nogueira and Souza [24] led us to set $\tau_{bb} = 16.2\%$.

3. Argentina:

   Bulacio [3] estimated $\tau_{la} = 23.61\%$ and Zee [28] estimated $\tau_{aa} = 21\%$.

4. Rest of the world:

   The updated version of Mendonza, Razin and Tesar [18] provides average labor income and average consumption taxes figures for Canada, France, Germany, Italy, Japan, and United Kingdom. Using PPP GDP's as weights, we took weighted average of these countries taxes and obtained $\tau_{lr} = 36.39\%$ and $\tau_{rr} = 9.31\%$. Note that these countries amount for 75% of world's PPP GDP (excluded US, Brazil and Argentina).

To calibrate the α_j's and α_{ij}'s we proceed as follows.

1. α_j:

   For Brazil, US and Argentina we set α_j to be equal to ratio of each country's service output to its GDP. This data is provided in the World Development Report 1998/99 [26]. This procedure yielded $\alpha_a = 63\%$, $\alpha_b = 50\%$ and $\alpha_u = 72\%$. To calibrate α_r we used the formula

$$\alpha_r = \frac{\alpha_w Y_w - \alpha_a Y_a - \alpha_b Y_b - \alpha_u Y_u}{Y_w - Y_a - Y_b - Y_u} = 0.5992,$$

   where Y_w is the world's GDP and α_w the world's services output as fraction of Y_w (both α_w and Y_w are provided in the aforementioned publication and Y_j is country's j GDP. To round off, we picked $\alpha_r = 60\%$.

2. $\alpha_{aj}, \alpha_{bj}, \alpha_{rj}, \alpha_{uj}$:

   To explain how we calibrated these parameters, we will take Argentina as our example. The same procedure was used for Brazil and US. From the Argentinean consumer first order conditions we have

$$\frac{(1-\alpha_a)\alpha_{ma}}{\alpha_a} = \frac{(1+\tau_{mj})p_{mt}c_{ma}}{(1+\tau_{aa})p_a c_a},\ m \in \{a, b, r, u\}$$

   In the above expression, $p_{mt}c_{ma}$ is the value of Argentina's import from country m and $p_a c_a$ is equal $\alpha_a Y_a$ (see the above section). We computed $p_{rt}c_{ra}$ as a residue. That is, let M_a be value of Argentinian total imports. Therefore, $p_{rt}c_{ra} = M_a - p_{bt}c_{ba} - p_{ut}c_{ua}$. The IMF's Direction of Trade Statistics [11]

provides the figures for M_a, $p_{bt}c_{ba}$ and $p_{ut}c_{ua}$. We obtained $\alpha_{ba} \cong 0.0516$, $\alpha_{ra} \cong 0.1425$ and $\alpha_{ua} \cong 0.0497$. Since $\alpha_{aa} + \alpha_{ba} + \alpha_{ra} + \alpha_{ua} = 1$, then $\alpha_{aa} \cong 0.7561$. By taking the same steps for Brazil and US, we got $\alpha_{ab} \cong 0.0178$, $\alpha_{bb} \cong 0.8374$, $\alpha_{rb} \cong 0.1063$, $\alpha_{ub} \cong 0.0386$, $\alpha_{au} \cong 0.0011$, $\alpha_{bu} \cong 0.0045$, $\alpha_{ru} \cong 0.3952$, and $\alpha_{uu} \cong 0.5992$. To obtain α_{ar}, α_{br}, α_{rr}, and α_{ur}, an additional step was required. By taking the Brazilian, Argentinian and American total exports and subtracting the value each of them exported to the other two we computed the amount each of these countries exported to the Rest of the World, as well as the total imports of the Rest of the World. With these information at hand, we applied the procedure detailed above. This led to $\alpha_{ar} \cong 0.0020$, $\alpha_{br} \cong 0.0048$, $\alpha_{rr} \cong 0.9109$, and $\alpha_{ur} \cong 0.0823$. As a minor comment, we reported the values here using the "$\cong$" because they were computed with more than four decimal places.

To calibrate the $\bar{k}_j$'s we proceed as follows.

1. US:

   According the World Development Report [26], US's GDP was equal to US$ 7,745,705 million in 1997. Cooley and Prescott [5] estimated that US's capital/output ratio is close to 3.32. We use these information to set $\bar{k}_u = 3.32 \times 7,745,705 \times 10^6$.

2. Brazil and Argentina:

   Using the data on GDP and GNP at current dollars and PPP GNP dollars provided in the World Development Report [26], one can estimated the PPP GDP for both Brazil and Argentina. We obtained $Y_a^{PPP} \cong 374,776.415$ million and $Y_b^{PPP} \cong 1,037,130.429$ million. Bugarin et alii [2] estimated a capital/output ratio of 2.3 for the Brazilian economy. We then set $\bar{k}_j = 2.3Y_j^{PPP}$ for $j = a$ and $j = b$.

3. Rest of the World:

   We used the procedure mentioned at the previous item to find out that $Y_r^{PPP} \cong 10,971,817.488$ million. We assumed that the rest of the world has the same capital output ratio as the US. Hence, $\bar{k}_r = 3.32Y_r^{PPP}$.

5 The Results

The goal of this section is to evaluate welfare consequences and real effects of trade agreements and a tax reform for the Brazilian economy. To carry out this task, we proceeded in the following way. First we computed the competitive equilibrium associated to the parameters we calibrated in the previous section. This equilibrium

is going to be our benchmark. We then computed the competitive equilibrium for the three distinct international tax systems and compared the outcomes.

Recall that the calibrated tariff and tax rates for Brazil, Argentina and USA are as follows:

TABLE I
CALIBRATED TARIFFS AND TAX RATES - % VALUES

Country	Argentina	Brasil	Rest of the World	USA	Labor Income Tax
Argentina	21	9.3	18.4	18.4	23.61
Brazil	0	16.2	23	23	18
US	1.94	2.52	2.01	5.467	27.733

Each line indicates how a country taxes the domestic goods and the goods produced by other countries, as well as the income tax on the country's labor income.

In the first experiment we simply drop τ_{ba} from its original value to 0. Observe that in this model economy a complete implementation of the Mercosur amounts to set both τ_{ab} and τ_{ba} equal to zero. Since the original (i.e., the calibrated) value of τ_{ab} is zero, we denominated this experiment Mercosur.

In the second experiment we set $\tau_{ba} = \tau_{ua} = \tau_{ab} = \tau_{ub} = \tau_{au} = \tau_{ub} = 0$. This amounts to set all intra-America trade tariffs in the model equal to zero. Therefore, we denominated this experiment FTAA.

The third experiment combines the FTAA with a reduction of the consumption taxes in Brazil. We dropped τ_{bb} from its original value of 16.2% to 5.467% (the level observed at the United States). We called this experiment FTAA with tax reform. The main results are presented in Table II.

We measured the welfare gain using equivalent variation as percent of benchmark GDP. All other figures in the table are percent changes from the benchmark competitive equilibrium.

The equivalent variation is a standard measure of welfare gains and/or losses in general equilibrium analysis. Let p^0 be price vector faced by the Brazilian consumer and u^0 the utility level she obtained before the reform. Let u^1denote the after reform utility level and $E(p, u)$ the expenditure function. The equivalent variation is given by $E(p^0, u^1) - E(p^0, u^0)$. Observe this difference tells how much income the consumer would need, at the benchmark prices, to obtain the after reform utility. For more on the equivalent variation and other welfare measures, see Varian [27].

Consider the Mercosur experiment. The Brazilian trade deficit falls 2.39%. All other variables change by less than 0.2%. A factor behind the small impact of a drop in τ_{ba} over the Brazilian economy is relative size of the countries. The Brazilian GDP is almost three times the Argentinian GDP. So, it is not surprising that the tariff drop did not have large impacts over the Brazilian economy.

A striking feature of the Mercosur experiment is the modest welfare gain. Kehoe and Kehoe [13] stated that "because Mexico's economy is the smallest, it will enjoy

the biggest NAFTA-produced increase in economic welfare" and "NAFTA's impact on the United States, although positive, is barely perceptible as a percentage of GDP." So, our finding is perfectly consistent with earlier studies.

Despite the small impact of the drop in τ_{ba} over the Brazilian economy, the Mercosur experiments has some insights. Since both k_{bn} and k_{bt} went up, the Mercosur generated a capital flow to Brazil. The physical output went up in both sectors. The amount of time worked went up. But the amount of labor in the non-tradable sector went down. So, there was some reallocation of resources across the two sectors of the Brazilian economy. The consumption of all goods increased. The real GDP went up. The trade deficit fell and CPI, real wage and real private income increased.

TABLE II
EXPERIMENTS'S RESULTS

reform	Mercosur	FTAA	FTAA with Tax Reform
c_{ab}	+0.18	+0.01	-0.97
c_{bb}	+0.01	-0.10	+9.76
c_{rb}	+0.05	-0.34	-1.32
c_{ub}	+0.05	+22.56	+21.35
c_b	+0.00	-0.02	+10.08
l_b	+0.02	-0.16	-0.63
l_{bn}	-0.02	-0.42	-5.48
l_{bt}	+0.11	+0.42	+10.13
k_{bn}	+0.06	-0.91	-7.34
k_{bt}	+0.19	-0.08	+7.97
$k_{bn} + k_{bt}$	+0.12	-0.54	-0.38
y_{bn}	+0.01	-0.60	-6.17
y_{bt}	+0.15	+0.16	+9.00
GDP at benchmark prices	+0.06	-0.32	-0.52
trade deficit	-2.39	+10.88	+7.80
consumer price index	+0.04	-0.69	-9.84
real wage (net of taxes)	+0.04	+0.16	+8.71
real private income (net of taxes)	+0.01	+0.32	+9.41
welfare gain (% of GDP)	+0.00	+0.10	+2.42

The FTAA experiment generates an increase of 10.88% in the Brazilian trade deficit. The welfare gain is 0.10% of the benchmark GDP. This is still a modest figure, but by far larger than the Mercosur one. The Brazilian consumption of the American tradable good (c_{ub}) increases by 22.56%. All other variables change by less than 1%. So, except for the trade balance and c_{ub}, the FTAA has small impacts over the variables.

Observe that both c_{ab} and c_{ub} went up, while l_b, c_b, c_{bb} and c_{rb} fell. The Brazilian consumer substituted away from the domestic good and the rest of the world tradable

good and toward leisure, c_{ab} and c_{ub}. There was an reallocation of labor from the non-tradable to the tradable sector of the Brazilian economy. Capital utilization went down in both sectors. So, a capital outflow took place. The tradable output went up, while the non-tradable one went down. Both GDP and CPI went down. Real wage and real private income experienced an increase.

We do not report these data here, but it is worth to mention that the FTAA has negligible effects over the rest of the world. Particularly, k_{rn} and k_{rt} are roughly constant. Recall that in our artificial economy there is a fixed capital stock. Since there is no capital outflow or inflow to the rest of the world, the FTAA generated an reallocation of the capital within Argentina, Brazil and US.

The Mercosur experiment showed that when a trade tariff τ_{ij} is reduced, capital flows from country j to country i. In the FTAA experiment, several τ_{ij}'s were simultaneously reduced. Thus, it is not possible to anticipate which country should receive or send capital abroad. It turned out that United States received capital, while Brazil and Argentina lost.

This result about capital deserves more attention. Evidence in the EU indicates that the capital movement goes from the rich countries (in this case the US) to the poor countries (Argentina and Brazil) during this episodes of formation of trade blocks. Kehoe and Kehoe [13] discuss in the detail the issue of capital flows in models of trade agreements. They show that larger welfare gains take place when there is a capital flow. However, any static model will hardly generate a capital flow from a richer to a poorer country. What drives the capital movement is the capital rate of return. Hence, a possible way that a model can generate a capital flow to a poorer country is by means of a productivity increase.

Kim [14] provides evidence that trade liberalization had a positive impact on the productivity of Korean manufactures. Tybout and Westbrook [22] shows that similar event took place in Mexico during the trade liberalization of the 90's. Herrendorf and Teixeira [7], Holmes and Schmitz [9] and Holmes and Schmitz [10] shows, under a theoretical point of view, why trade liberalization may have a positive impact over a country productivity.

Despite not capturing the productivity surge and capital flow associated to a international trade opening process, the model still predicts welfare gains in both Mercosur and FTAA experiments. We believe that these welfare we computed are lower bounds. We anticipate that a more sophisticated model will display even larger welfare gains.

Another point to be discussed is the observed GDP fall in the FTAA experiment. That fall was driven by a drop in y_{bn}. Observe that when the Brazilian government reduces tariffs and tax rates there is a fall in the government fiscal revenue. This will lead to a fall in g_b and a consequent fall in y_{bn}.

The aforementioned fall in g_b brings an important point to light. A reduction of tax burden, as was done in the above experiments, has to be accompanied by a reduction in the government expenditures. An interesting exercise would consist

in open the Brazilian economy to international trade and raise some tax rates to compensate for the tariff reduction. This exercise is left for future research.

The FTAA with tax reform experiment generate a huge welfare gain (when compared to the previous two). There is a gain of the order of 2.42% of the GDP. The Brazilian consumer substituted away from c_{ab} and c_{rb} toward c_{bb}, c_{ub}, c_b and leisure.

Recall that our model is static. Thus, statements about capital flows have to be evaluated with care. Anyway, it is interesting to see that in the FTAA experiment the sum $k_{bn} + k_{bt}$ went down by 0.54%, while in the last experiment it went down by a smaller amount (0.38%). Hence, the third experiments suggests that a tax reform may help Brazil to attract capital.

There was a flow of production factors to the tradable sector. Both l_{bt} and k_{bt} went up. Resources left the non tradable sector. As a consequence of this reallocation of resources, y_{bt} grew and y_{bn} fell.

The fall in the GDP was larger than in the FTAA experiment. Again, this fall was driven by the reduction in g_b. The trade deficit increased, but less than in the FTAA simulation. On the other hand, the decrease in the CPI and the increase in the net real wage and net private income were by far larger.

Now, lets analyze the last experiment carried on in this paper. The calibrated value of τ_{bu} was 2.52%. As mentioned in section 4, this number is a weighted average of tax rates on Brazilian exports to US. This procedure does not take into consideration non tariff barriers, as quotes. So, the effective tariff rate is clearly higher than 2.52%. To address this issue, we proceed as following: we assume that τ_{bu} was equal to 8.1% (which is the average tariff that the European Union place on Brazilian products) and run the three experiments again. Surprisingly, the results did not change much. We report them below.

The numbers are extremely similar to those of Table II. In the particular case of the welfare gains, the differences are negligible. This finding has a striking policy implication. The model suggests that most of the gains Brazil can obtain from a trade agreement arise from the reduction of the Brazilian tariffs. More specifically, a unilateral reduction of the Brazilian tariffs would increased the welfare. Besides, if this unilateral reduction of tariffs are also followed by a tax reform, the welfare gains would be substantial.

The result is not a surprise if we look at the tariffs imposed by the US on the goods imported from the Brazil. Even when we increased this average tariff from 2.52% to 8.1% this tariff is still small when compared to the taxation that Brazil imposed on the consumption of the domestic good. That is, the distortions that the US government places is to small compared to the distortion introduced domestically. Therefore, substantial welfare gains can be obtained by a unilateral reduction of Brazilian taxes and tariffs.

We also should keep in mind that we must be underestimating this results since we are working on a static model. Tax reduction should increase private income and private investment raising the gains computed above.

TABLE III
EXPERIMENTS'S RESULTS FOR A HIGHER
INITIAL US TARIFF ON BRAZILIAN GOODS

reform	Mercosur	FTAA	FTAA with Tax Reform
c_{ab}	+0.18	+0.07	-0.91
c_{bb}	+0.01	-0.08	+9.77
c_{rb}	+0.05	-0.28	-1.27
c_{ub}	+0.05	+22.63	+21.42
c_b	+0.00	-0.02	+10.09
l_b	+0.02	-0.13	-0.61
l_{bn}	-0.02	-0.44	-5.50
l_{bt}	+0.11	+0.55	+10.26
k_{bn}	+0.06	-0.85	-7.27
k_{bt}	+0.19	+0.13	+8.20
$k_{bn} + k_{bt}$	+0.12	-0.40	-1.10
y_{bn}	+0.01	-0.59	-6.16
y_{bt}	+0.15	+0.33	+9.18
GDP at benchmark prices	+0.06	-0.25	-0.45
trade deficit	-2.33	+8.00	+5.00
consumer price index	+0.04	-0.64	-9.79
real wage (net of taxes)	+0.04	+0.20	+8.75
real private income (net of taxes)	+0.01	+0.34	+9.43
welfare gain (% of GDP)	+0.00	+0.10	+2.42

6 Conclusion

A small scale general equilibrium model was used to evaluate the impact of trade agreements and tax reforms over the Brazilian economy. The main finding is that most of the welfare gains arise from the reduction of Brazilian domestic taxes and import tariffs. A reduction of trade tariffs charged by foreigners on Brazilian goods do not have large welfare effects on the Brazilian families.

The tariff and tax reductions performed in this paper were not compensated by an alternative source of revenue for the government. Consequently, the government real expenditure was reduced in most of the experiments. An interesting exercise would consist in carry out a tariff reduction compensated by a tax burden increase in another sector of the economy so that the government revenue would remain constant.

The model used in this essay is a static one. Consequently, there is no capital accumulation. Additionally, neither a tariff reduction nor a tax reform induces any productivity gain. A obvious venue for future research is to evaluate the impacts of the trade agreements and tax reforms in a dynamic model in with endogenous productivity gains, as in Herrendorf and Teixeira [7] and Holmes and Schmitz [9].

7 Appendix

We will now show that definition 1 implies that each country will satisfy its balance-of-payment constraint. Therefore, it is not necessary to introduce any balance-of-payment constraint in the set of equations that characterize the competitive equilibrium.

Recall that a single period economy is being considered. Hence, there is a market for capital services but not a market for capital stock. Thus, the balance-of-payment constraint in this economy is simply the current account component of the balance-of-payments.

The balance-of-payment equation of a country can be easily derived from definition 1. Without loss of generality, consider Argentina (country a). The budget constraint of the Argentinian consumer is

$$(1+\tau_{aa})p_{at}c_{aa} + (1+\tau_{ba})p_{bt}c_{ba} + (1+\tau_{ra})p_{rt}c_{ra} +$$

$$(1+\tau_{ua})p_{ut}c_{ua} + (1+\tau_{aa})p_a c_a = (1-\tau_{la})w_a l_a + r\bar{k}_a.$$

Using the market clearing condition $l_{an} + l_{at} = l_a$ and the Argentinian government budget constraint $p_a g_a = \tau_{la} w_a l_a + \tau_{aa} p_{at} c_{aa} + \tau_{ba} p_{bt} c_{ba} + \tau_{ra} p_{rt} c_{ra} + \tau_{ua} p_{ut} c_{ua} + \tau_{aa} p_a c_a$, the above equation can be written as

$$p_{at}c_{aa} + p_{bt}c_{ba} + p_{rt}c_{ra} + p_{ut}c_{ua} + p_a(c_a + g_a) =$$

$$w_a(l_{an} + l_{at}) + r(k_{an} + k_{at}) + r(\bar{k}_a - k_{an} - k_{at}).$$

Since each production function displays constant returns to scale, $p_a(c_a + g_a) = w_a l_{an} + r k_{an}$ and $p_{at} \sum_j c_{aj} = w_a l_{at} + r k_{at}$. Combine the last three equations to obtain

$$p_{at}c_{aa} + p_{bt}c_{ba} + p_{rt}c_{ra} + p_{ut}c_{ua} + p_a(c_a + g_a) =$$

$$p_a(c_a + g_a) + p_{at} \sum_{j \in \mathcal{I}} c_{aj} + r(\bar{k}_a - k_{an} - k_{at}).$$

Cancel the identical terms out to obtain

$$p_{at}(c_{ab} + c_{ar} + c_{au}) - (p_{bt}c_{ba} + p_{rt}c_{ra} + p_{ut}c_{ua}) + r(\bar{k}_a - k_{an} - k_{at}) = 0.$$

The first term in the above sum is the value of the Argentinian exports. The second is the value of the imports. The third is the capital income that Argentinians receive from abroad (or pay, if the term is negative). Hence, the above constraint states that the Argentinian current account must have a zero balance. As explained above, this is exactly the Argentinian balance-of-payment constraint.

References

[1] Bergoeing, R. and Kehoe, T (2001). "Trade Theory and Trade Facts." Federal Reserve Bank of Minneapolis Research Department, Staff Report 284.

[2] Bugarin, M.; Ellery Jr., R.; Gomes, V. and Teixeira, A. (2002). "The Brazilian Depression in the 1980s and 1990s". Unpublished manuscript.

[3] Bulacio, J. (1999). "La Carga Impositiva sobre el Capital e el Trabajo." Anales de la XXXIV Reunión de La Asociación Argentina de Economía Política.

[4] Cavalcante, J. and Mercenier, J. (1999). "Uma Avaliação dos Ganhos Dinâmicos do Mercosul Usando Equilíbrio Geral." *Pesquisa e Planejamento Econômico* 29, 153-184.

[5] Cooley, T. and Prescott, E. (1995). "Economic Growth and Business Cycles." In *Frontiers of Business Cycle Research*, ed. Cooley, T., pp 1-38. Princeton, Princeton University Press.

[6] Castilho, M. (2001). "O Acesso das Exportações do Mercosul ao Mercado Europeu ." Anais do XXIX Encontro Nacional da Associação Nacional dos Centros de Pós-Graduação em Economia.

[7] Herrendorf, B. and Teixeira, A. (2001). "How trade policy affects technology adoption and total factor productivity." Unpublished manuscript.

[8] Gonzaga, G.; Terra, M. C. and Cavalcante, J. (1998). "O Impacto do Mercosul sobre o Emprego Setorial no Brasil." *Pesquisa e Planejamento Econômico* 28, 475-508.

[9] Holmes, T. and Schmitz, J. (2001). "A Gain from Trade: from Unproductive to Productive Entrepreneurship." *Journal of Monetary Economics* 47, 417-446.

[10] Holmes, T. and Schmitz, J. (1995). "Resistance to New Technology and Trade Between Areas." *Federal Reserve Bank of Minneapolis Quarterly Review* 19, 2-17.

[11] IMF Statistics Departments (2001). *Direction of Trade Statistics Yearbook 2001.* Washington, International Monetary Fund.

[12] Kehoe, P. and Kehoe, T. (1994). "A Primer on Static Applied General Equilibrium Models." *Federal Reserve Bank of Minneapolis Quarterly Review* 18, 2-16.

[13] Kehoe, P. and Kehoe, T. (1994). "Capturing Nafta's Impact with Applied General Equilibrium Models." *Federal Reserve Bank of Minneapolis Quarterly Review* 18, 17-34.

[14] Kim, E. (2000). "Trade Liberalization and Productivity Growth in Korean Manufacture Industries: Price Protection, Market Power and Scale Efficiency." *Journal of Development Economics* 62, 55-83.

[15] Kydland, F. and Prescott, E. (1996). "The Computational Experiment: An Econometric Tool." *Journal of Economic Perspectives* 10, 69-85.

[16] Kydland, F. and Prescott, E. (1982). "Time to Build and Aggregate Fluctuations." *Econometrica* 50, 1345-1370.

[17] Lejour, A.; Mooji, R. and Nahuis, R. (2001). "EU Enlargement: Economic Implications for Countries and Industries." CPB Netherlands Bureau for Economic Policy Analysis, document 11.

[18] Mendonza, E.; Razin, A. and Tesar, L. (1994). "Effective Tax Rates in Macroeconomics Cross-Country Estimates of Tax Rates on Factor Incomes and Consumption." *Journal of Monetary Economics* 34, 297-323.

[19] Rebelo, S. (1997). "What Happens when Countries Peg Their Exchange Rates?". National Bureau of Economic Research, working paper 6168.

[20] Rebelo, S. and Végh, C. (1995). "Real Effects of Exchange Rate Based Stabilization: An Analysis of Competing Theories". National Bureau of Economic Research, working paper 5197.

[21] Rosal, J.M. and Ferreira, P. (1998). "Imposto Inflacionário e Opções de Financiamento do Setor Público em um Modelo de Ciclos Reais de Negócios para o Brasil." *Revista Brasileira de Economia* 52, 3-37.

[22] Tybout, J. and Westbrook, M. (1995). "Trade Liberalization and the Dimensions of Efficiency Change in Mexican Manufacturing Industries." *International Economic Review* 39, 53-78.

[23] Sachs, J. and Werner, A. (1995). "Economic Reform and the Process of Global Integration." *Brookings Papers on Economic Activity* 1, 1-95.

[24] Siqueira, R.; Nogueira, J. and Souza, E. (2001). "A Incidência Final dos Impostos Indiretos no Brasil: Efeitos da Tributação de Insumos." *Revista Brasileira de Economia* 55, 513-544.

[25] The World Bank. *World Development Report 2000/2001* (2001). New York, Oxford University Press.

[26] The World Bank. *World Development Report 1998/99* (1999). New York, Oxford University Press.

[27] Varian, H. (1992). *Microeconomic Analysis*. Third Edition. New York, W. W. Norton & Company.

[28] Zee, H. (1998). "Revenue, Efficiency and Equity of Major Taxes in Chile: a Preliminary Assessment." Banco Central del Chile, document de trabajo 42.