

# Trade Openness and Gender in Uruguay: a CGE Analysis<sup>1</sup>

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## Abstract

The data for Uruguay shows that there is gender discrimination in the private labor market and that women spend more time than men in domestic work and less in labor market. We take into account these and other features to build a gender aware CGE model with endogenous labor supply and a home production function. This kind of model is a useful tool to evaluate the impact of different policies and, specially gender policies. In this paper we analyze the gender differentiated impacts of trade openness in Uruguay on employment, wages and time distribution. We simulated different scenarios of tariff changes. Trade openness improves women situation in terms of employment and wages, but the impact on gender gaps depends on how trade openness affect trade flows. If net exports to Argentina increase, female demand increases and gender gaps go down. On the contrary, if net exports to Brazil and the rest of the world increase unskilled male demand expands. As regards to time distribution, the impact also depends on the elasticity of labor supply, which is different by skills.

Keywords: trade openness, gender, general equilibrium model, home production, leisure, wage curve

JEL classification: D68, D13, J16, J22, F16

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## **1. Introduction**

Uruguay is a small Latin American country that has a strong comparative advantage in agricultural production. In the 1990s unilateral trade liberalization and integration with MERCOSUR partners led to a significant reduction of protection to the domestic market. As a consequence, there was a change in relative prices and a reallocation of resources from manufacture to service sector. Women participation in labor market increased, although there is evidence that in 2003 women still assigned less time to labor market than men, while the opposite happened with time assigned to domestic work. Additionally, some studies conclude that gender discrimination in the labor market persists (Rivas and Rossi, 2000; Amarante, 2001; Bucheli and Sanroman, 2005).

In principle, a country may benefit from trade openness because it causes an increase in trade and productive specialization. Productive efficiency increases due to a better resource allocation, leading to an improvement of consumption possibilities. Furthermore, when imperfect competition exists, openness may report additional benefits through the access to a larger variety in consumption of differentiated goods, the use of economies of scale and the fall in prices induced by the decline of monopoly rents. In addition, international trade leads to changes in relative prices of goods, in relative demands of productive factors and as a consequence, in their relative remuneration. This means that we may expect changes in income distribution. In particular, trade openness may have gender-differentiated effects.

There are three different mechanisms through which trade openness affects labor market by gender. First, the gender distribution of the impact in terms of employment will depend on the sectoral intensity in the use of male and female labor. If trade openness benefits sectors intensive in male (female) labor, men (women) employment will improve. The second mechanism stems from this effect. Indeed, the changes in the relative demand by gender affect the gender wage gap. Therefore, we may expect that a growth in female intensive sectors would decrease the gender wage gap. Anyway, labor discrimination will contribute to widen or reduce the effect on the gender gap. A third source comes from the change in labor supply induced by modifications in employment opportunities and wages. Therefore, it may lead to an intra-household reallocation of time spent in labor market,

domestic work and leisure. However, the supply of child care services affects the possibilities of expanding time assigned to labor market.

Most of the empirical work focuses on whether trade policies affect women's employment relative to men and the gender wage gap. In contrast, evidence about the effects on the time allocation among household members is less frequent. Some gender-aware CGE models allow to measure these three sources of impact via incorporating a home production function and three activities to spend time in (market work, domestic work and leisure) as proposed by Fontana and Wood (2000).

Following this strategy, different results were obtained for Nepal (Fofana, Cockburn and Décaluwé, 2003), South Africa (Fofana et al, 2005), Pakistan (Siddiqui, 2007), Bangladesh and Zambia (Fontana, 2003), when simulating an abolition of tariffs. In the five countries, time of women in labor market rises but the gender wage gap decreases only in three of them. The effect on domestic work and leisure is neither conclusive. For example, in Bangladesh, the increase in the opportunity cost of working for women –due to the decline of the gender wage gap- leads to some substitution of male and female in home production. In Nepal, in spite of a decline of the gender wage gap, women do not benefit with a reduction of time spent in domestic work. In fact, female entrance to the labor market is accomplished with a decrease of leisure time as men's leisure time rises. Thus, trade openness seems to have more equitable effects in Bangladesh.

The aim of this paper is to analyze the gender-differentiated effects of total abolition of tariffs applied to goods in Uruguay, following the methodological strategy pursued by the above mentioned literature. Specifically, we study the effects on wages, employment, and allocation of time between labor market and domestic work, using a gender-aware CGE model. We also discuss to what extent trade liberalization in the 1990s can explain the stylized facts about labor market and gender in Uruguay.

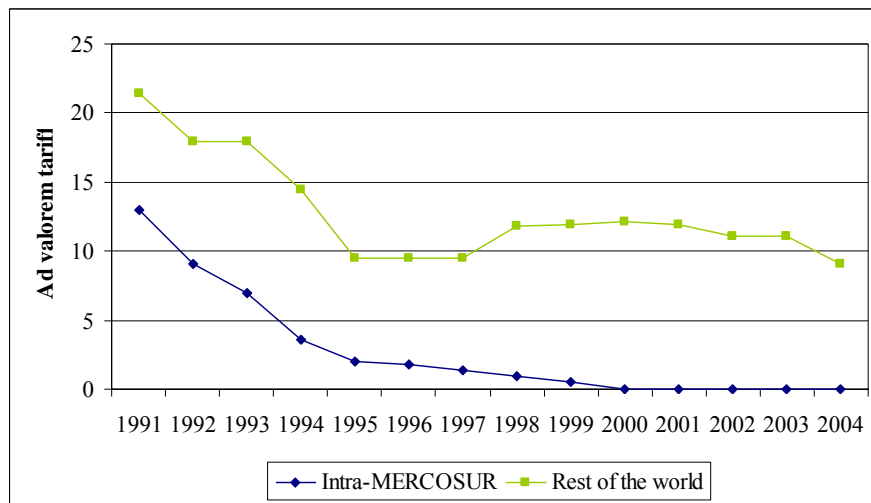
The paper is organized as follows. First, we describe the Uruguayan economy in general and its labor market in particular. Secondly, we present the model and the data we use. Then, we analyze the results of different trade policy scenarios and their sensibility to changes in key parameters of the model. Finally, we draw some conclusions.

## 2. The Uruguayan Economy

### 2.1. Trade openness

Uruguay is a small country whose population - about 3.4 million in 2005- live mostly in urban areas (92 percent). Traditionally, production and exports have relied on agriculture, husbandry and meat processing. As many Latin American countries, in the 1990s Uruguay underwent through an important process of trade openness. From 1990 to 1995 there was a significant tariff reduction as a result of unilateral trade liberalization and trade integration within MERCOSUR (Common Market of the South). The two processes can be easily identified in figure 1, which presents the average tariff protection within MERCOSUR and the average tariff applied to the rest of the world. As we can see, the average protection reduced significantly until 1995. In the last ten years the average tariff applied to imports from the rest of the world has not been much modified, while the intra-MERCOSUR tariff is practically zero since 2000.

**Figure 1. Uruguay: Average tariff protection, 1991- 2004**



Source: Secretaría del MERCOSUR

The process of trade openness affected labor market in many ways. First of all, there was an important restructure of employment. Manufacturing lost importance both in GDP and employment: while in 1990 the sector employed 23.3 percent of workers, in 1999 this percentage fell to 15.9 percent. On the other hand, the share of services and traditional export activities in employment gained importance.

Second, the dispersion of labor earnings increased. One of its most important sources was the rise of the reward to education. As additionally unemployment and informality increased affecting mainly unskilled workers, we may interpret that the relative demand for skilled labor has increased. Casacuberta and Vaillant (2004) argue that this rise was due to the adoption of new technologies -complementary to skilled labor- that was induced by trade liberalization.

## 2.2. Gender in the Uruguayan economy

Since the middle of the 1980s, women's participation in the labor market has had an increasing trend meanwhile men's one have presented a little decline. Table 1 shows this evolution for the group of 18 to 54 years old: female participation rate rose from 62 percent in 1986-1990 to 72 percent in 2001-2004 and male rate decreased from 94 percent to 92 percent in the same period.

**Table 1. Labor characteristics of the group of 18 to 54 years old**

	1986-1990	1991-2000	2001-2004
<b>Women</b>			
Participation rate	61.7	68.4	71.9
Unemployment rate	12.3	13.5	19.9
Employment rate	54.1	59.1	57.2
<b>Men</b>			
Participation rate	94.1	93.3	92.1
Unemployment rate	6.2	7.5	12.0
Employment rate	88.2	86.3	80.9
<b>Wage gap (log difference) *</b>			
All	0.146	0.098	0.009
Private sector	0.273	0.160	0.074
Public sector	-0.170	-0.086	-0.178

\* Only employees (self-employment excluded)

Source: Continuous Household Survey

There are several empirical works focusing on female participation in labor market in Uruguay that conclude that it increases with the education level and decreases with household's income and age. Besides, it is lower for married women and for women with little children, although the likelihood of participation increases when children grow (Diez de Medina, 1992; De Soria, Rivas and Taboada, 2001). In a study restricted to couples, Bucheli (2002) found that participation is more likely when women live with inactive elderly people, suggesting that they take in charge some domestic tasks that allow women

to assign more time to labor market work. Bucheli (2002) also found that participation of women living with a partner is higher when the partner is unemployed. This result is consistent with an added worker behavior, that is, a reaction to changes in household income. As unemployment changes in the cycle, we may interpret that women enter and exit the labor market following the changes in their partner's income and thus, do not belong to the core labor force. However, if the two partners of a couple have similar labor vulnerability, and more specifically a similar probability of being unemployed, evidence based on cross-section information will show a positive relationship between women's participation and partner's unemployment. Thus, this relationship would not stem from the transitory behavior proposed by the added worker hypothesis. Piani (2003) found relatively high level of educational homogamy in Uruguay, giving support to the last argument.

Obviously, time spent in labor market also depends on the likelihood of being employed. As shown in table 1, female unemployment rate has been persistently higher than male unemployment in spite of the increase of women labor market participation. Unemployment is particularly high for non-skilled women who also suffer a relative high duration of unemployment. Indeed, men and women have similar hazard to move from a job to unemployment, thus the higher female unemployment is due to differences in duration (Bucheli and Casacuberta, 2005). In the context of job search models, we may interpret that women have higher reservation wages and have a lower probability of accepting a job offer that is, of waiting more time in the state of unemployment. Additionally, we expect that the job offers arrival rates and offered wages are lower for women because of labor market discrimination. Notice that this argument shows the difficulty to draw the frontier between unemployment and non-participation. In fact, long-run unemployment frequently ends in exiting the labor force.

Table 1 also reports the raw gender wage gap measured as the difference of the male and female mean log hourly wage. The gap was positive in 1986-90 and since then, has had a decreasing trend. In recent years, its value has been close to zero. In spite of these figures, several studies point out the presence of gender discrimination in the labor market. Indeed, some Uruguay literature follows the spirit of Oaxaca's proposal to measure gender discrimination. According to this proposal, the raw gender gap may be decomposed in two terms. One of them stems from the gender difference in endowments and the other one

from the gender difference in endowments' rewards. The latter is a measure of gender discrimination.

The broad conclusion of Uruguayan studies is that the raw gap cannot be totally explained by endowments. Therefore, we may interpret that there is labor market discrimination. Rivas and Rossi (2000) find that the decline of the raw gap in the 1990s in the private sector was mainly due to an improvement of women's human capital and, in a less extent, to a change in endowments' rewards. They conclude that at the end of the decade, discrimination took account for more than 100% of the raw gender gap in the private labor market. This overall picture does not fit for public wage earners. Rivas and Rossi (2002) compare private and public wage earners in the nineties and conclude that gender discrimination increased for the former but decreased for the latter. Furthermore, Amarante (2001) finds that at the end of the 1990s, there was not evidence of discrimination in the public sector.

When employed, women and men present different distribution among occupations and industries. In broad terms, we may say that women tend to concentrate in fewer jobs than men. According to Amarante and Espino (2001), this gender distribution among occupations reflects a segregation phenomenon and in the 1990s, it has had an increasing trend in the private wage earners labor market. In contrast, segregation has been lower and stable in the public sector. However, Amarante and Espino remark that their measure of segregation does not fully take into account the hierarchical position of the worker. Bucheli and Sanromán (2005) analyse this subject estimating discrimination throughout the wage distribution. They found that there is a sharp acceleration in the upper distribution that affects women in the private sector. They interpret this finding as evidence of a glass ceiling, that is, the presence of barriers to promotion for women.

Time spent in non-remunerated work has been less studied than time in labor market. There is a single survey in Uruguay that collects information about use of time, carried out in 2003. Its main characteristics are presented in Annex 1. In broad terms, it reports individual characteristics as sex and age, labor market information as participation and occupation, and the time distribution of people over 14 years old. Specifically, it inquires the hours spent in labor market and in a list of domestic work tasks, such as buying food, feeding children, giving medicines to the elder, etc. The characteristics of the main

variables collected by the survey are reported in Aguirre and Batthyány (2005), who find that women assign more time to domestic work than men, whereas men spend more time in the labor market.

In table 2 we show the estimation of the time distribution for women and men of 14 to 65 years old by educational level<sup>3</sup>. We suppose that people –regardless of their sex or education level- assign 10 daily hours to personal care, that is, a minimum time needed for sleeping, feeding, hygiene and health care. Thus, we calculate daily leisure time as the difference between 14 and total (market and domestic) work time.

Basically women’s total work burden is only slightly larger than men’s: 27% compared with 26%. The main difference though is in the distribution of work between System National Accounts (SNA) work and non-SNA work. Women spend 16% of their time in domestic work and 11% in labor market work. The distribution is quite different for men: the figures are 6% and 20%, respectively. These findings are consistent with evidence in many other countries, both developing and developed (see for example data reported in 1995 UNDP Human Development Report). In contrast, the gender difference in time assigned to leisure is not so significant.

We also report time distribution according to the worker’s level of education. Regardless of the education level, women assign more time to domestic work and men spend more time in market work. Skilled women assign more time to market work than unskilled women, but instead of reducing domestic work time, they reduce leisure time.

**Table 2. Weekly time assignment of population between 14 and 65 years old by gender. In percentages**

	All			Less than 12 years of schooling			12 years of schooling or more		
	Men	Women	All	Men	Women	All	Men	Women	All
Market work	20.2	11.1	15.4	19.2	9.3	14.1	23.5	15.3	18.7
Domestic work	5.6	16.2	11.2	5.5	16.7	11.2	5.9	15.1	11.3
Leisure	32.5	31.0	31.7	33.7	32.3	33.0	28.9	27.9	28.3
Personal care	41.7	41.7	41.7	41.7	41.7	41.7	41.7	41.7	41.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Own estimations based on Survey on the Use of Time and CHS

<sup>3</sup> The survey does not collect educational level. We estimate the figures presented in table 2 after matching the Use of Time Survey and the Household Survey. The methodological aspects about this match are presented in the Annex 1.

### **3. Model and Calibration**

The effects of trade liberalization on macro and microeconomic variables are estimated using a CGE model. In this section we present an overview of the model and its calibration. Finally, we discuss to what extent our model and its calibration represent the gender features of the Uruguayan labor market.

#### *3.1. Model*

The core model is based on Laens and Terra (1999, 2000) and Terra et al (2006). We maintain its structure in terms of the analysis of trade-related issues but we work with alternative specifications regarding the labor market in order to take into account gender issues. Specifically, we use three different versions of the model: first, we disaggregate male and female labor demand (model 1), second, we consider male and female labor supply as endogenous (model 2) and third, we incorporate domestic work in the model (model 3).

The general structure of the CGE model is quite conventional. Uruguay is assumed to be a quasi-small economy (following Harris, 1984) that has three trading partners: Argentina, Brazil and the rest of the world. The Uruguayan economy is explicitly modeled, while import demand from the trading partners is assumed to be perfectly elastic and export demand presents a downward slope that is a negative function of export prices in Uruguay. We assume perfect competition in all sectors, and goods are differentiated by geographic origin (Armington, 1969). There are ten representative households according to level of income. Government collects taxes, pays transfers to households and buys goods. Government savings are obtained as a residual. Complete core model and equations are presented in Annex 2.

The model presents two distinctive features. In the first place, the labor market module follows a wage curve behavior specification, introducing unemployment, which affects only unskilled workers, both men and women. There are different interpretations about the existence of a negative relationship among wages and unemployment (Blanchflower and Oswald, 1994). The efficiency wage model, which argues the firm's need to pay a wage premium because of efficiency reasons, seems to give the most attractive explanation. When unemployment rises the premium needed to promote workers'

effort and to retain them declines. In this paper we use different wage curves for women and men. Specifically, we use Bucheli and González (2007) estimations who found a stronger relationship for women. In the context of efficiency wage models, this may be due to gender differentiated levels of investment in specific human capital. The higher the investment level, the more costly it is to dismiss the worker and to recruit and train a new worker. That is, firms tolerate more worker's shirking. Thus, when unemployment rises, the needed wage premium will not decline as much as for workers with low specific human capital. As it is usually argued, specific human capital level is lower for women. Additionally, Bucheli and González (2007) remark that a female added worker behavior would also deepen the wage curve. Indeed, the labor supply increase coming from this behavior would push down female wages, strengthening the "primary" wage curve effect.

Secondly, we extend the model in order to allow the introduction of gender differences. The previous versions of this CGE model did not disaggregate labor by gender and assumed labor participation as exogenous. We relax these assumptions by steps as in Fofana et al (2003, 2005).

First, in Model 1 we disaggregate female and men labor. This means to relax the assumption of perfect substitution between men and women in production. Gender segmentation in the labor market allows assessing a differentiated-gender impact on wages and employment due to the changes in sectoral structure. Following Fontana (2001) we assume identical substitution elasticity for all sectors. However, in the public sector we assume fixed employment and one wage for both female and men labor, that is, perfect substitution among female and men labor<sup>4</sup>. We maintain the assumption of fix public sector employment.

There are six factors of production: skilled female labor, skilled male labor, unskilled female labor, unskilled male labor, public labor and capital.

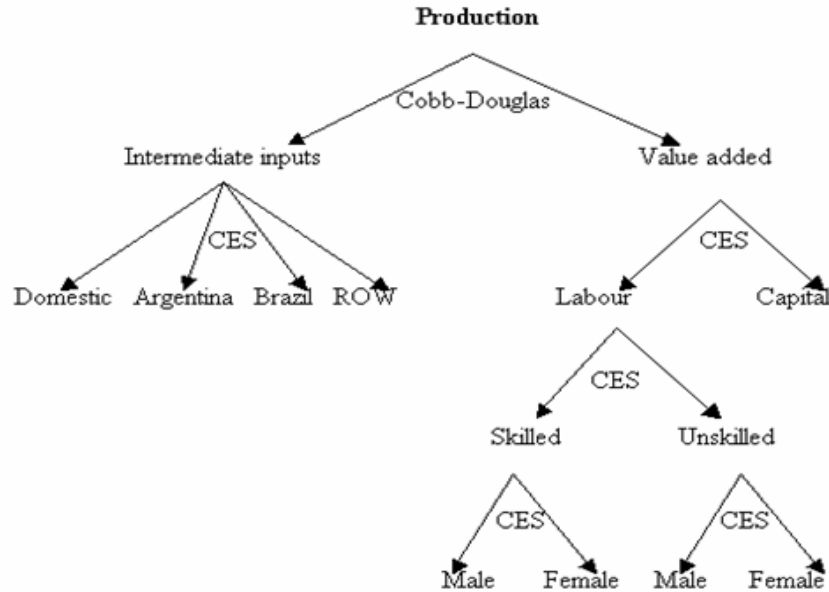
Following Laens and Terra (1999), we assume a nested production function. At the top level, a Cobb Douglas function combines intermediate inputs and value added. At the second level, value added is composed by capital and labor. At the third level, labor is a

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<sup>4</sup> This assumption is consistent with empirical findings about gender discrimination in the public sector in Uruguay (Amarante, 2001).

composed factor of skilled and unskilled labor. Finally, a new equation that combines labor by sex in order to get a composite labor by education is included in the model<sup>5</sup>. Figure 2 presents more clearly the nested production function for this model.

**Figure 2. Production function of the firm**



Labor by gender is combined following a CES function:

$$ws_{s,i} = \left[ \sum_g (wl_{g,s,i} \cdot (1 + tfac_{g,s,i}))^{1-\theta_{g_i}} \cdot \xi g_i^{\theta_{g_i}} \right]^{1/(1-\theta_{g_i})} \quad (1)$$

In which  $ws_{s,i}$  is the wage for composite labor by skills,  $wl_{g,s,i}$  are the wages for each labor type respectively,  $tfac$  is the labor tax rate,  $\xi g$  is the distribution parameter, and  $\theta_{g_i}$  is the elasticity of substitution between men and women. Subindex  $s$  refers to a subset that includes labor categories by skills (skilled and unskilled), subindex  $g$  refers to labor categories by gender (male and female) and subindex  $i$  refers to sectors.

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<sup>5</sup> We adopt this production function in order to consider the evidence that there is segmentation by gender in the labor market in Uruguay.

Then, to get aggregated labor, labor by skills is combined in the firm's production function following the CES function:

$$w_i = \left[ \sum_s (wS_{s,i})^{1-\theta_i} \xi_i^{\theta_i} \right]^{1/(1-\theta_i)} \quad (2)$$

in which  $w_i$  is the wage for aggregated labor,  $\xi_i$  is the distribution parameter and  $\theta_i$  is the elasticity of substitution between labor by skill.

In a second step, we relax the assumption of exogenous labor force and we introduce non-labor market time, which is composed by both leisure and domestic work (Model 2). Men and women spent their time in market work and non-market work. However, there is a minimum subsistence time required that is fixed.

Domestic work at home and leisure are introduced in the utility function of the households, but we assume them to be perfect substitutes. Each household maximizes its utility subject to a budget constraint, which includes market income earned by the household plus non-labor income.

Utility function is a Cobb – Douglas function that combines consumption of leisure by type of labor ( $L$ ) and of market goods ( $C$ ) for each type of household:

$$U_f = \prod_{lab} L_{lab,f}^{\mu_{lab,f}} \prod_i C_{if}^{\mu_{if}} \quad (3)$$

The budget constraint for each type of household is:

$$\sum_i p_i C_{i,f} + \sum_{lab} w_{lab} L_{lab,f} = FY_f = R_h + \sum_{lab} w_{lab} LM_{lab,f} + \sum_{lab} w_{lab} L_{lab,f} \quad (4)$$

where  $FY_f$  refers to full income of the household (including income derived from leisure),  $R_h$  refers to non-labor income.

Workers also face a time constraint, spending their total time in market labor and leisure:

$$T_{lab,f} = LM_{lab,f} + L_{lab,f} \quad (5)$$

From the optimization of the utility function, subject to the budget and time constraints, we can derive labor supply equations ( $ls_{lab,f}$ ) and final goods demand of households ( $c_{if}$ ):

$$ls_{lab,f} = \max hs_{lab,f} - \frac{\mu_{lab,f} \cdot y_f (1 - td_f)(1 - msav_f)}{(1 - \sum_{lab} \mu_{lab,f}) \cdot w_{lab}} \quad (6)$$

Where  $\max hs_{lab,f}$  is the maximum hours available for leisure and work, and is considered a fixed parameter in the model,  $y_f(1 - td_f)(1 - msav_f)$  represents households' available income and  $w_{lab}$  is the wage for each type of labor. Note that household income and wage elasticity of supply are different among types of households and categories of labor and there are not constant.

$$c_{if} = \frac{\mu_{if} \cdot y_f (1 - td_f)(1 - msav_f)}{(1 - \sum_{lab} \mu_{lab,f}) \cdot pf_i} \quad (7)$$

Finally, Model 3 considers that households use part of their time to produce home goods, which are consumed by themselves. Thus, we distinguish between leisure and domestic work. Additionally, the model requires fixing an elasticity of substitution between male and female labor in home production. Following Fontana and Wood (2000), we fix it at a lower level than the elasticity of substitution between men and women in labor market, in order to reproduce the rigidity of labor at the household level.

In this case, households' utility is a function of the consumption of market produced goods, home goods ( $CZ$ ) and leisure, and the budget constraint includes home goods.

$$U_f = \prod_{lab} L_{lab,f}^{\mu_{lab,f}} \cdot CZ_f^{\mu_{CZ}} \prod_i C_{if}^{\mu_{if}} \quad (8)$$

s.t.

$$\sum_i p_i C_{i,f} + \sum_{lab} w_{lab} L_{lab,f} + pz_f CZ_f = FY_f = R_h + \sum_{lab} w_{lab} LM_{lab,f} + \sum_{lab} w_{lab} L_{lab,f} + pz_f CZ_f$$

and

$$T_{lab,f} = LM_{lab,f} + L_{lab,f} + LZ_{lab,f} \quad (10)$$

Labor supply is now:

$$ls_{lab,f} = \max hs_{lab,f} - lz_{lab,f} - \frac{\mu_{lab,f} \cdot y_f (1 - td_f)(1 - msav_f)}{(1 - \sum_{lab} \mu_{lab,f} - \mu_{CZ}) \cdot w_{lab}} \quad (11)$$

Where  $lz_{lab,f}$  is the time used by different labor categories to domestic work.

The final goods demand of households also changes:

$$c_{if} = \frac{\mu_{if} \cdot y_f (1 - td_f)(1 - msav_f)}{(1 - \sum_{lab} \mu_{lab,f} - \mu_{zf}) \cdot pf_i} \quad (12)$$

And a new equation that determines demand of domestic goods is introduced:

$$cz_f = \frac{\mu_{zf} \cdot y_f (1 - td_f)(1 - msav_f)}{(1 - \sum_{lab} \mu_{lab,f} - \mu_{zf}) \cdot pz_f} \quad (13)$$

Home goods are produced and consumed by the same family.

Minimizing the costs of production of domestic goods subject to the production function, we obtain the price of domestic goods ( $pz_f$ ) and the demand of work for production of domestic goods ( $lz_{lab,f}$ ):

$$pz_f = \frac{\left[ \sum_{lab} \alpha h_{lab,f}^{1/\rho_f+1} \cdot w l_{lab}^{\rho_f/\rho_f+1} \right]^{(\rho_f+1)/\rho_f}}{AH_f} \quad (14)$$

$$lz_{lab,f} = \left( \frac{pz_f \alpha h_{lab,f}}{w l_{lab}} \right)^{1/\rho_f+1} \cdot AH_f^{-(\rho_f/\rho_f+1)} \cdot QZ_f \quad (15)$$

Where  $\alpha h_{lab,f}$  is the share parameter in the CES production function,  $AH_f$  is the scale parameter and  $\rho_f = (1 - \sigma_z)/\sigma_z$

$\sigma_z$  being the elasticity of substitution between different labor categories in the domestic good production function.

Finally, the equilibrium condition in the domestic good market is:

$$QZ_f = cz_f \quad (16)$$

In Annex 2 we present the calibration of parameters of the three versions of the model.

The model is run using software GAMS (General Algebraic Modeling System).

### 3.2. Calibration

We use data for year 2000 to calibrate the model, in the form of a Social Accounting Matrix (SAM). Changes to the original SAM are described in detail in Terra et al (2006). Basically, it has 23 sectors of production, one being an informal sector that only produces for domestic market and another one the public sector. Then, it has three factors of production -skilled labor, unskilled labor and capital-, two kind of national institutions –

households, presented in ten representative household according to level of income, and government- and three trading partners –Argentina, Brazil and the rest of the world.

For the purposes of this paper, we modified the SAM in order to adapt it to the three specifications of the model, introducing the gender dimensions by steps.

As model 1 considers four types of private labor, we distinguished them in the SAM, using data from the Continuous Household Survey for year 2001. The share of each labor category in total labor by sectors is the following:

**Table 3. Share of labor categories by sector**

Sector of activity (SAM)	Skilled female labor	Skilled male labor	Unskilled female labor	Unskilled male labor	Total
Agriculture	3.0	27.6	8.0	61.5	100.0
Husbandry	0.0	0.0	11.5	88.5	100.0
Forestry	13.6	33.7	1.6	51.1	100.0
Other primary	0.5	2.7	3.9	92.9	100.0
Meat processing	4.3	10.4	21.3	64.0	100.0
Dairy products	4.3	10.4	21.3	64.0	100.0
Rice	4.3	10.4	21.3	64.0	100.0
Tanning	2.9	15.6	17.7	63.8	100.0
Wood and paper	0.6	6.8	12.0	80.5	100.0
Chemicals	11.8	33.7	15.6	38.8	100.0
Ceramics	0.0	0.0	1.8	98.2	100.0
Export activities	5.6	11.0	34.3	49.2	100.0
Non tradable activities	8.6	23.6	12.2	55.6	100.0
Import activities	4.5	14.8	11.3	69.5	100.0
Hotels and restaurants	12.8	9.3	27.0	50.9	100.0
Health	38.5	25.3	26.9	9.4	100.0
Other services	36.0	39.3	12.2	12.5	100.0
Construction	3.8	15.9	2.8	77.5	100.0
Refinery	12.1	31.6	6.5	49.9	100.0
Gas	13.5	23.0	6.9	56.6	100.0
Trade and transport	7.6	17.6	17.3	57.5	100.0
Informal activities	0.0	0.0	34.4	65.6	100.0
Average	18.3	22.4	16.6	42.7	100.0

Source: SAM

There are several male-intensive activities, such as agriculture, husbandry and other primary activities, while health, export activities and other services employ a higher percentage of women. In fact, female labor is concentrated in few sectors, as table 4 shows. The activity “other services”, which includes private education, services to firms and domestic service, concentrates almost 50 percent of total female labor. This figure is even higher when we consider only skilled female labor, while unskilled women are employed in

more activities, such as informal activities, trade and transport (basically retail) and health. Notice that the main activities that employ female labor account for less than 20% of total exports, while this figure increases to almost 39% when we consider only exports to Argentina.

**Table 4. Concentration of female labor by sector of activity. In percentage**

Sector	Total female labor	Skilled female labor	Unskilled female labor	Share of total exports	Share of exports to Argentina
Other services	49.7	70.8	26.4	5.7	12.0
Health	14.4	16.2	12.4	0.0	0.0
Informal activities	12.3	0.0	25.8	0.0	0.0
Trade and transport	11.0	6.4	16.1	12.6	26.4
Rest of activities	12.6	6.6	19.2	81.6	61.6
Total	100.0	100.0	100.0	100.0	100.0

Source: SAM

Table 5 shows labor income by deciles and types of labor. As we can see, the importance of female labor income is higher in the deciles of middle income, from the fourth to the ninth decile. This is consistent to the fact that unskilled women, that are concentrated in the first deciles of income, work less, whereas in the richest households income relies more on skilled men. This last fact may be explained by the existence of a glass ceiling for female wages.

**Table 5. Households' labor income by deciles**

	Skilled women	Skilled men	Unskilled women	Unskilled men	Public labor	Total	Women (%)
First decile	0.4	0.8	21.4	67.2	10.2	100.0	21.8
Second decile	0.8	1.2	20.7	63.1	14.3	100.0	21.4
Third decile	1.2	1.8	20.5	58.7	17.8	100.0	21.7
Fourth decile	2.3	3.2	22.2	53.2	19.1	100.0	24.5
Fifth decile	4.0	5.0	21.5	48.7	20.9	100.0	25.5
Sixth decile	6.2	7.1	18.4	44.7	23.7	100.0	24.6
Seventh decile	7.6	10.5	18.1	37.5	26.2	100.0	25.7
Eighth decile	10.2	12.7	15.2	33.7	28.3	100.0	25.4
Ninth decile	13.6	18.8	11.4	24.8	31.4	100.0	25.0
Tenth decile	15.3	28.8	6.2	14.5	35.2	100.0	21.4

Source: SAM

In the model 2 labor supply is endogenous and depends on the wage and on the households' income as shown in equation (6). At the benchmark, the wage elasticity of supply is higher for women than for men. The wage elasticity is higher for skilled,

especially in the case of women. Additionally, among women the elasticity decreases with household income. The same patterns are observed for income elasticity.

Model 2 includes also a new activity: leisure. Following Fontana and Wood (2000), this activity is a fiction, assuming that it “produces” using only labor, “pays” to households and produces one type of good that is consumed only by households. In Annex 1 we explain how we estimate time devoted to leisure by households and labor categories. In order to introduce this data into the SAM, we value time spent in leisure as the opportunity cost of not working in the market. For doing so, we calculate the average hour wage for each labor category and each household. This is important because the average hour wage depends not only on the qualification of the worker but also on other variables, such as the social network of the household. We assume that there is a minimum time assigned to personal care. Following Fontana and Wood (2000), we fix this minimum time in 10 hours per day.

Model 3 separates leisure activity in leisure and domestic work. Annex 1 also presents the estimation of time spent in domestic work. In the SAM, domestic work is also valued as the opportunity cost of not working in the market. The opportunity cost is evaluated for each category of worker and for each type of household (defined by deciles of income).

Table 6 shows the ratio between male and female valued time assigned to each activity. Women spend more time than men in domestic work while men spend more time in market work and leisure. The gender gap of time assigned in market work is wider among unskilled workers.

**Table 6. Ratio of valued time (men/women)**

	Skilled	Unskilled
Market work	1.8	2.6
Leisure	1.1	1.3
Domestic work	0.4	0.4

Source: SAM

### 3.3. Model: scope and limitations

In sum our model and the calibration methodology follows previous works in CGE gender-aware models (Fofana et al, 2003 and 2005; Fontana, 2001; Fontana and Wood, 2000). There are two main differences with previous models. First, we assume different

behavior of private and public labor market. This is important in Uruguay because, as above mentioned, empirical evidence suggests that there is gender discrimination in private sector but not in the public sector. This feature could not be ignored in a model for Uruguay because the public sector accounts for 29% of total wages in our SAM and the level of employment is rigid. Then, in our model we assume one kind of labor not differentiated by gender, which is fixed. In contrast, in the private sector we assume a market labor segmented by gender.

Second, we assume ten representative households by level of income. In Uruguay empirical evidence shows that workers from different socioeconomic level present different behavior in the labor market. Unlike other developing countries, rural population is not relevant in Uruguay. Therefore, categorizing households by income level is more pertinent than the usual rural-urban distinction. In fact, the calibrated elasticities of supply in our model decrease with the socioeconomic level of the household.

The model also considers other Uruguayan features. In the case of unskilled workers we consider two different wage curves to incorporate unemployment by gender. This is an important feature of the Uruguayan economy where unskilled unemployment is quite high and there is evidence that its relationship with wages differs between sexes. Additionally, we take into account gender segregation in private sector assuming that female and male labor are imperfect substitutes in the labor demand.

Thus, this model incorporates important gender features of the Uruguayan labor market, which improve its previous versions. In future versions other gender features may be introduced. First, it would be worth to distinguish between households of different compositions in order to take into account that women are more likely to participate in labor market when they are lone parents, have no children or live with elder people. Second, it would be interesting to consider the presence of a glass ceiling for women. This phenomenon is not considered in the CGE model literature. Two possible strategies in order to incorporate it would be to introduce exogenous wage differentials (wider for higher wages) or to consider a new top labor category (i.e. high management) where substitution between men and women is very low. Finally, other aspect that the model does not explore is the impact of a tariff reduction on the cost of domestic good production. Our model assume that this good is produced only with labor, while in fact some goods as wash

machines or microwaves, which in the case of Uruguay are usually imported, could increase home production productivity.

## **4. Scenarios and Results**

### *4.1. Simulation scenarios*

With the purpose of assessing gender differentiated effects of trade policies we simulate three different scenarios. The first one assumes a complete liberalization of trade with the rest of the world, which implies a null tariff level for imports coming from the rest of the world. In the base year, trade with MERCOSUR is already liberalized, and tariffs to imports from Argentina and Brazil are already zero. Although we are conscious that this scenario is quite extreme and is not plausible to happen in the short and medium term, we think that it might provide interesting insights into how trade openness affects labor market by gender and also allows us to compare the conclusions with the results from other studies.

The second and third scenarios are backwards experiments that simulate an increase in protection. One of these scenarios simulates the tariff structure of 1994, when trade openness was starting to be implemented in Uruguay, and the other one simulates also the existence of reference prices in textiles. Reference prices act as tariffs, so we simulate the equivalent ad valorem tariffs associated with these prices, taken from Terra et al (2005). Garments and textiles are female labor intensive, and for that reason we might expect different results on gender parameters when we introduce reference prices in these sectors. These two scenarios are analyzed together in order to compare how reference prices affected labor market in the 1990s. Table 7 presents the tariff structure applied in 1994 and the tariff structure at the base year (2000) for comparison purposes. Garments and textiles are considered as “export activities” in the SAM used in this work. When we introduce an equivalent tariff to reference prices, the tariff applied to imports from the rest of the world for “export activities” increases to 30.5% while the one applied to import activities increases to 14%.

**Table 7. Ad valorem tariffs simulated for each sector of activity**

Sector of activity (SAM)	Tariff structure in 1994			Tariff structure at benchmark
	Argentina	Brazil	ROW	ROW
Agriculture	2.1	2.1	13.7	3.9
Rice	4.5	4.5	17.7	2.4
Ceramics	5.3	5.3	17.6	12.7
Tanning	0.7	0.6	6	0.1
Export activities	6.3	6.4	18.7	12.9
Forestry	0.8	1.1	11.5	7.8
Meat processing	2.5	2.4	15.5	2.0
Husbandry	1.5	1.4	14.2	0.5
Gas	1.7	1.7	15	0.0
Import activities	2.9	2.9	13.9	7.5
Dairy products	5.6	5.6	16.6	3.8
Wood and paper	6.5	6.5	18.2	5.3
Non tradable activities	4.2	4.1	15.2	10.1
Other primary activities	1.1	1.3	12.9	0.2
Chemicals	1.2	1.5	9.3	6.7
Refinery	0.7	1.1	10.7	0.5
Other services	1.1	1.1	13.9	0.0

#### 4.2 Results

In this section we analyze, first, the impact of total trade liberalization and then we focus on the scenarios where trade protection increases.

##### a. Total trade liberalization

Complete trade openness to the rest of the world has the expected positive impact on macroeconomic variables. Both exports and imports increase by more than 10 percent. Meanwhile, real GDP, absorption and investment rise. The impact is higher in the models with endogenous labor supply, especially when we consider Model 3, which also introduces domestic work. Since exports of Uruguay are relative intensive in labor, trade liberalization leads to an increase of wages and labor supply. Then, GDP and consumption possibilities increase more than in a scenario where labor supply is fixed.

**Table 8. Impact of trade openness on macroeconomic variables. Percentage change**

	Exogenous labor supply	Endogenous labor supply	Endogenous labor supply and home production
Absorption	0.53	0.54	0.70
Household consumption	0.69	0.69	0.71
Investment	0.16	0.17	1.37
Real GDP	0.78	0.78	0.95
Exports	12.96	12.94	13.28
Imports	10.25	10.24	10.50
Consumer price index	-0.13	-0.13	-0.12

Since tariffs applied to imports from MERCOSUR partners are near to zero, trade liberalization affects only tariffs applied to the rest of the world (ROW). Then, imports from ROW show a significant increase while imports from Argentina and Brazil fall. Table 8 shows that the former increase more than 39% and the latter fall 22% and 25% respectively. Uruguayan economy benefits from a significant reduction of trade diversion from MERCOSUR partners. At the same time exports to all destinations increase, but the rise is higher for Argentina (almost 15%) and Brazil (around 14%) than for the ROW (less than 12%). This happens because the average price of the export to the region falls more.

**Table 9. Impact of trade openness on trade flows**

Model	Trade Flow	Argentina	Brazil	Rest of the world
Exogenous labor supply	Exports	14.7	13.9	11.4
	Imports	-22.2	-25.2	39.2
Endogenous labor supply	Exports	14.8	13.9	11.4
	Imports	-22.2	-25.2	39.2
Endogenous labor supply and home production	Exports	14.8	14.2	11.9
	Imports	-22.1	-25.1	39.5

The increase in exports to the three partners generates an increase in labor demand for all categories of workers. In the case of skilled workers, as we assume perfect competition wages increase and, when labor supply is endogenous, employment increases too. In the case of unskilled workers, for which we assume a wage curve behavior, unemployment falls while wages and employment increase. The reduction of unemployment increases wages because firms are willing to increase the wage premium that they pay in order to promote efficiency among workers and/or avoid quitting.

Table 10 shows relative intensity in the use of factors and balance of trade by partners for aggregated sectors<sup>6</sup>. As shown, trade patterns with main commercial partners differ substantially. Uruguay has a trade surplus with Argentina in services, which are highly intensive in skilled labor, especially female labor. On the other hand, the country has a trade surplus with Brazil and the ROW mainly in agriculture and agroindustries, which are intensive in unskilled male labor. However, Uruguay presents a significant trade deficit with the three partners in importable manufactures, which is also intensive in unskilled male labor. As a consequence, the change in trade flows from liberalization leads to a change in relative factor demand. The increase of net exports of Argentina leads to a higher increase of skilled female demand relative to skilled men. In the case of unskilled labor, as male labor demand is affected in two opposite way, trade openness leads to a higher increase of relative female labor demand.

**Table 10. Trade balance and relative intensity in the use of factors of main sectors at the benchmark**

Sector	Relative intensity				Trade Balance (millions of dollars)				
	Skilled Female	Skilled Male	Unskilled Female	Unskilled Male	Capital	ARG	BRA	ROW	Total
Agriculture and agroindustries	0.6	0.8	0.9	1.2	1.0	-9	284	587	862
Exporting manufactures	0.5	0.6	1.0	0.7	1.2	10	54	377	441
Import substitution manufactures	0.8	1.0	0.8	1.1	1.0	-383	-322	-1,232	-1,938
Tradable services	1.5	1.4	0.8	0.5	1.1	435	-24	-162	249
Non tradable services	2.6	1.4	2.3	1.3	0.6	-	-	-	-
Oil and gas	1.0	1.0	0.6	0.8	1.1	-29	-8	-57	-94
Total	1.0	1.0	1.0	1.0	1.0	23	-16	-487	-480

Source: SAM

Labor demand increases more for women for both skill levels. In model 1, in the case of skilled labor this means a higher increase of wages for women (Table 11). Therefore, the gender wage gap falls. For unskilled workers, unemployment falls more

<sup>6</sup> There are six aggregated sectors: agriculture and agroindustries, which comprise primary activities and food industry; import substitution manufactures, which comprise chemicals, paper and ceramics; exporting manufactures that include textiles, garments and tanning; tradable services that include services to enterprises and tourist services such as transport, hotels and restaurants; non tradable services, which are mainly health and informal activities; and oil and gas.

among women. This, added to the fact that the relationship between unemployment and wages is stronger for women, leads to a higher increase in female wages. Additionally, employment increases more for women than for men. Therefore, the three gender gaps fall.

**Table 11. Impact of trade openness on unemployment, employment and wages.**  
**Percentage change**

Skill	Gender	Exogenous labor supply	Endogenous labor supply	Endogenous labor supply and home production
Unemployment				
Unskilled	Female	-4.30	-4.35	-4.37
Unskilled	Male	-4.13	-5.22	-5.48
Employment				
Total	Female	0.18	0.28	0.25
Unskilled	Female	0.34	0.32	0.27
Skilled	Female	0.00	0.24	0.23
Total	Male	0.21	0.17	0.20
Unskilled	Male	0.33	0.19	0.24
Skilled	Male	0.00	0.14	0.14
Wages				
Unskilled	Female	0.66	0.67	0.67
Skilled	Female	1.01	0.83	0.84
Unskilled	Male	0.42	0.54	0.57
Skilled	Male	0.94	0.86	0.88

Model 1 does not allow a supply response to the increase in labor demand. When we introduce an endogenous labor supply in Models 2 and 3, the increase in wages affects positively the labor supply while the consequent rise of household income has the opposite effect. In the case of skilled workers the first effect predominates for both sexes, resulting in an increase in labor supply. The final effects on relative employment and wages will depend on the shape and shifts of labor supply and demand curves for each sex. In this case, employment increases more for women and wages increase more for men. Thus, the employment gap declines, but the gender wage gap increases, contrary to what happened in Model 1.

In the case of unskilled labor, labor supply declines. This is because the effect of the increase in households' income outstrips the effect of the rise in wages. Men reduce labor supply more, and as a consequence unemployment falls more among this group of workers. Contrary to Model 1, the gender unemployment gap increases. If the wage curve for both

sexes were identical, the gender wage gap would also increase. Indeed, as male unemployment declines more than female's, the wage increase would be higher. However, the wage curve behavior is stronger for women. The final effect is a higher wage increase for women, so as in Model 1, the gender wage gap falls.

Model 3 distinguishes leisure and domestic work. Table 12 shows the change in the use of time by worker categories. Skilled workers increase labor market supply and reduce time spent in domestic work and leisure. The increase in the labor market supply is quite higher for women, reducing employment gap as already mentioned. In contrast, women reduce less leisure and domestic time, therefore the gender domestic work gap increases whereas gender leisure gap declines.

Unskilled workers behave differently. Both men and women reduce their labor market supply, and, as already explained, the gender market work gap declines. Unskilled workers increase leisure and domestic work, and the effect is more important for men. Thus, unlike skilled workers, the gender domestic work gap falls and the gender leisure gap increases.

Assuming that households are composed by men and women of the same skill (Piani, 2003), trade openness generates an intra-household time reallocation. In the case of “unskilled households”, equity improves in terms of gender time distribution between labor market and domestic work. This result is not observed for “skilled households”.

**Table 12. Impact of trade openness on time distribution for each labor category. Percentage change. Model 3**

	Labor supply	Leisure time	Time spent in domestic work
Skilled female workers	0.23	-0.13	-0.10
Skilled male workers	0.14	-0.16	-0.12
Unskilled female workers	-0.08	0.02	0.01
Unskilled male workers	-0.19	0.13	0.09

#### b. Backwards experiments

The backwards experiments may be useful to test which of the stylized facts of the Uruguayan economy and labor market from 1994 to 2000 can be explained by trade openness to the region and the world. Under this scenario, we simulate an increase in tariffs

applied to imports from the three partners, but tariffs are higher for imports from the ROW, as already shown in table 7.

Table 13 shows that the increase in protection has the opposite effect on macroeconomic variables compared to the trade openness scenario. Tariffs increase more for imports from the ROW, and then imports fall, mainly from this origin.

**Table 13. Impact of trade protection on macroeconomic variables. Percentage change.**

	Exogenous labor supply	Endogenous labor supply	Endogenous labor supply and home production
Tariff structure in 1994			
Absorption	-0.48	-0.41	-0.59
Household consumption	-0.55	-0.49	-0.51
Investment	-0.57	-0.32	-1.66
Real GDP	-0.70	-0.62	-0.81
Exports	-13.12	-13.09	-13.43
Imports	-10.55	-10.52	-10.80
Consumer price index	0.11	0.12	0.10

The impact on labor market demand is also the opposite than under the trade openness scenario: it decreases for all categories of workers (see table 14). Unemployment rises and wages go down. Labor supply increases in the models where it is assumed to be endogenous. This happens because the fall in wages reduces the household's income; then the positive effect on labor supply prevails over the negative impact of wages. As a consequence wages fall more than in the fixed labor supply model.

In Model 3 employment among skilled workers increase because the increase in labor supply outstrips the fall in labor demand. The employment increases more for women and the fall in wages is also higher. As a consequence the skilled gender wage gap increases and the gender employment gap falls. Table 15 shows that time spent in leisure and domestic work fall both for women and men. The fall in both activities is higher for men, which means an increase in gender domestic work gap and a decline in leisure gap.

In the case of unskilled labor, unemployment increases more than in model 1, both for men and women because of the increase in labor supply. Then wages decrease more. The fall in employment and the increase in unemployment are deeper for men. Thus, both gender gap decline but gender wage gap increases. Men and women reduce time spent in

leisure and domestic work in a similar magnitude, maintaining unchanged the gender leisure gap and slightly increasing the gender domestic work gap.

**Table 14. Impact of trade protection on unemployment, employment and wages.  
Percentage change. Tariff structure of 1994**

Skill	Gender	Exogenous labor supply	Endogenous labor supply	Endogenous labor supply and home production
Unemployment				
Unskilled	Female	2.82	3.15	3.23
Unskilled	Male	4.42	4.46	4.86
Employment				
Total	Female	-0.12	0.11	0.14
Unskilled	Female	-0.23	-0.11	-0.05
Skilled	Female	0.00	0.35	0.35
Total	Male	-0.22	-0.05	-0.09
Unskilled	Male	-0.35	-0.26	-0.32
Skilled	Male	0.00	0.29	0.28
Wages				
Unskilled	Female	-0.42	-0.46	-0.48
Skilled	Female	-0.09	-0.30	-0.31
Unskilled	Male	-0.43	-0.44	-0.47
Skilled	Male	-0.02	-0.17	-0.20

**Table 15. Change in the use of time for each labor category  
Tariff structure of 1994**

	Labor supply	Leisure time	Time spent in domestic work
Skilled female workers	0,35	-0,19	-0,17
Skilled male workers	0,28	-0,31	-0,26
Unskilled female workers	0,19	-0,04	-0,05
Unskilled male workers	0,07	-0,04	-0,06

When we simulate an additional increase in protection due to the introduction of reference prices for textiles and garments, the macroeconomic impact is very similar to the results presented in table 13, but deeper. Table 16 presents the impact on labor market. It should be noted that the introduction of references prices in order to protect female employment (textiles and garments) contribute to minimize the negative impact of tariff increased on unskilled female employment. However, unskilled female unemployment increases more, their wages fall more, and the rest of the rest of workers labor conditions

worsen. In terms of gender gap, the only difference compared to the previous scenario is that gender unskilled wage gap declines in model 3. This happen because the sectors that are being protected are export sectors, and even when protection does reduce import competition, the negative impact on exports is even higher when the policy is implemented.

**Table 16. Impact of trade protection on unemployment, employment and wages. Percentage change. Tariff structure of 1994 plus reference prices in textiles and garments**

Skill	Gender	Exogenous labor supply	Endogenous labor supply	Endogenous labor supply and home production
Unemployment				
Unskilled	Female	2.83	3.31	3.37
Unskilled	Male	4.76	4.79	5.20
Employment				
Total	Female	-0.12	0.11	0.15
Unskilled	Female	-0.23	-0.09	-0.02
Skilled	Female		0.34	0.34
Total	Male	-0.24	-0.07	-0.12
Unskilled	Male	-0.12	-0.29	-0.35
Skilled	Male		0.28	0.26
Wages				
Unskilled	Female	-0.42	-0.49	-0.50
Skilled	Female	-0.13	-0.34	-0.35
Unskilled	Male	-0.46	-0.47	-0.51
Skilled	Male	-0.08	-0.22	-0.25

## 5. Sensitivity analysis

Results obtained may be sensitive to changes in some of the parameters adopted in the study. In order to test how sensitive results are, we run three different sensitivity analyses. We also include a new scenario that simulates the break of MERCOSUR agreement through an increase in tariffs applied to imports from MERCOSUR countries.

### 5.1. Changes in elasticity of substitution by gender in the production function

In the model, the elasticity of substitution among men and women in the production function of all products is the same, at the value of 1.1. However, it may be assumed that in some sectors the substitution among men and women is more imperfect, such as in the construction sector, where only 6 percent of workers are women. Therefore, we run a sensitivity analysis allowing the value of the elasticity of substitution among men and women in the production function to vary among sectors. Even though there is no estimation of this elasticity, we assume that sectors that at the benchmark present a high

intensity in the use of male or female labor (over 80 percent) present an imperfect substitution among labor by gender and the elasticity was set at 0.1. Then, other sectors present a medium intensity (between 70 and 80 percent), and the elasticity was set at 0.3. Finally, sectors that hire both male and female labor maintain the elasticity value of 1.1. Table 17 shows the values adopted for each sector.

**Table 17. Elasticity of substitution among workers by gender**

Elasticity of substitution		
Low	Medium	High
Agriculture, Husbandry, Forestry, Other primary, Wood and paper, Ceramics, Construction, Refinery, Import activities	Meat processing, Dairy products, Rice, Tanning, Non tradable activities, Gas, Trade and transport	Chemicals, Export activities, Hotels and restaurants, Health, Other services, Informal activities

Table 18 shows the impact of trade openness in Model 3 (endogenous labor supply and home production) on employment and wages when the elasticity of substitution by gender varies among sectors. We can see that there are no significant differences with the results presented in the previous section. Although female employment increases more and male employment increases less, the differences are very slight. The main conclusions about the effects of trade openness on gender gaps remain.

**Table 18. Impact of trade openness on unemployment, employment and wages**

Skill	Gender	Elasticity equal in all sectors	Elasticity different in some sectors
Unemployment			
Unskilled	Female	-4.37	-4.40
Unskilled	Male	-5.48	-5.46
Employment			
Total	Female	0.25	0.26
Unskilled	Female	0.27	0.29
Skilled	Female	0.23	0.22
Total	Male	0.20	0.20
Unskilled	Male	0.24	0.23
Skilled	Male	0.14	0.14
Wages			
Unskilled	Female	0.67	0.68
Skilled	Female	0.84	0.84
Unskilled	Male	0.57	0.56
Skilled	Male	0.88	0.88

## 5.2 Changes in the elasticity of substitution in the home production function

Substitution among men and women in domestic work may also be assumed as imperfect. In the model, this imperfection is reflected in the domestic good production function, which is a CES with an elasticity of substitution set at 0.7. In this section we run a sensitivity analysis changing this parameter to a lower value (0.2) and a higher value (1.2). This elasticity may change the impact on the time distribution by gender. Table 19 presents the impact of trade openness on time distribution by gender with the three values of the elasticity adopted.

**Table 19. Impact of trade openness on time distribution of workers, with different elasticity of substitution value in the domestic production function**

	Labor supply	Leisure time	Time spent in domestic work
<b>Elasticity = 0,2</b>			
Skilled female workers	0.21	-0.15	-0.05
Skilled male workers	0.13	-0.17	-0.06
Unskilled female workers	-0.07	0.02	0.01
Unskilled male workers	-0.18	0.13	0.03
<b>Elasticity = 0,7</b>			
Skilled female workers	0.23	-0.13	-0.10
Skilled male workers	0.14	-0.16	-0.12
Unskilled female workers	-0.08	0.02	0.01
Unskilled male workers	-0.19	0.13	0.09
<b>Elasticity = 1,2</b>			
Skilled female workers	0.24	-0.12	-0.14
Skilled male workers	0.15	-0.16	-0.18
Unskilled female workers	-0.08	0.02	0.02
Unskilled male workers	-0.19	0.12	0.15

Trade openness increases skilled labor demand and wages, and skilled workers are tempted to increase labor supply. When the substitution in the domestic good production among genders is more imperfect, skilled workers increase labor supply less, reduce leisure time more and reduce domestic work less. A higher substitution of workers by gender in the home production function leads to an increase in time spent by unskilled men in household activities. In spite of this, the general conclusions about the effect of tariff reduction on gender gaps remain.

### 5.3. Maximum time available for work, domestic work and leisure

In the model we assume that the maximum time available for work, domestic work and leisure is 14 hours per day for both genders. The rest of the hours of the day are supposed to be the minimum necessary for sleep, eat, etc. We might assume however that women count with fewer hours to freely distribute between the different activities, because of the rigidity of some tasks at home, such as childcare, eldercare, etc. In order to assess the impact of this gender rigidity at home, we assume that women count with fewer hours per day to work at labor market, at home and to spend in leisure activities, setting the maximum time available for women at 10 hours.

Results on time distribution are, as expected, particularly important among women. When skilled women face a restriction on the maximum available hours to spend in the three activities, they increase time spent in labor market, but less. Leisure time and domestic time fall more because the original amount of hours at the base year is lower. On the other hand, unskilled female workers reduce labor supply less, while they increase more time spent in leisure and in domestic activities.

**Table 20. Impact of trade openness on time distribution of workers, with different availability of hours per day for women and men**

	Labor supply	Leisure time	Time spent in domestic work
<b>MAXHS= 10 (WOMEN)</b>			
Skilled female workers	0.17	-0.18	-0.13
Skilled male workers	0.14	-0.16	-0.12
Unskilled female workers	-0.06	0.03	0.02
Unskilled male workers	-0.19	0.13	0.09
<b>MAXHS= 14</b>			
Skilled female workers	0.23	-0.13	-0.10
Skilled male workers	0.14	-0.16	-0.12
Unskilled female workers	-0.08	0.02	0.01
Unskilled male workers	-0.19	0.13	0.09

### 5.4. Break of MERCOSUR agreement

Trade openness scenario simulates liberalization only with the ROW, because in the benchmark tariffs to MERCOSUR imports are already zero. Therefore, we cannot simulate the gender-differentiated effects on employment, wages and time allocation of liberalization with MERCOSUR partners. In this section we present results of a new

backwards experiment, which simulates an increase of tariffs to MERCOSUR partners, using the same tariff structure at the benchmark applied to imports from the rest of the world. In order to analyze the effects of trade openness with MERCOSUR partners, signs obtained should be interpreted as the opposite.

Table 21 presents the impact on trade by partner. We can expect that trade liberalization with MERCOSUR partners leads to a high increase of trade with the region, reducing imports from the ROW.

**Table 21. Impact on trade flows from an increase in protection to import form MERCOSUR**

Scenario	Trade Flow	Argentina	Brazil	Rest of the world
Increased protection to MERCOSUR	Exports	-8,0	-7,7	-6,5
	Imports	-28,3	-35,8	16,3
Increased protection to Argentina	Exports	-4,0	-4,0	-3,2
	Imports	-32,7	8,0	7,6
Increased protection to Brazil	Exports	-3,6	-3,4	-2,9
	Imports	6,6	-40,6	7,1

Table 22 presents the impact of this simulation on the labor market in the Model 3. Trade openness with MERCOSUR partners has a similar impact than trade openness with the rest of the world. Labor demand increases, especially for female and skilled workers. However, the magnitude of the impact is smaller than the results presented in table 11.

**Table 22. Impact of trade protection from MERCOSUR on unemployment, employment and wages. Percentage change.**

Skill	Gender	Increased protection to MERCOSUR	Increased protection to Argentina	Increased protection to Brazil
Unemployment				
Unskilled	Female	2,04	1,07	0,90
Unskilled	Male	2,21	1,23	0,95
Employment				
Total	Female	-0,17	-0,08	-0,08
Unskilled	Female	-0,18	-0,09	-0,08
Skilled	Female	-0,15	-0,07	-0,07
Total	Male	-0,06	-0,04	-0,03
Unskilled	Male	-0,05	-0,04	-0,02
Skilled	Male	-0,08	-0,03	-0,04
Wages				
Unskilled	Female	-0,30	-0,16	-0,13
Skilled	Female	-0,40	-0,20	-0,18
Unskilled	Male	-0,22	-0,12	-0,09
Skilled	Male	-0,22	-0,11	-0,10

## 6. Concluding remarks

In the 1990s the Uruguayan economy deepened trade openness. At the same time a reallocation of employment towards services sector, an increase in wage gap by skill, and an increase of unemployment. Female participation in labor market grew and the gender wage gap decreased.

In this paper we analyze the gender differentiated impacts of trade openness in Uruguay using a gender aware CGE model. Two main simulations were implemented. First, complete trade liberalization eliminating tariffs with the rest of the world. Second, a backward experiment that sets tariff to the level of 1994.

The abolition of tariffs improves women situation in terms of employment and wages. The gender employment gap declines for all types of workers. The gender wage gap is reduced among unskilled workers but in the case of skilled workers, the result depends on the specification of the model considered. When we introduce endogenous labor supply, the wage gap increases.

The effect of an abolition of tariffs on time distribution is different by skills too. Skilled workers reduce time spent in leisure and domestic work and increase time spent in labor market. The increase in total work burden is higher for women whereas the gender

leisure gap falls. On the contrary, unskilled workers reduce their labor supply, what is explained by the increase of household income. Meanwhile, domestic work and leisure time increase. As the decline in the gender gap increases the relative opportunity cost of female non-participation in labor market, we may expect a decrease in the traditional specialization (i.e. women in domestic work and men in labor market). Indeed, we find a reduction of gender labor market and domestic work time gaps. However, the increase in leisure is higher for men.

The simulation of a backwards experiment that sets the tariff structure of 1994 has the opposite results than the total tariffs abolition scenario on macroeconomic variables. In the labor market, demand for all type of workers decrease, wages go down, unemployment increases and the gender wage gap increases for both skill levels. These results are consistent with some of the stylized facts observed in the 1990s in Uruguay. Trade openness with the region and the world increased relative demand of female labor, which could explain the observed decrease of gender wage gap. However, the results would show a decrease of unemployment while in facts it grew. This inconsistency reflects one limitation of our model, which does not consider changes in technology. In fact, in the 1990s there was a strong increase in productivity in Uruguay, which was partly due to an unskilled labor saving technological change.

Our results point out that the differentiated gender impact of a tariff reduction or an increase in protection depends on the magnitude and direction of the changes in trade flows. Factor content of trade varies among partners. Net exports to Argentina are skilled and female intensive while net exports to Brazil and ROW are more intensive in unskilled male labor. Similar conclusions were found in Terra et al (2006) when analyzing the differentiated impact by skills.

The paper also shows that it is important to introduce endogenous labor supply in the model because the calibrated elasticities of supply for Uruguay lead to non-neglected changes in labor market participation. Thus, the results obtained with a fixed labor supply are different. The modelization of labor supply is then key.

Unlike other gender-aware models, our model considers the different behavior of the public and private sectors in terms of gender discrimination. This fact is very important

in a Uruguayan model, because public employment share in total employment is relevant, and there is evidence that there is no discrimination in the public sector.

It is also important to count with appropriate data. First, the SAM should distinguish the gender specific activities. In fact, our results should be treated carefully, because the sectoral aggregation of our SAM does not allow considering separately those sectors that present more segregation by gender, specially garments, textiles, domestic service and education. Second, it is necessary to have good quality surveys about use of time. Even when the Uruguayan survey has some limitations (such as coverage), the collected information is consistent with the evidence for other countries.

We simulated a specific policy to protect unskilled women: the introduction of reference prices in unskilled female intensive sectors. The policy improves the relative situation of unskilled women, but it worsens the situation of all workers in the labor market. We conclude that this type of indirect policy is not the best way to improve poorer female conditions in the labor market. A more direct policy to tackle the problem, such as direct subsidies, would be a best option.

We also run a sensitivity analysis that assumes that women count with fewer hours to distribute among different activities. This assumption tries to reflect that the burden of domestic tasks is downwards rigid for women. Under this assumption, we find that women face a restriction to change their labor market participation. Policies that supply child and elder care services would relieve the burden and provide women more time to assign in order to maximize their utility.

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## **Annex 1: The estimation of the distribution of time**

Information about the time devoted to home production is available in a unique time use survey *EUS (Encuesta sobre Uso del Tiempo y Trabajo No Remunerado)* carried out by the Department of Sociology of the FCS-UdelaR. The survey was collected over four months in 2003 in the city of Montevideo and its metropolitan area. This region concentrates 59% of the urban population that in turn is 95% of total population.

The observation unit is the household and the sample size is 1.200 households. The respondent is the person responsible of the household tasks: 84% of the respondents are women and 16% are men. Aguirre & Batthyány (2005) present more information about the characteristics the survey and analyze the main results.

The survey inquires about several personal characteristics of the members of the household, such as the relationship with the respondent, sex and age. A set of questions collects information about characteristics of the labor market participation of all the members: hours of work, commuting time, occupation, etc. The most important feature of the survey is that it seeks to identify and quantify the main types of labor that people over 14 years old engage. The questionnaire offers a list of tasks and the respondent has to inform the time spent in each task the week previous the interview. Additionally, she has to report the distribution among the household members of the whole time spent in each task. Notice that this second question is asked only when the respondent actually does the task.

In order to estimate time spent in domestic work, we consider the following tasks: to buy food and home furnishing; to take care of pets and plants; to organize and distribute household tasks; several tasks related to child care (to feed children, to take them to school, to play with them, to help them with their homework, to bath them, to make them sleep); to take care of the elder (to help them in many way, to give them their medicines and to accompany them). We do not include some tasks because its low frequency: to buy and mend clothes; to repair the house or home furnishings; to go to do some errands for the home.

The time spent in each task is collected in a table. The tasks appear in the rows and the columns distinguish the members of the household. As just one column is used for the children of the respondent, it is not possible to know the sex of every person. Specifically, there is a problem when the respondent has at least two children of different sex. In these

cases we assign the average of time to each child older than 14 years old. As there is also only one column to report information about the mother and mother-in-law of the respondent, we proceed analogously. The same happens with the father and father-in-law.

Another disadvantage of the data is that the survey does not inquire about the time distribution of the tasks that the respondent does not do. Thus, each task that is responsibility of another member of the household is not considered. As 84% of the respondents are women, we may expect to observe missing information about time distribution of tasks traditionally considered “male tasks”. This appears to be the case of “repairing the house or home furnishing” which consequently has been dropped of the instrumental definition of domestic work.

The calibration of the CGE model requires disaggregating domestic work between categories that take into account sex, education and income of the household. As the *EUS* does not inquire about the last two variables, we assigned the information about domestic work provided by this survey to the Household Survey (*ECH*) microdata collected in 2001 by *INE*. Notice that we use the *ECH* of 2001 for the calibration of other CGE model variables. We pursue the following procedure. First, we fit a model based on the individual *EUS* data to explain the time spent on domestic work. Then, then we apply the estimated coefficients to microdata of the *ECH*.

In order to estimate the coefficients we use a Generalized Lineal Model. The dependent variable is the amount of time spent on domestic work by the individual. The independent variables are chosen between the set of potential determinants that are collected both in the *EUS* and the *ECH*.

The explanatory variable are: i) a dummy variable that takes value 1 when the individual works in the labor market; ii) the amount of hours spent in the labor market the week previous to the interview; iii) the age and its square; iv) a dummy variable that takes value 1 if there is a woman (other than the individual) older than 13 years old; v) a privation indicator; vi) size of the household; vii) number of household members less than 14 years old. The privation indicator stems from a privation index that weights the lack of some condition that reflects a lack of status. Among the plausible conditions to be considered, we choose a set of goods whose possession is collected in both *EUS* and *ECH*: water-heater; heater; fridge; television set in colors; pay channel television; washing

machine; dishwasher; microwave oven; personal computer; access to internet; car of personal use; telephone. The weights reflect that the highest the percentage of people who possess the good, the highest the feeling of privation -thus, the highest the privation index-.

We fit a model for men and a model for women. The results appear in Table A1.

Table A1. Results of the GLM estimation. Dependent variable: time spent in domestic work.

	Women	Men
Worker (value 1 if worker)	-13,057 **	3,534
	4,143	3,378
Hours spent in labor market	-0,011	-0,180 *
	0,096	0,053
Age	3,083 *	1,543 *
	0,272	0,251
Age squared	-0,032 *	-0,017 *
	0,003	0,003
Another women (a)	-19,484 *	-45,508 *
	2,710	9,680
Privation index	10,051 **	1,030
	4,080	3,082
Household size	-4,359 *	-4,971 *
	0,839	0,445
Number of members less than 14 years old	2,381 **	0,820
	1,049	0,974
Constante	-1,908	47,731 *
	5,913	11,285

(a) Takes value 1 if there is a woman (other than the individual) older than 13 years old

\* 99%; \*\* 95%

## **Annex 2: Core model and calibration of parameters**

The CGE model is based on Terra et al (2006). Its structure is quite conventional in terms of the analysis of trade-related issues but we work with alternative specifications regarding the labor market in order to take into account gender issues. Specifically, we use three different versions of the model: first, we disaggregate male and female labor demand (model 1), second, we consider male and female labor supply as endogenous (model 2) and third, we incorporate domestic work in the model (model 3).

The main features of the CGE model (model 0) are:

- It is a multi-sector model, including two special cases. In one of them we assume that employment and wages are fixed: this sector gathers all the activities in which institutional arrangements and/or trade unions are a deterrent to workers' dismissal or to wage reductions (mainly, public services and the financial sector). The other one consists on an informal sector that produces one type of good destined only to domestic final consumption.
- We assume that Uruguay has three trading partners (Argentina, Brazil and the rest of the world). The Uruguayan economy is explicitly modeled while in the case of the other trading partners only the supply of imports and the demand for exports are endogenous.
- Perfect competition is assumed in all sectors. However, goods are not homogenous, as they are differentiated by geographic origin.
- We assume that there are ten representative households which represent different income levels (by deciles of the income distribution).
- Government collects tariffs and taxes. Government revenue is used to buy goods and services and to make transfers to households. We assume that government has fixed consumption of goods and services (in physical units) and the transfers to households are updated by the change in the average wage. Government savings is obtained as a residual.
- On the production side, the study uses a nested production function. At the top level, firms combine intermediate inputs with value added following a Cobb-Douglas function. Value added is obtained with a constant elasticity of substitution (CES) function that combines capital and composite labor. Then, composite labor is

obtained by combining skilled and unskilled labor with a CES. In the informal sector, value added is only composed by unskilled labor.

- Goods are imperfect substitutes in consumption (Armington). The small country assumption is made for imports, so the country faces a perfectly elastic supply curve in the external markets. However, it is assumed that the country faces a downward sloping demand curve for exports (quasi small open economy)<sup>7</sup>. Export demand is a function of relative prices and real income in the trade partners, which are considered exogenous.
- Total demand for each sector is composed by domestic demand (intermediate and final) plus exports to each of the trading partners.
- Trade balance is fixed so imports and exports of goods and services maintain the benchmark data's difference. The equilibrium in the model is defined by the simultaneous equilibrium in goods and factor markets and in the external sector.
- There are three factors of production: capital, skilled labor and unskilled labor (in further specifications of the model labor market is also segmented by gender). The supply of each factor is fixed and there is no international mobility. Skilled labor is employed only in the formal sector. Unskilled labor may be employed in the formal or the informal sector.
- Unemployment is fixed.
- The model was run using GAMS (General Algebraic Modeling System).

### Equations

First we present all the equations of the basic model (model 0). Then we will specify the main characteristics of the three versions of the model:

Model 1: Disaggregating labor demand by gender

Model 2: Endogenous labor supply and leisure

Model 3: Endogenous labor supply and domestic work

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<sup>7</sup> Following Cox's specification (1994).

Lower fonts indicate endogenous variables, capital fonts refer to exogenous variables and Greek letters indicate parameters. The subscripts  $i, j$  refer to sectors, the subscripts  $z, t$  refer to geographic zones, the subscripts  $f$  refer to representative households grouped according to income levels, the subscripts  $k$  refer to  $f$  plus government and the subscript  $h$  refers to factors of production as follows:

$$i, j = \{1, 2, \dots, J\}$$

$$z = \{\text{Uruguay (u), Argentina (a), Brazil (b), rest of the world (r)}\}$$

$$t = a, b, r$$

$$f = (f1, f2, f3, f4, f5, f6, f7, f8, f9, f10)$$

$$K = (f1, f2, f3, f4, f5, f6, f7, f8, f9, f10, g)$$

$$H = (SL, NSL, CAP)$$

Where  $SL$  refers to skill labor,  $NSL$  refers to unskilled labor and  $CAP$  refers to capital.

We can define a subset LAB of factors H:

$$LAB = (SL, NSL)$$

## 1. Demand Structure

Demand functions are derived from a Cobb Douglas utility function which is an increasing function of consumption of composite goods that combines different varieties of differentiated goods. In turn, the sub-utility functions follow an Armington specification (1969) in perfect competition sectors. In the perfectly competitive sectors, goods are differentiated by geographic origin.

Consumers maximize a Cobb Douglas utility function subject to their budget constraint. As such, demand for each good is stated thus:

$$c_{if} = \mu_{if} \cdot \frac{y_f (1 - td_f)(1 - msav_f)}{pf_i} \quad (1)$$

where  $c_{if}$  is the demand for a composite final good  $i$  (differentiated by geographic origin),  $y_f$  is the total income of a representative household  $f$  in Uruguay,  $td_f$  is the direct tax rate,  $msav_f$  is the marginal propensity to save and  $pf_i$  is the composite price index. This index can be written as:

$$pf_i = \left( \sum_z \lambda_{zi}^{\phi_i} (p_{zi})^{1-\phi_i} \right)^{1/(1-\phi_i)} \quad (2)$$

being  $\lambda_{zi}$  the share parameter in the Armington function,  $\Phi_i$  the elasticity of substitution between goods from different origin and  $p_{zi}$  the market price of good  $i$  from market  $z$ .

Investment demand of good  $i$  is a fixed share of total investment  $I$ :

$$c_{inv} = \mu_{inv} \frac{I}{pf_i} \quad (3)$$

Final demand of a differentiated good  $i$  produced in country  $z$  by an institution  $k$  is:

$$d_{zik} = \lambda_{zi}^{\phi_i} \cdot \left( \frac{p_{zi}}{pf_i} \right)^{-\phi_i} \cdot c_{ik} \quad (4)$$

where  $d_{zik}$  is the final domestic demand of institution  $k$ .

The export demand for a representative domestic firm is a decreasing function of the export price:

$$e_{iz} = \frac{e_{0iz} \cdot p_{iz}^{-\eta_i} \cdot R_t}{ER \cdot pd_{zi}^{-\eta_i}} \quad (5)$$

where  $e_{iz}$  is the demand for a variety of the differentiated good  $i$  in market  $z$ ,  $p_{iz}$  is the export price from Uruguay,  $pd_{zi}$  is the domestic price index of good  $i$  in market  $z$ ,  $R_t$  is the real income of the partner  $t$ ,  $ER$  is the exchange rate and  $e_{0iz}$  is a parameter.

## 2. Production

Each sector combines primary factors and intermediate inputs following a Cobb-Douglas production function. The value added is a nested CES production function combining skilled labor, unskilled labor and capital.

## 3. Cost

Total variable cost is derived from a Cobb-Douglas constant return to scale production function. The variable unit cost is:

$$v_i = \omega_i (vc_i (1 + tind_i))^{1-\sum_j \alpha_{ji}} \cdot \prod_j v_{ji}^{\alpha_{ji}} \quad (6)$$

where  $v_i$  is the variable unit cost,  $vc_i$  is the value added cost and  $vi_{ij}$  is the composite price of intermediate inputs.  $\alpha_{ij}$  is the distribution parameter of a Cobb-Douglas production function,  $tind_i$  is the value added tax rate and  $\omega_i$  is a parameter.

In turn, value added is a combination of labor and capital specified as a CES. Thus,  $vc_i$  is:

$$vc_i = \left[ (1 - \delta_i)^{\sigma_i} \cdot r_i^{(1-\sigma_i)} + \delta_i^{\sigma_i} \cdot w_i^{(1-\sigma_i)} \right]^{1/(1-\sigma_i)} \quad (7)$$

where  $r_i$  and  $w_i$ , are the rental rate of capital and the average wage,  $\delta$  is the distribution parameter of the CES function for value added, while  $\sigma_i$  is the elasticity of substitution between capital and labor.

As the model considers two types of labor, the average wage is a combination of skilled and unskilled wage. It is assumed that skilled labor and unskilled labor are combined following a CES function, so the average wage is:

$$w_i = \frac{1}{\varphi_i} \cdot \left[ (1 - \xi_i)^{\theta_i} \cdot (wu)^{1-\theta_i} + \xi_i^{\theta_i} \cdot ws^{1-\theta_i} \right]^{1/(1-\theta_i)} \quad (8)$$

where  $w_i$  is the average wage,  $wu_i$  and  $ws_i$  are the unskilled and the skilled wages, respectively,  $\xi$  and  $\varphi$  are the distribution and scale parameters, and  $\theta_i$  is the elasticity of substitution between skilled and unskilled labor.

The intermediate inputs are differentiated by geographic origin with an Armington formulation. The composite price of intermediate inputs is:

$$vi_{ji} = \left( \sum_z \gamma_{zji}^{\phi_j} \cdot (p_{zj})^{1-\phi_j} \right)^{1/(1-\phi_j)} \quad (9)$$

where  $p_{zj}$  is the price in the local market of input  $j$  used in sector  $i$  in each zone,  $\gamma_{zji}$  is the CES distribution parameter and  $\phi_j$  is the elasticity of substitution between goods from different origins.

#### 4. Input and factor demand by firm

Firms maximize their profits so demand for intermediate inputs and value added (labor and capital) in each sector is obtained from their maximization program:

$$x_{zji} = \frac{\alpha_{ji} \cdot v_i}{vi_{ji}} \left( \frac{p_{zj}}{\gamma_{zji} \cdot vi_{ji}} \right)^{-\phi_j} \quad (10)$$

where  $x_{zji}$  is the demand for input  $j$  coming from country  $z$  and used by sector  $i$  for each firm in sector  $i$ . It is a decreasing function of the input price.

Valued added demand is a decreasing function of the value added cost and an increasing function of the unitary cost and output in each sector:

$$va_i = \alpha v_i q_i \frac{v_i}{vc_i (1 + tind_i)} \quad (11)$$

Factor demand is a decreasing function of the return rate and is an increasing function of value added and its price:

$$fd_{hi} = \left( \frac{w_{hi}}{\delta_{hi} \cdot vc_i} \right)^{-\sigma_i} \cdot va_i \quad (12)$$

Finally, labor demand equations are the following:

$$l_{lab,i} = \left( \frac{w_{lab} (1 + tfac_{lab})}{\xi_i \cdot w_{l,i}} \right)^{-\theta_i} \cdot fd_{hi} \quad (13)$$

## 5. Domestic pricing

In the perfect competitive sectors, the equilibrium price of output is equal to its variable unit cost ( $v_i$ ):

$$p_{ui} = v_i (1 + tex_i) \quad \text{when } i = \text{competitive sectors} \quad (14)$$

where the lower case “ $u$ ” refers to Uruguay, and  $tex$  is the excise tax paid by sector  $i$ . The firms charge the same price in domestic and foreign markets.

## 6. General Equilibrium

Public services fix prices, wages and employment whereas production level and capital demand is endogenous.

Income of the households is endogenous and is the sum of the returns to factors of production and transfers from the government:

$$y_f = \sum_i (l_i \cdot w_i + k_i \cdot r_i) + tr_f + \overline{wglg} \quad (15)$$

Government income is the sum of the receipts of tariff collection, indirect taxes and profits from public firms:

$$y_g = \sum_i (l_i \cdot w_i + k_i \cdot r_i) \cdot tind_i + \sum_i (\pi_i) + \sum_i \left( \sum_z \tau_{zi} d_{zi} n_{zi} p_{zi} + n_{ui} \sum_z \sum_j \tau_{zj} x_{zji} \cdot n_{zj} \cdot p_{zj} \right) \quad (16)$$

Government expenditure is the sum of household transfers, public wages and government consumption:

$$GE = \sum_f \bar{tr}_f + \sum \bar{d}_{zig} p_{zi} + \overline{wg} \bar{lg} \quad (17)$$

where  $GE$  is the government expenditure,  $d$  is the government consumption of good  $i$ , which is a fixed coefficient,  $wg$  is the public wage and  $lg$  is public employment, both fixed.

Government savings is the difference between government income and expenditure:

$$SG = y_G - GE \quad (18)$$

It is assumed as endogenous.

The equilibrium condition in the labor market is:

$$LS_{lab} = \sum_i l_{lab,i} \quad (19)$$

where  $LS_i$  is the supply of labor, which is exogenous.

The equilibrium equation for capital is:

$$K_i = k_i \quad (20)$$

where  $K_i$  is capital supply (exogenous).

When factors are assumed to be sector specific there is one equilibrium condition for each factor and sector, but when factors are assumed perfectly mobile there is only one equation for each factor.

The equilibrium conditions in the goods market require that supply equals demand in each sector:

$$q_i = d_{ui} + \sum_j x_{uij} + \sum_t e_{it} \quad (21)$$

Finally, the external equilibrium is:

$$\sum_i \sum_t e_{it} \cdot p_{ui} ER - \sum_i \sum_t d_{it} p_{zi} - \sum_i n_{ui} \sum_j \sum_t x_{tji} \cdot p_{tj} = B \quad (22)$$

In all the simulations  $B$  is fixed in terms of the numeraire.

In the equilibrium, investment is equal to total savings:

$$I = \sum_f (msav_f \cdot y_f \cdot (1 - td_f)) + SG - SCCB \cdot ER$$