Documentos de Trabajo

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María Inés Terra, Marisa Bucheli y Carmen Estrades

Documento No. 24/07
Diciembre, 2007

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October 2007

María Inés Terra, Marisa Bucheli, Carmen Estrades[2]

[1] This work was carried out with financial and scientific support from the Poverty and Economic Policy (PEP) Research Network, which is financed by the Australian Agency for International Development (AusAID) and the Government of Canada through the International Development Research Centre (IDRC) and the Canadian International Development Agency (CIDA). The authors acknowledge the collaboration of Rodrigo Ceni who participated in different phases of the study. We are very thankful for the comments received from Marzia Fontana, Wilfredo Maldonado, Masakazu Watanuki, André Lemelin and Renato Flores, Bernard Décaluwé, Ismaël Fofana, Veronique Robichaud, John Cockburn and Silvia Laens. All remaining errors and omissions are our own responsibility.

[2] Departamento de Economía, Facultad de Ciencias Sociales, Universidad de la República, Uruguay. E-mail addresses: iterra@decon.edu.uy; marisa@decon.edu.uy, carmen@decon.edu.uy.

Abstract

In this paper we analyze the gender differentiated impacts of trade openness in Uruguay using a gender aware CGE model with endogenous labor supply and a home production function. We simulate complete trade liberalization and an increase in tariffs to the level of 1994. Trade liberalization increases female employment and wages, reducing the gender wage gap. These findings are consistent with Çagatay (2001) and Fofana et al (2003). The effect of trade openness on time distribution of workers is different by skills. Skilled workers, mainly women, reduce time spent in leisure and domestic work increasing labor supply. In contrast, unskilled workers increase leisure time, especially men. Trade openness leads to a more equitable distribution of time spent in domestic work. When there is a more imperfect substitution among genders in the home production function, women reduce more leisure time. The increase in tariff to the level of 1994 has the opposite results.

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

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

Resumen

En este trabajo se analizan los efectos diferenciados por género de una apertura comercial en Uruguay, usando un modelo de equilibrio general computable que considera la dimensión de género. El modelo incorpora además una oferta de trabajo endógena y una función de producción de bienes domésticos. En el marco de este modelo, se simula una apertura comercial total y un incremento de aranceles al nivel vigente en 1994. Los resultados muestran que una apertura comercial aumenta el empleo y los salarios femeninos, reduciendo la brecha salarial de género. Estos resultados son consistentes con Çagatay (2001) y Fofana et al (2003). El efecto de una apertura comercial sobre la distribución del tiempo de los trabajadores es diferente por nivel de calificación. Los trabajadores calificados, especialmente las mujeres, reducen el tiempo dedicado al ocio y al trabajo doméstico incrementando su oferta laboral. Por el contrario, los trabajadores no calificados aumentan el tiempo de ocio, en especial los hombres. La apertura comercial lleva a una distribución más equitativa del tiempo dedicado a tareas domésticas. Cuando hay una sustitución más imperfecta entre hombres y mujeres en la función de producción doméstica, las mujeres reducen en mayor medida el tiempo dedicado al ocio. Un aumento de los aranceles al nivel vigente en 1994 tiene resultados opuestos.

Palabras clave: apertura comercial, género, modelos de equilibrio general, función de producción doméstica, ocio, curva de salarios

1. Introduction

Uruguay is a small Latin American country that has strong comparative advantages in agriculture. 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 assign less time assigned to labor market than men, while the opposite happens with time assigned to domestic work. Additionally, some studies conclude that gender discrimination in the labor market persists.

In principle, a country may benefit from trade openness because it causes an increase of trade and productive specialization. Productive efficiency increases due to a better resource allocation and at the same time, welfare rises through 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. However, 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 earnings gender gap. Therefore, we may expect that a female intensive sectors growth would decrease the gender 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 is important to evaluate the intra-household reallocation of resources.

Other aspects, such as public provision of social services, might also be affected, but empirical studies rarely focus on them. Most of the empirical work study whether trade

policies affect women's employment relative to men and the earnings gender 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 complete trade openness in Uruguay, following the methodological strategy pursued by the above mentioned literature. Specifically, we study the effects on wages, employment, allocation of time between labor market and domestic work, and income distribution, using a gender-aware CGE model.

The paper is organized as follows. First, we present an introduction to the Uruguayan economy in general and to labor market in particular. Secondly, we present the model and the data we use. Then, we analyze the results of three different trade policy scenarios. Finally, we draw some conclusions.

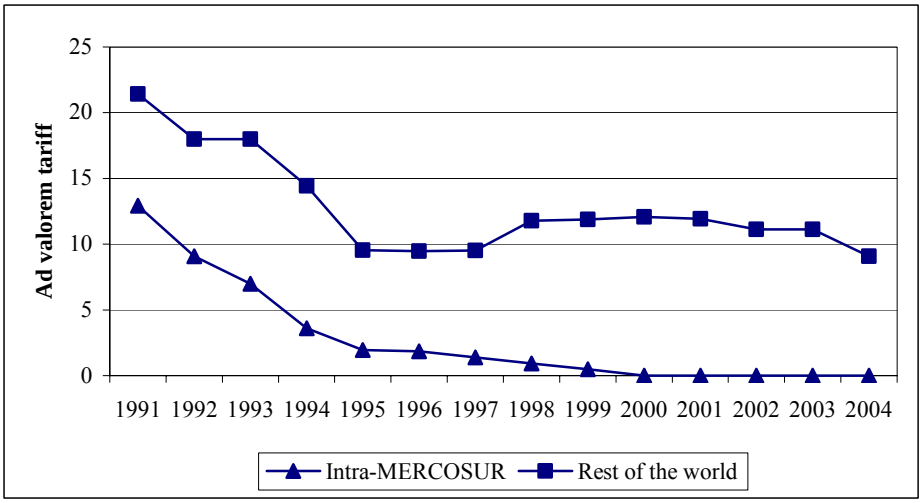
2. The Uruguayan Economy

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 and liberalization of capital markets. Although the liberalization process had started in the 1970s, it deepened in the 1990s. 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. Although in the last ten years the average tariff applied to imports from the rest of the world has not been much modified, the intra- MERCOSUR tariff is practically zero.

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 rewards 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
Women			
Participation rate	61.7	68.4	71.9
Unemployment rate	12,3	13,5	19,9
Employment rate	54.1	59.1	57.2
Men			
Participation rate	94.1	93.3	92.1
Unemployment rate	6,2	7,5	12,0
Employment rate	88.2	86.3	80.9
Wage gap (log difference) *			
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 female participation is more likely for women who live with inactive elderly people or whose husband is unemployed.

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.

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. According to Bucheli and Sanromán (2005) the discrimination measure increases throughout the wage distribution. Furthermore, there is a sharp acceleration in the upper distribution, which they interpret as evidence of a glass ceiling.

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.

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 figures are reported in Aguirre and Batthyány (2005). The survey for time use does not collect information about education or income of the household. Thus, we match the data provided by this survey and the Household Survey in order to estimate the amount of hours assigned to domestic and labor market work by gender and educational level. The methodological aspects about this match are presented in the Annex 1.

In table 2 we show the estimation of the time distribution for women and men of 14 to 65 years old. 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. According to these estimations, 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. In contrast, the gender difference in time assigned to leisure is not so important.

We also report time distribution according to the worker's level of education. Regardless the education level, women assign more time to domestic work and men spent more time at 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. 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

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. The core model is based on Laens and Terra (1999, 2000) and 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).

3.1. Model

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 household and buys goods. Government savings is 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). One of them is the existence of efficiency wages, paid by firms in order to promote effort or reduce the quitting rate among workers. When unemployment rises the wage needed to promote workers' efficiency declines.

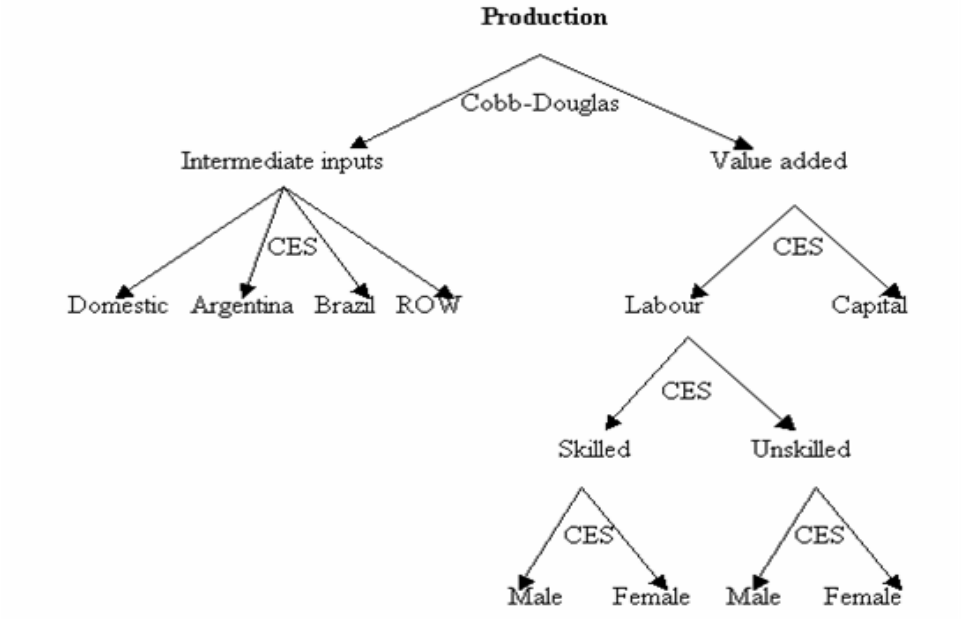
Secondly, we extend the model in order to allow the introduction of gender differences. The previous CGE model versions did not disaggregate labor by gender and assumed labor participation as exogenous. We relax these assumptions by steps as in Fofana et al (2003, 2005).

First, in Model 1 we disaggregate female and men labor demand. This means to relax the assumption of perfect substitution between men and women in production. Following Fontana (2001) we assume identical substitution elasticity for all sectors. Gender segmentation in the labor market allows assessing a differentiated-gender impact on wages and employment due to the changes in sectoral structure.

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

As the model has four types of labor, the average wage is a combination of skilled female, skilled male, unskilled female and unskilled male wage. 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 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. 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:

$$ws_{s,i} = \left[\sum_{g} (wl_{g,s,i}.(1 + tfac_{g,s,i}))^{1-\theta g_i} .\xi g_i^{\theta g_i} \right]^{1/(1-\theta g_i)}$$

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, ξg is the distribution parameter, and θg_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.

Then, to get a factor of aggregated labor (*l*), labor by skills is combined in the firm's production function following the CES function:

$$w_{li} = \left[\sum_{s} (ws_{s,i}.)^{1-\theta_i} .\xi_i^{\theta_i} \right]^{1/(1-\theta_i)}$$

in which w_{li} is the wage for aggregated labor, ξ_i is the distribution parameter and θ_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. Thus, Model 2 introduces the idea that men and women are not perfect substitutes in non-labor market. As we need to subtract from the available time the minimum subsistence volumes of non-market work required, we follow Fontana and Wood (2000) who propose to fix this minimum volume in 10 hours per day.

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:

$$U_f = L_{mal,f}^{\mu_{mal,f}} L_{fem,f}^{\mu_{fem,f}} . \prod_i C_{if}^{\mu_{if}}$$

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

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

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.

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

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 previous works (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.

$$U_f = L_{mal,f}^{\mu_{mal,f}} L_{fem,f}^{\mu_{fem,f}}.CZ_f^{\mu z_f} \prod_i C_{if}^{\mu_{if}}$$

Labor supply is now:

$$ls_{lab,f} = \max hs_{lab,f} - lz_{lab,f} - \frac{\mu_{lab,f}.y_f(1-td_f)(1-msav_f)}{(1-\sum_{lab}\mu_{lab,f}-\mu z_f).w_{lab}}$$

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

The final goods demand of households also changes:

$$c_{if} = \frac{\mu_{if}.y_f(1-td_f)(1-msav_f)}{(1-\sum_{lab}\mu_{lab,f}-\mu z_f).pf_i}$$

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

$$cz_f = \frac{\mu z_f.y_f(1-td_f)(1-msav_f)}{(1-\sum_{lab}\mu_{lab,f}-\mu z_f).pz_f}$$

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 ($lz_{lab,f}$):

$$pz_f = \frac{\left[\sum_{lab} \alpha h_{lab,f}^{\,1/\rho_f+1} . wl_{lab}^{\,\rho_f/\rho_f+1}\right]^{(\rho_f+1)/\rho_f}}{AH_f}$$

$$lz_{lab,f} = \left(\frac{pz_f \alpha h_{lab,f}}{wl_{lab}}\right)^{1/\rho_f+1} . AH_f^{\,-(\rho_f/\rho_f+1)} . QZ_f$$

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

σz_f 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:

$QZ_f = cz_f$

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 the other one a public sector. Then, it has three factors of production -skilled labor, unskilled labor and capital-, two 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 core 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 labor, we distinguished them in the SAM, using data from the Continuous Household Survey for year 2001. The factorial use of the sector is now the following:

Table 3. Labor intensity 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.

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 presents how labor income by deciles relies on the different 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 seventh 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

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 valuate 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.

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 valuated as the opportunity cost of not working in the market.

In terms of market value, time spent in market work, leisure and domestic work is shown in table 6. It must be noticed that in this case we are not considering time in hours but time valued at the opportunity cost, and for that reason there are significant differences with table 2[3]. When we value time spent in labor market, leisure and domestic work according to the opportunity cost, the share of market work for skilled workers is higher than the estimations presented in table 2. The opportunity cost for the same category of worker varies according to the type of household (defined by deciles of income). Skilled workers in higher income households obtain higher wages and assign more time at market work. In contrast, skilled workers in lower income household obtain lower wages and assign more time in leisure and domestic work. Therefore, for skilled workers, total hours spent in market work are in average valuated at a higher opportunity cost than hours spent in leisure and domestic work. Despite this, the main conclusions about the time distribution by gender remain; women spend more time working at home while men spend more time at market work. Also, unskilled workers spent more time in leisure.

Table 6. Valued time distribution for each labor category

	Skilled women	Skilled men	Unskilled women	Unskilled men
Market work	34.6	52.2	19.4	39.6
Leisure	41.8	39.3	53.3	51.7
Domestic work	23.6	8.5	27.3	8.7
Total	100.0	100.0	100.0	100.0

Source: SAM

[3] Besides, in table 6 time spent in personal care is not considered, and for that reason percentages presented in table 2 are much lower.

4. Scenarios and Results

4.1. Simulation scenarios

The aim of this paper is to assess how trade openness affects welfare, relative prices, specialization, trade and labor market in Uruguayan economy using different specifications of a CGE model. With that in mind, 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. They simulate a trade closure, by setting tariffs at the level of 1994, when trade openness was starting to be implemented in Uruguay. One of these scenarios simulates the tariff structure of 1994, 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 import 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 base year
	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 on macroeconomic and labor market variables, and specialization patterns. 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. However, 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 mainly 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%).

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

Table 10 shows relative intensity in the use of factors and balance of trade by partners for aggregated sectors[4]. 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

[4] 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.

a trade surplus with Brazil and the ROW mainly in agriculture and agroindustries, which are intensive in unskilled male labor. Importable manufactures present a similar factor intensity pattern. In this sector Uruguay presents a trade deficit with the three partners.

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

As a consequence, the change in trade flows from liberalization leads to a change in relative factor demand. The increase in exports to the three partners generates an increase in labor demand and wages for all categories of workers. This happens in the three models, as shown in table 11, which presents changes in labor market variables. Therefore, unemployment falls among unskilled workers. Employment and wages increase for both unskilled and skilled workers, except in Model 1, in which skilled employment does not change because it is assumed fixed.

Unskilled labor demand increases for both genders, but it increases more for women. As a consequence, female unemployment falls more. The fall of unemployment increases wages because firms are willing to increase the wage premium that they pay in order to promote efficiency among workers. The increase of wages is higher for unskilled women than for unskilled men. Thus, the gender wage gap falls. The gender wage gap also falls for skilled workers, because demand for skilled women increases more than demand for skilled men.

Thus, trade openness reduces the gender wage gap both among skilled and unskilled workers. At the same time, it widens the wage gap between skilled and unskilled labor. These two trends can be explained by the changes in trade flows, which lead to changes in

relative factor demand. The second trend, the increase in the wage premium, is a consequence of the higher increase of exports to Argentina, which are intensive in skilled labor, and the significant rise of imports from the rest of the world, which are intensive in unskilled male labor. On the other hand, the reduction in the gender gap responds to the fact that exports to Argentina are more intensive in skilled female labor while imports from the ROW are more intensive in unskilled male labor. Then, female labor demand increases more than male labor demand for both skills.

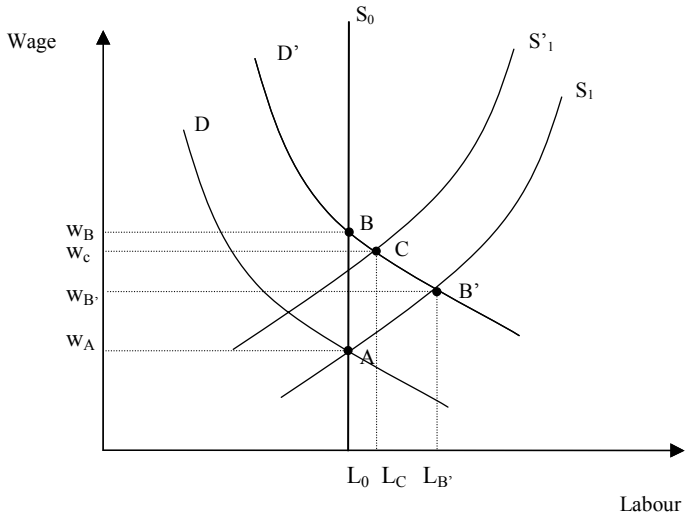
Table 11. Impact of trade openness on unemployment, employment and wages. Percentage change

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, as labor supply is assumed constant. When we introduce an endogenous labor supply in Models 2 and 3, skilled workers increase time spent in the labor market and their wages increase less than in the previous model. The effect is particularly important among skilled women. This situation is illustrated in figure 3. The initial equilibrium locus of wages and employment is represented by point A. When assuming fixed labor supply, the increase in labor demand leads to an increase of wages from A to B. In contrast, in Models 2 and 3, labor supply increases with wages. Thus, a shift of the demand means a movement from A to B'. Additionally, the increase of the income of the rest of the household, originated on the rise

of wages and employment, produces a reduction of labor supply. Therefore, the final equilibrium is reached in C, where employment, labor supply and wages are higher than in A.

Figure 3. Changes in skilled labor market according to model 1 and 2



In the case of unskilled labor, trade liberalization also increases labor demand but the changes in labor market cannot be explained with the same figure, because we are assuming a wage curve specification. Compared to Model 1, wages increase slightly more because unemployment falls more. The fall of unemployment is higher for unskilled men than women, because men reduce labor supply more than women. Their behavior is consistent with an increase of their household income originated in the rise of wages and employment of unskilled labor. This effect outstrips a potential increase of labor supply originated by the rise of their wages.

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, which is consistent with the rise of their wages. The behavioral reaction is deeper among women. Specifically, their increase in the labor market supply is quite higher than for men. Unskilled workers behave differently. Both men and women reduce their labor market offer, because, as already explained, total income of the household increases. As a consequence, unskilled workers increase leisure and domestic work, but the effect is more important for men.

Assuming that households are composed by men and women of the same skill, trade openness generates an intra-household time reallocation, making men dedicate more time to domestic work activities and thus improving equity within households. In spite of this, skilled women lose a high percentage of leisure time.

Table 12. Impact of trade openness on time distribution for each labor category. Percentage change. Model with endogenous labor supply and domestic work

	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

Under a trade openness scenario, all types of households increase their income (table 13). The richest households are the most benefited. This is a result of the relative increase of skilled wages and employment. Imports increase mainly in sectors intensive in capital and unskilled labor while exports increase more in sectors intensive in skilled labor. Although this would be a rough measure of income distribution we can say that trade openness could likely generate a general welfare improvement but at the same time it would increase inequality.

Table 13. Households' income variation. Percentage change

	Exogenous labor supply	Endogenous labor supply	Endogenous labor supply and home production
First decile	0.64	0.64	0.66
Second decile	0.66	0.65	0.67
Third decile	0.66	0.65	0.67
Forth decile	0.68	0.68	0.70
Fifth decile	0.69	0.69	0.70
Sixth decile	0.68	0.68	0.70
Seventh decile	0.67	0.67	0.69
Eighth decile	0.67	0.67	0.69
Ninth decile	0.69	0.70	0.71
Tenth decile	0.73	0.74	0.74

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 14 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 14. 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 is also the opposite than under the trade openness scenario (see table 15). Labor demand decreases for all categories of workers, especially for men. Unemployment rises, employment decreases and wages go down. However, 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 the case of unskilled labor, unemployment increases more, both for men and women. Because there is no unemployment among skilled workers, the rise in labor supply leads to an increase in employment but a deeper fall in wages. This is particularly important for women whose labor supply increases more. As a consequence the gender gap increases, especially for skilled women.

Table 15. 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 16 shows what we have already explained: the rise of labor supply, especially among skilled workers. Unskilled female workers increase time spent in labor market more in the experiment with reference prices, because of the increase in unskilled female labor demand in the protected sector. Time spent in domestic work falls for all types of labor categories, deepening the negative impact of the wage fall.

Table 16. 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

Lastly, we can see in table 17 that income falls for all types of households, but falls more among the richest households, especially in the first specification of the model, because employment among skilled workers is considered as fixed.

Table 17. Households' income variation. Percentage change

	Exogenous labor supply	Endogenous labor supply	Endogenous labor supply and home production
	Tariff structure in 1994 plus reference prices in textiles		
First decile	-0,50	-0,48	-0,51
Second decile	-0,54	-0,51	-0,53
Third decile	-0,54	-0,50	-0,53
Forth decile	-0,58	-0,53	-0,56
Fifth decile	-0,58	-0,53	-0,55
Sixth decile	-0,56	-0,51	-0,53
Seventh decile	-0,52	-0,47	-0,49
Eighth decile	-0,50	-0,45	-0,47
Ninth decile	-0,52	-0,46	-0,48
Tenth decile	-0,59	-0,52	-0,53

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 14, but deeper. Table 18 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) does not contribute to improve female conditions in labor market. On the contrary, female wages fall more than male ones, 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 18. 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 and a new backwards 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 19 shows the values adopted for each sector.

Table 19. 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 20 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 conclusion that trade openness reduces the gender gap remains.

Table 20. 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 21 presents the impact of trade openness on time distribution by gender with the three values of the elasticity adopted.

Table 21. 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
Elasticity = 0,2			
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
Elasticity = 0,7			
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
Elasticity = 1,2			
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 female labor demand and wages, and skilled women are tempted to increase labor supply. However, when the substitution in the domestic good production among genders is more imperfect, skilled women increase labor supply less, and they are not able to reduce time spent in domestic work as much as they would like. In order to increase time spent in labor market, they must reduce leisure time. A more perfect substitution of workers by gender in the home production function also benefits unskilled women, because unskilled men increase more time spent in household activities under this assumption.

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 22. 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
MAXHS= 10 (WOMEN)			
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
MAXHS= 14			
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 23 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 23. 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 24 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 24. 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, an increase of unemployment and informality took place. Female participation in labor market grew and discrimination increased.

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.

Trade liberalization improves women situation in terms of employment and wages. This is consistent with Çagatay (2001) and Fofana et al (2003), who conclude that trade openness has a positive impact on female employment in semi-industrialized countries. The gender wage gap is reduced among skilled workers and unskilled workers. Additionally, the premium for education increases. Skilled workers are most benefited because exports to Argentina, which are intensive in this factor, increases more than exports to other partners. Among skilled workers, female employment and wages increase more. Unskilled women are also better off than unskilled men.

These results are consistent with some of the stylized fact mentioned before. Trade liberalization increases demand of skilled and female labor. However, the model shows a decrease of unemployment while in facts it grew. This inconsistence shows 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.

The paper also shows that it is important to introduce endogenous labor supply in the model. When doing so, some of the results obtained in the model with a fixed labor supply vary. The increase in labor supply provoked by the increase in wages for skilled workers generates a lower increase in wages. On the contrary, unskilled workers reduce labor supply, which leads to a higher decrease in unemployment and a higher increase in wages.

The effect of trade openness on time distribution of workers is different by skills. When wages increase, skilled workers reduce time spent in leisure and domestic work,

because they increase time spent in labor market. The reduction of leisure time is higher for women than for men. On the contrary, unskilled workers increase leisure time, especially men. For both skilled and unskilled workers, trade openness leads to a more equitable distribution of time spent in domestic work. However, when there is a more imperfect substitution among genders in the home production function, trade liberalization leads to an increase in skilled female labor supply at the expense of a higher reduction in leisure time.

The simulation of a backwards experiment that sets the tariff structure of 1994 has the opposite results than the trade openness scenario: employment and wages go down, unemployment increases and the gender wage gap increases for both skills. These results, with a higher magnitude, are similar to results obtained when we simulate a breaking of MERCOSUR agreement.

We also show that a specific policy to protect a female intensive sector, the introduction of reference prices in female intensive sectors, has a negative effect on female wages and employment, because of its negative impact on exports.

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 and domestic service.

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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 owen; 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)[5]. 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

[5] 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, …, J}

z = {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:

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

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:

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

being λ_{zi} the share parameter in the Armington function, Φ_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:

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

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

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

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:

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

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_{oiz} 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:

$$v_i = \omega_i \left(vc_i \left(1 + tind_i \right) \right)^{1-\sum_j \alpha_{ji}} . \prod_j vi_{ji}^{\alpha_{ji}} \quad (6)$$

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. α_{ij} is the distribution parameter of a Cobb-Douglas production function, $tind_i$ is the value added tax rate and ω_i is a parameter.

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

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

where r_i and w_i,, are the rental rate of capital and the average wage, δ is the distribution parameter of the CES function for value added, while σ_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:

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

where w_i is the average wage, wu_i and ws_i are the unskilled and the skilled wages, respectively, ξ and φ are the distribution and scale parameters, and θ_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:

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

where p_{zj} is the price in the local market of input j used in sector i in each zone, γ_{zji} is the CES distribution parameter and ϕ_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:

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

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:

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

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

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

Finally, labor demand equations are the following:

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

5. Domestic pricing

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

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

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:

$$y_f = \sum_i (l_i.w_i + k_i.r_i). + tr_f + \overline{wg}\,\overline{\lg} \tag{15}$$

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

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

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

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

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:

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

It is assumed as endogenous.

The equilibrium condition in the labor market is:

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

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

The equilibrium equation for capital is:

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

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:

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

Finally, the external equilibrium is:

$$\sum_i \sum_t e_{it} . p_{ui} ER - \sum_i \sum_t d_{ti} p_{ZI} - \sum_i n_{ui} \sum_j \sum_t x_{tji} .. p_{tj} = B \qquad (22)$$

In all the simulations *B* is fixed in terms of the numerary.

In the equilibrium, investment is equal to total savings:

$$I = \sum_f \left(msav_f . y_{f.} \left(1 - td_f\right)\right) + SG - SCCB.ER$$