The effects of increasing openness and integration to the MERCOSUR on the Uruguayan labour market. A CGE modeling analysis[1].

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Abstract

Uruguay is a small economy. Its integration to MERCOSUR has increased the exposure to regional macroeconomic inestability. The aim of this paper is to assess the impact of regional integration on labour market and poverty. We estimated wage differentials between labour categories, finding a 60% wage gap between formal and informal workers. A CGE model with an efficiency wage specification for unskilled labour was built. Results show that regional shocks deeply affect Uruguayan economy. The consideration of efficiency wage model is particularly important when shocks lead to a reallocation of resources towards sectors intensive in unskilled labour. A subsidy on formal, unskilled labour could contribute to decrease informality and therefore increase GDP, but this type of policy need to be carefully implemented, because it may have negative effects on investment. Finally, the effects on poverty and income distribution obtained through microsimulations are consistent with the results of the CGE experiments.

Keywords: Uruguay, labour market, general equilibrium model, regional integration, efficiency wage, microsimulation, poverty

JEL classification: D58, I32, F15, F16, J41

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1. Introduction

In the nineties, with the sign of MERCOSUR agreement, Uruguay deepened its economic integration within the region and the trade liberalization process. As a consequence, trade within MERCOSUR increased significantly but also increased with the rest of the world. Trade openess led to a resource reallocation from manufacturing sectors towards services, affecting deeply labour market structure. The regional economic crisis that started with the Brazilian currency devaluation in 1999 led to a four-year economic recession, worsening labour market and poverty indicators.

The purpose of this study is to find out how the labour market is affected by external shocks, particularly those associated with the integration process or by changes in trade policies of the bloc. It intends to estimate the effects on specialization, trade, employment and wages stemming from those shocks or from changes in trade policies, taking into account the imperfections and specific features of the labour market in different sectors. It also pursues the identification of the impact on poverty and income distribution. In addition, it would try to evaluate policy options to lower the costs associated to this process, directed to improve employment.

The strategy consists on a review of the main characteristics of Uruguayan labour market and an estimation of wage differentials between sectors and labour categories in order to obtain the stylised facts to be considered in the model. Then, a CGE model was built with the purpose of running different scenarios of regional shocks, and trade and labour market policies. Finally, microsimulations were run in order to evaluate the impact of these shocks on poverty and income distribution.

In section 2 a brief overview of the Uruguayan economy is presented and the main features of the labour market are analysed, indicating the existence of imperfections that should be taken into account for the specification of the CGE model used in the analysis.

Section 3 describes the main characteristics of the CGE model, the way it was calibrated and the design of simulations carried out. It also presents the main aspects of the

microsimulations methodology that is adopted to analyse the impact on poverty and income distribution.

In section 4 we present the results obtained and finally in section 5 the main conclusions are drawn.

2. Economic overview

2.1 Recent economic performance

During the last 25 years Uruguay gradually adopted several reforms focused on the liberalization and opening of real and financial flows, in order to increase the ties of the Uruguayan economy with the world economy, to achieve macroeconomic stability and to set the market as the mechanism of allocation of resources. The process started in the mid-seventies, with great transformations in the financial sector but only minor progress in trade opening. By the end of the 70's, financial flows were completely liberalized, while trade flows reforms were carried out more gradually. Starting from a maximum of 150% in 1980, by January 1993 the highest tariff was set to 20%.

The 1990's were dominated by the creation of the MERCOSUR, an imperfect customs union among Argentina, Brazil, Paraguay and Uruguay. The creation of the MERCOSUR implied the existence of free trade within the bloc and the adoption of a common trade policy in relation to third countries. One of the crucial decisions in this matter was the enforcement of a common external tariff (CET), which was agreed in 1994 and enforced in 1995. The CET adopted varied between 0% and 20%, with an average of 11%. However, many exceptions to its application were accepted, and to the present the four countries still apply different external tariffs to some goods, mainly capital goods and computing and telecommunication goods. The full enforcement of the CET –due to 2010- means that Argentina, Paraguay and Uruguay would have to increase their tariffs on these goods until reaching the CET. These countries do not graciously accept this increase, as they are afraid it will hinder competitiveness in most sectors.

Since the creation of the MERCOSUR Uruguayan exports improved their access to a very large market (the sum of Argentina and Brazil). Trade within MERCOSUR increased significantly, and by 1998, 55% of Uruguayan exports of goods were destined to the bloc. This was in part because of the creation of the MERCOSUR, but also because the loss of competitiviness of Uruguayan exports to third countries, due to the overvaluation of local currency as a consequence of a policy of price stabilization based on exhange rate. Since similar stabilization policies were adopted in Brazil and Argentina, exports to those countries were still competitive.

The situation changed dramatically when the Brazilian currency started to float in January 1999, affecting Uruguayan exports directly and indirectly (through the Brazilian impact on Argentina). The share of Uruguayan exports of goods to Brazil declined from more than a third in 1998 to a little more than 20% in 2001. In 2002, financial crisis in Argentina also affected Uruguayan economy. The reduction of Argentine income level, the restrictions on credit access and the change in relative prices in that country had a negative impact on Uruguayan exports of goods and services. The total service exports (basically tourism) fell more than 35% in the first quarter of 2002 compared to the same period of 2001 (in 2001 80% of the tourists were Argentines). Exports of goods to Argentina dropped about 70% in the first semester of 2002 relative to the first semester of the previous year. The Argentine crisis had relevant effects on financial activity as well. By 2001, the share of deposit stock of non-residents from Argentina was high, but in February 2002 started an important deposit outflow with the withdrawal of non-resident deposits. The critical situation was worsened by fraud in three of the main private banks in Uruguay. By August, the deposit stock in the Uruguayan banking system had been reduced by 50% relative to the beginning of the year, which forced to abandone the exchange rate system in June 2002. A floating exchange rate was adopted, leading to a significant depreciation of the local currency. The exchange rate accumulated a total 106% increase from December 2001 to December 2002.

The 1990's were a period of economic growth, in contrast with the long run performance of the country: between 1990 and 1998 GDP increased by an annual rate higher than 4% (see Table 1). However, by the end of 1998 this process began to reverse and after the Brazilian

devaluation of January 1999 recession was completely installed. In 2003 recovery started, mainly driven by exports, which grew 18%. Uruguayan exports had an 80% competitiveness gain in relation to Brazil and other trade partners, as a result of the depreciation of the Uruguayan currency. Total GDP increased 2,2% in 2003 and 12,3% in 2004.

Table 1

Main indicators

Year	GDP a/	Annual inflation a/	Fiscal balance b/	Current account balance b/	Imp. goods & serv. b/	Exp. goods & serv. b/	Gross capital formation b/	Unempl. rate c/
1990	0,3	112,5	-3,0	2,0	18,10	23,53	12,20	8,5
1991	3,5	102,0	-1,8	0,7	17,86	20,69	15,13	8,9
1992	7,9	68,5	0,3	-0,8	19,63	20,45	15,38	9,0
1993	2,7	54,1	-1,7	-1,8	19,56	19,13	15,64	8,3
1994	7,3	44,7	-2,8	-2,3	20,38	19,77	15,87	9,2
1995	-1,4	42,2	-1,5	-1,3	19,10	19,00	15,41	10,3
1996	5,6	28,3	-1,4	-1,2	19,86	19,67	15,24	11,9
1997	5,0	19,8	-1,4	-1,1	20,54	20,55	15,22	11,4
1998	4,5	10,8	-0,9	-1,8	20,58	19,85	15,87	10,1
1999	-2,8	5,7	-4,0	-2,3	19,30	18,03	15,14	11,3
2000	-1,4	4,8	-4,0	-2,8	20,98	19,30	13,96	13,6
2001	-3,4	3,6	-4,3	-2,6	20,04	18,35	13,77	15,3
2002	-11,0	25,9	-4,2	3,1	20,01	21,97	11,52	16,9
2003	2,2	10,2	-3,2	-0,5	24,56	26,07	12,59	16,9
2004	12,3	7,6	-1,8	-0,8	27,94	29,65	13,29	13,1

Source: Elaborated with data from BCU and INE.

a/ Annual cumulative variation
b/ Percentage of GDP (current prices)
c/ Urban areas

2.2 Recent trends in the Uruguayan labour market

In the nineties, the economic reforms carried out in Uruguay, the increased openness and the creation of the MERCOSUR led to a restructuring process that determined changes in the composition of GDP as well as in the use of technology (Cassoni and Fachola, 1997; Croce, Macedo and Triunfo, 2000; Tansini and Triunfo, 1998a; 1998b). Between 1991 and 2002, the share of manufacturing employment fell strongly, from 21% to 13% of total

urban employment[4]. On the other hand, the share of services, especially in retail, restaurants, hotels and financial services, increased: these sectors, together with the construction sector, rose from 27,5% of total employment in 1986 to 39% in 2002. This, in turn, has impinged on the Uruguayan labor market, displacing workers from some economic activities and changing the requirements of the work force.

Four stylised facts characterized the evolution of the Uruguayan labor market in the nineties: a) a generalized increase in labor productivity (output per worker); b) an increase of the unemployment rate associated with the destruction of unskilled jobs; c) an increase in wage dispersion, with a relative improvement of skilled wages; d) an increase in informality. In this new decade, these trends have deepened.

As regards the skill level of workers[5], the unemployment rate is considerably lower for skilled workers, whereas unskilled workers show the highest unemployment rates. The unemployment rate in Uruguay climbed from 8.8% in 1991 to 16.9% in 2002. Even prior to the severe economic crisis that affected Uruguay between 1998 and 2002, the unemployment rate showed an increasing trend in a context of economic growth. This evolution differed clearly according to the education level of the labor force.

Another relevant change that occurred during the nineties was the reduction in public employment as a result of the ongoing state reform process. Public employment share in total employment fell from 24% in 1986 to 18% in 2002. However, at the same time public employment for skilled workers rised slightly. As a consequence, this structural change reinforced the effects of the changes observed in tradable sectors: greater destruction of unskilled jobs (UNDP, 2001) [6].

The changes in the productive structure affected not only the quantity, but also the quality of employment. Several studies suggest that precariousness, informality and

[4] In 2001 the share of manufacturing employment was 17%. Between 2001 and 2002 methodology to measure industry product was modified by the INE, so the fall in 2002 might be overvaluated.
[5] We consider that a worker is skilled if he has at least 12 years of formal education.
[6] In 1997-99, 22.400 unskilled and 5.600 skilled public jobs were destroyed. During the same period 3.600 new skilled jobs were created. The outcome was the destruction of 24.400 public jobs.

underemployment increased throughout the decade, especially for workers with low education level.[7] The destruction of low skilled jobs that took place both in the public sector and in the tradable sector drove unskilled workers towards employment in small productive units or self - employment and led to an increase in precariousness and informality (UNDP, 2001; Bucheli, 2005). In this context, informality became one of the most important imperfections among labour market: it affected more than one third of employed workers along this period.

3. Methodology

3.1. Labour market specification

As it was pointed out in the previous section, Uruguayan labour market presents serious problems of unemployment and informality. Therefore, we considered that these imperfections needed to be captured in the model. However, we needed to focus on one type of imperfection. Since one of the distinguishing features of Uruguayan labour market is the existence of a persistent wage differential between formal and informal jobs, we adopted a dual market labour approach.

The theory of dual labour markets is based on a two-tier regime where a primary and a secondary sector coexist with unemployment. Workers in the upper tier (primary sector) enjoy higher wages and fringe benefits; also, stability, union protection and labour regulation enforcement are more likely in this sector. Meanwhile, the low wage sector (secondary) market clears and workers in it are not able to underbid those in the primary sector. Rationing of jobs in the primary sector explains the existence of queues and the persistence of unemployment. On the other hand, the secondary sector provides flexibility to the economy, adjusting its size to fluctuations of the business cycle.

[7] Precarious workers are those private dependent workers who are not covered by social security, have an unstable job or receive no remuneration for their work. Informal workers are those not covered by social security. Underemployment comprises workers who work less than 40 hours a week but would be willing to work additional hours.

The efficiency wage model provides a microeconomic foundation for these features. Different versions propose a persistent wage gap and a negative relationship between the rate of unemployment and the upper tier wage. In the Shapiro-Stiglitz version, firms are interested in paying wages above the expected outside because of cost monitoring reasons. For the worker, the cost of losing his job increases with wage; therefore, higher wages encourage effort and disincentive shirking. Unemployment has the same effect because it affects the ease to find a new job in case of being fired.

The same results arise in versions based on "recruit, retain and motivate" reasons. On one hand, a high wage eases to fill vacancies, reduces the quit rate and motivates effort. On the other hand, high unemployment affects the likelihood of finding a new job if dismissed (and therefore, effort) and the ease of voluntary turnover (quit). The importance of retaining is also pointed in versions that focus on hiring and training costs or on adverse selection reasons -i.e the most productive workers find easily a better job outside-. In any case, firms find profitable to reduce the quit rate through higher wages; besides, unemployment affects both the ease of finding another job and the effect of wages upon quitting.

In the CGE model we assumed that an efficiency wage model might explain the wage gap between formal and informal workers. In order to estimate the wage gap we used the Continuous Household Survey (*CHS*) collected by the National Statistics Institute (*INE*) in 2003. We restricted the sample to wage earners and self-employed workers between 18 and 59 years of age. Informal workers are the ones who do not contribute to the social security system for the main occupation's information.

We made different estimations of the wage gap. First, we used a very simple econometric model: we regressed by OLS the log hourly wage on individual and labour characteristics, including a dummy variable that identified if the worker was formally employed.[8] The estimated dummy' parameter (*G1*) is a measure of the wage gap.

[8] We controlled personal characteristics (age, education, gender, marital status, geographical region), the type of occupation (public servants, size of the establishment of the private wage earners, self-employed who own some property and self-employed who does not) and other labour characteristics (part-time and industry).

Secondly, we used the usual way of decomposing wage differences proposed by Oaxaca (1973) and Blinder (1973). We estimated an earning equation for the formal workers and another one for informal workers. The difference of the characteristic's rewards –weighted by the mean of the formal workers- is interpreted as the mean wage gap (*G2*). Analogously, we estimated the difference between coefficients but weighted by the average characteristics of informal workers (*G3*)

This estimation ignores the endogeneity of the selection decision of being formal o informal. We expect unobservable individual characteristics to be correlated with being formal or informal (i.e. people with easy access to informal networks or to informal benefits could have more potential gains on being informal). To deal with this problem we estimated a switching regression model and used it to calculate the gap between the predicted wage of an average informal worker and the one he would have had in the formal sector (*G4*).

The results of the estimations are in Appendix 1. We report the different estimations of the wage gap in Table 1. The four alternative estimations suggest that the formal workers are highly remunerated.

Table 2

Estimated mean difference in earnings between formal and informal workers (log Wf – log Wi)	
Raw gap	0,85
Estimated gap	
G1	0,59
G2	0,65
G3	0,60
G4	0,52

In the next section a CGE model that captures this conclusions is presented.

3.2 The CGE model

In order to analyse the effects of several external shocks and some specific policies on the Uruguayan labour market, a Computable General Equilibrium (CGE) model was used. It is

based on the model by Laens and Terra (2000), with several changes regarding labour market behaviour, export demand and institutional design.

The structure of the core CGE model is quite conventional in terms of the analysis of trade-related issues, but an alternative specification is made regarding the labour market. We used two different versions of the model for the simulations: an efficiency wage model and a competitive labour market model.

The main features of this model are:

- It is a multi-sector model with 23 sectors. Among them, there are two special sectors. One of them gathers all the activities (mainly, public services and the financial sector) where employment and wages are fixed, because institutional arrangements and/or trade unions power are a deterrent to workers dismissal or to wage reductions. By law, public employment is fixed: no new public employers are hired, and the existing ones cannot be fired. Although trade unions could have been introduced in the model, our intention was to focus on labour market duality between formal and informal workers. Trade unions modelization might be included in a future specification of the model.
- The other special sector is an informal sector that produces one type of good destined 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[9]. Government savings is obtained as a residual.

- On the production side, we use 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 CES function that combines capital and composite labour. Then, composite labour is obtained combining with a CES skilled and unskilled labour. In the informal sector, value added is composed only by unskilled labour.
- 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)[10]. 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 that imports and exports of goods and services maintain the difference existing in the benchmark data. 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 and unskilled labour (the labour market is segmented by qualifications). The supply of each factor is fixed and there is no international mobility. Skilled labour can only be employed in the formal sectors, while unskilled labour can also be employed in the informal sector.
- In the model with efficiency wages, this behaviour is applied to all formal activities, except for those in the fixed employment sector, which we named APUBLIC, because it is mainly composed of public activities. Unemployment is

[9] In 2001 social security transfers represented nearly 83% of total government transfers to households. In 1989 a constitutional reform established that social security benefits are adjusted to the evolution of Average Wage Index.
[10] Following Cox specification (1994).

fixed, so when unskilled workers are fired from the efficiency wage sectors, they go to the informal sector where they receive a lower wage. The specification of efficiency wage behaviour follows Thierfelder and Shiells (1997).

The model was run using GAMS.

3.3 Calibration of the CGE model

The model was calibrated using a Social Accounting Matrix (SAM) with data for the year 2000. It was taken from Barrenechea, Katz and Pastori (2004). Originally, the SAM included 30 different activities and 36 different commodities. Even though this disaggregation was quite appropriate for this study, some adjustments had to be made.

Specifically, it was necessary to show the differences in labour, according to the qualification of workers and to their status of formality or informality. Therefore, labour was separated into skilled and unskilled labor. Among skilled workers, informality is not easily available, so it was assumed that skilled labour is always formal. Information about qualifications and formality of workers was taken from the 2003 Continuous Household Survey (CHS) collected by the National Statistics Institute (INE). Workers with twelve or more years of formal education were considered skilled workers.

In order to study the labor market, it was also necessary to separate between private and public activities, because in the public sector there are rigidities concerning both wages and employment. Some activities, which are carried out by public and private agents (for example, education or electricity supply), needed to be decomposed. Therefore, a new activity was created, including all activities carried out by the public sector[11]. This sector combines skilled and unskilled labour, such as private sector, but public employment is considered fixed. To separate public from private activities, information was also taken from the 2003 CHS.

[11] That is: Electricity and Water Supply, Petroleum Refinery, Communications, Postal Service, Financial Services and Educational Services.

In addition, government final consumption was disaggregated in the new matrix. In the original SAM, government final consumption expenditure was included in a miscellaneous sector called "other services". Final consumption expenditure of the government was estimated from National Accounts. Then, final consumption expenditure was disaggregated according to the information provided by the 1995 SAM (Lorenzo, Osimani and Caputti, 1999; Laens and Terra, 2000).

The rest of the world needed to be disaggregated as well. Argentina and Brazil were separated from the rest of the world, creating three foreign agents. In this case, data was taken from National Accounts and trade statistics from the Central Bank (BCU).

Finally, an informal sector was created besides those originally considered in the SAM. It was assumed that the informal sector produces a composite good of all the activities in which informal labour was identified. This "informal good" is produced entirely for final consumption of households. It was assumed that value added of the informal sector includes only wages. The total amount of informal sector wages was estimated with data from the CHS. As a result, informal sector includes activities such as agriculture and other primary activities, construction, retail, and textiles and clothing, which have an important component of informality.

3.4 The microsimulations methodology

The CGE model provides some insights about the poverty effects of the shocks and policies that were simulated. However, the combination of these results with a microsimulation methodology provides more precise information about poverty and income distribution, by tracking the economy-wide changes at the household level. Several approaches have been developed with this purpose, as shown by Bourguignon, Pereira de Silva and Stern (2002).

The microsimulations are based on household data but there is no need to reconcile this data with the SAM because the procedure only needs information about changes in wages, employment and unemployment. The method assumes that changes in the labour market

can be replicated by a random selection procedure, which imposes counterfactual changes in labour market parameters calculated for the benchmark year. This approach follows Paes de Barros and Leite (1998), Paes de Barros (1999), Frenkel and González (2000), Ganuza et al (2002) and Ganuza et al (2004). It was applied for the case of Uruguay by Bucheli et al (2002) and by Laens and Perera (2004). The SPSS program used in this paper is the same one used in the latter work.

The rationale for using microsimulations is that a CGE model captures only partial distribution of income between families, therefore making it difficult to see the real impact of shocks or policies on income distribution and poverty. A crucial assumption adopted in this methodology is that a person's position in the labor market is the main determinant of his income and poverty status.

The procedure takes CGE results as inputs. Labor market structure is considered as a function of seven parameters: participation rate, unemployment rate, wage structure, overall average wage, worker's education level and structure of employment (sector of activity and occupation category). In this study, the participation rate is fixed, so it is not considered for the microsimulations. In turn, sector of activity is defined in terms of formal or informal activity.

Once the changes in the labor market parameters are obtained from the CGE results, the microsimulation methodology is applied. The procedure uses random numbers to simulate the changes in the labor market structure that are consistent with the parameters introduced. On average, the effect of the random changes will reflect the impact of the new (simulated) parameters in the labor market. The microsimulations are repeated a large number of times using Monte Carlo numbers and allowing the determination of confidence intervals for the indicators of poverty and income distribution. In each simulation, changes on poverty and income distribution are measured through the percentage of population under the poverty line, the poverty gap, the Gini coefficient and the Theil coefficient. Data from CHS for the year 2000 was used.

For each scenario, several changes in labor market structure were simulated, first separately, and then sequentially. The idea behind establishing a sequence is that changes in labor parameters follow some order, which is not neutral. The commonly accepted sequence is the following: first the person decides whether to participate or not in the labour force; then the market decides whether he or she will be employed or not; then the person decides whether to work in the formal or in the formal sector and this determines a certain wage level and, in the aggregate, the average wage. Finally, labor market structure by education level is defined. This sequence was applied in the three models considered. As unemployment is fixed in the model, the corresponding rate remains unchanged. The analysis was made taking the whole sequence into account.

4. Simulation design and results

4.1 Simulation design

In section 2 we pointed out that the increasing openness and the integration of the Uruguayan economy to the MERCOSUR augmented its vulnerability to external shocks, particularly those originating in Argentina or Brazil. With that idea in mind, we carried out some simulations in order to show how and why some of the forces at work during the 2002 crisis affected the Uruguayan labour market.

As it was explained in section 2 the crisis had many components: recession in Argentina and Brazil, change in relative prices that affected Uruguayan exports to those countries, credit constraints, financial turmoil, external debt growth, capital flight, etc. It is impossible to evaluate with our CGE the specific weight of each of these factors in the genesis and the deepening of the crisis, particularly because there was a very significant financial component, which cannot be tracked by this model.

Nevertheless, we chose to simulate two relevant components of the 2002 crisis: the change in relative prices vis-à-vis the main trade partners (due to devaluations in those countries) and the foreign savings constraint. In order to assess the effects of the change in relative prices that occurred when Argentina abandoned the currency board regime, we simulated a 40% decline in domestic prices nominated in dollars in Argentina and 7% decrease in the

price of imports from that origin (ARGRP scenario), which was what really happened between 2000 and 2002 in Argentina[12]. In order to compare the effects of the shocks originating in one or the other MERCOSUR partner, we simulated an identical change in prices in Brazil (BRARP).

The third simulation that we carried out was a restriction in foreign savings. In 2000 the Uruguayan current account was running a deficit, which was financed by capital inflow from the rest of the world. In 2002 the situation reversed and no capital inflow was available, so a severe adjustment was needed to obtain a current account surplus. Therefore, in this simulation we fixed in zero the current account balance (EXTSAV).

As it was mentioned in section 2, the MERCOSUR is an imperfect customs union because the common external tariff has not been fully enforced in the four countries. We simulated its full enforcement in order to assess the effects that it might have on the Uruguayan labour market, especially because the rise in capital goods tariffs might have a negative effect due to a competitiveness loss (CET).

Finally, we simulated a specific labour market policy. Assuming that a reduction in the relative cost of labour might improve employment, we simulated a 10% direct subsidy on formal employment of unskilled labour (DIRTAX).

Table 3 summarizes the five experiments, and show how variables or exogenous parameters are affected. The complete model equations are presented in Appendix 2.

Table 3

Simulation scenario	**Variable or exogenous parameters**	**Variation (%)**	
ARGRP	Domestic price index ($DP_{ARG\ i}$)	-40%	
	Exports price from Argentina ($PW_{ARG\ i}$)	-7%	
BRARP	Domestic price index ($DP_{BR\ i}$)	-40%	
	Exports price from Brazil ($DP_{BR\ i}$)	-7%	
EXTSAV	Current account balance (B)	-100%	*
CET	Common external tariff (t)		
DIRTAX	Labour taxes (trab)	-10%	

* In benchmark the current account balance was 4% of GDP

[12] Data was taken from Indec- National Institute of Statistics and Censuses of Argentina.

The results of these five simulations with the CGE model are presented in table 4 –variation of main macroeconomic variables- and table 5 – effect on labour market variables.

4.2 Simulations of regional shocks and results

These experiments show the vulnerability of the Uruguayan economy to regional shocks, which has increased due to geography and to the deepening of the integration process with the MERCOSUR countries.

Table 4

Macroeconomic variables for each simulation
Percent Variation

	Relative prices change with Argentina	Relative prices change with Brazil	External Savings Restriction	Common External Tariff	Subsidy to Unskilled labour
			Perfect competition model		
Absortion*	-0,38	-0,24	-4,42	-0,23	-0,03
Household Consumption*	-0,14	-0,12	-0,66	-0,18	1,65
Investment*	-2,24	-1,19	-31,32	-0,77	-10,00
Exports*	-7,26	-2,79	9,97	-3,18	-0,44
Imports*	-5,95	-2,04	-11,82	-2,54	-0,36
Real GDP	-0,48	-0,33	-0,54	-0,29	-0,03
Real Exchange Rate	4,19	2,15	1,45	-0,36	-0,81
Export Price	-0,12	-0,09	0,00	0,00	0,00
Import Price	-2,96	-2,44	0,00	0,00	0,00
Consumer Price	0,05	0,00	-0,25	0,09	-0,21
			Efficiency wage model		
Absortion*	-1,13	-0,30	-4,59	-0,22	0,20
Household Consumption*	-0,28	-0,23	-0,58	-0,17	1,85
Investment*	-7,38	-1,03	-33,13	-0,75	-9,39
Exports*	-8,99	-4,62	10,25	-2,78	-0,34
Imports*	-8,22	-4,27	-11,91	-2,14	-0,26
Real GDP	-1,11	-0,27	-0,64	-0,29	0,19
Real Exchange Rate	4,37	2,57	1,57	-0,45	-0,60
Export Price	-0,40	-0,29	0,00	0,00	0,00
Import Price	-2,67	-2,16	0,00	0,00	0,00
Consumer Price	0,04	0,03	-0,14	0,09	-0,17

A change of relative prices in any of the MERCOSUR partners generates a GDP decline in Uruguay, a reduction of exports and imports and a decrease in investment. The reduction of both exports and imports is due to our choice of model closure, which fixes current account balance. When export demand falls as a consequence of the relative price change with the trading partner, imports fall as well, and adjustment is through exchange rate, with a devaluation of local currency.

The macroeconomic impact of the same change in relative prices hits harder when it happens in Argentina than when it happens in Brazil. This could be explained by the relative importance of exports to each country in the benchmark: 24% of total exports were destined to Argentina, 17% to Brazil and 59% to the rest of the world. In turn, the share of imports from those origins was 26%, 18% and 56%, respectively.

This result should be taken cautiously because it is not necessarily true that a shock coming from Brazil will always have lower effects on the Uruguayan economy than a shock from Argentina. This result is highly dependent on the prevailing macroeconomic conditions, as the region has been affected by severe instabilities and this has changed significantly the trade composition by origin or destination. As long as Brazil increases its relative importance as trade partner for Uruguay, the impact of a relative price change in that country could increase substantially.

The impact of an Argentine relative price change is higher when efficiency wages and the existence of an informal sector are assumed. In this case, real GDP falls by 1.1%, while it decreases 0.38% when the neoclassical assumptions are adopted. The variation of Argentine relative prices generates a very significant reduction of investment in Uruguay, which would reach 7.4% in the efficiency wage model and 2.2% in the perfect competition model. Investment declines because government savings decline (as government revenue gets lower) and so do household savings.

Table 5

Labour Market Variables for each simulation
Percent Variation

	Relative prices change with Argentina	Relative prices change with Brazil	External Savings Restriction	Common External Tariff	Subsidy to Unskilled labour
			Perfect competition model		
Informal Emp	-0,48	0,21	0,48	-0,01	-4,97
Unskilled Emp	0,10	-0,04	-0,10	0,00	1,02
Unskilled Wage	0,34	-0,33	-1,14	-0,17	6,98
Skilled Wage	-0,95	0,20	-0,33	-0,23	0,07
			Efficiency wage model		
Informal Emp	-0,28	0,19	0,37	0,02	-4,36
Unskilled Emp	0,12	-0,08	-0,16	-0,01	1,86
Wage Differential	0,16	-0,11	-0,21	-0,01	2,75
Unskilled Wage	0,00	-0,42	-0,94	-0,19	6,50
Skilled Wage	-1,00	0,09	-0,23	-0,23	-2,76

On the contrary, a change of relative prices with Brazil has greater impact on the Uruguayan GDP when the perfect competition model is used. This could be explained by the factor intensity of goods traded, which is quite different from one country to the other. Trade flows with Argentina are more intensive in skilled labour than trade flows with Brazil (see tables 6 and 7). Therefore, a competitiveness loss with Argentina generates a reallocation of resources towards industries that make an intensive use of unskilled labour and capital (see table 8).

Table 6

Factor Intensity of export by destination

	Argentina	Brazil	Rest of the world
Skilled labour / Unskilled labour	0.68	0.30	0.37
Capital / Unskilled labour	0.94	1.47	1.82

Table 7

Specialization and Factor Intensity by sector

	Skill Labour/ Non Skill Labour	Capital/ Non Skill Labour	Trade Balance (millions of U$S)			% of Exports			% of Imports		
			ARG	BRA	RM	ARG	BRA	RM	ARG	BRA	RM
Agriculture & agroindustries	0.08	0.67	1	338	964	11.9	55.9	66.1	12.1	14.7	9.4
Other manuf. goods	0.37	1.33	-411	-330	-1289	25.8	34.7	17.6	63.7	73.1	70.6
Services	1.33	1.06	434	-24	-162	62.3	9.4	16.4	24.2	12.1	20.0
Total	1.00	1.00	23	-16	-487	100	100	100	100	100	100

We have adopted the assumption that the skilled labour market is perfectly competitive while the unskilled labour segment is subject to efficiency wages, so that an increase in demand for unskilled labour and a reallocation of resources to those sectors make the results differ more than in the case when the reallocation of resources operates in the opposite direction.

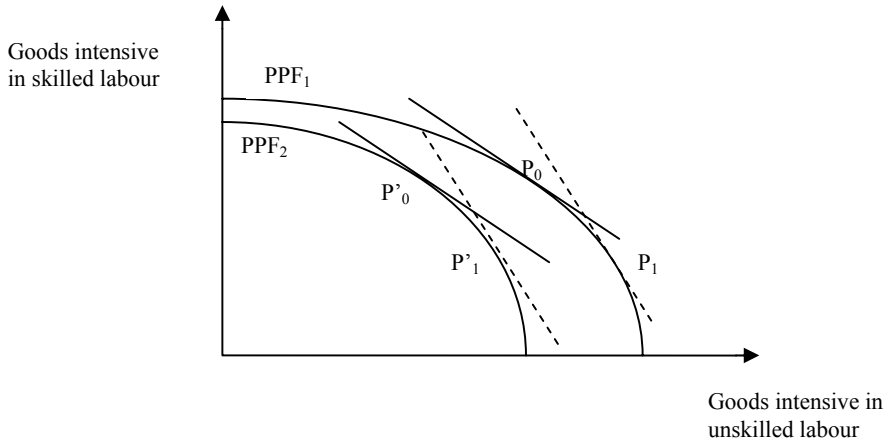
In fact, when there are reasons for paying an efficiency wage, there is an inefficient resource allocation. The production possibilities frontier shifts to the origin when specialization becomes biased towards the production of goods intensive in unskilled labour. Therefore, the larger the specialization in goods intensive in unskilled labour, the greater the inefficiency generated by the existence of efficiency wages and the greater the difference in GDP in relation to an economy where the labour market is perfectly competitive.

Table 8

Output shares and variation by sector

	Percentages			
	AGRI	MANUF	SERV	INFORMAL
Share of sector in total output	15,4	16,4	63,8	4,4
		Argentina RP		
Perfect Comp	5,1	2,4	-0,8	-0,3
Efficiency Wage	6,1	1,5	-1,9	-0,2
		Brazil RP		
Perfect Comp	-2,9	-1,6	0,2	0,1
Efficiency Wage	-3,6	-1,4	0,3	0
		External Savings Restriction		
Perfect Comp	2,1	0,8	-1,5	0,5
Efficiency Wage	2,8	0,9	-1,8	0,3
		CET		
Perfect Comp	-0,6	1,2	-0,1	-0,1
Efficiency Wage	-0,8	1	-0,2	0
		Subsidy to Unskilled labour		
Perfect Comp	2	0,3	-0,4	-2,3
Efficiency Wage	1,1	0,2	0	-1,9

In order to simplify the problem, we can gather production in two big sectors, according to their intensity in skilled or unskilled labour. The following graph illustrates the argument:



The curve PPF_1 is the production possibilities frontier when the labour market is perfectly competitive, while PPF_2 shows the production possibilities frontier when there are

efficiency wages in the unskilled labour market segment. Production possibilities are reduced more as production gets more specialized in goods that are intensive in the use of unskilled labour. P_0 and P'_0 show the best production combinations under perfect competition and under efficiency wages for the initial relative prices. The graph shows that as relative prices change, favoring an increase in the production of goods intensive in unskilled labour, the production combinations shift to P_1 and P'_1, respectively. It can be observed that P_1' is more distant from P_1 than P_0' is from P_0, due to the bias in the production possibilities frontier. This is explained because when employment increases in the efficiency wages sector, there is an efficiency loss due to an increase of the wage differential.

Table 4 shows that the Argentine change in relative prices generates a very significant reduction in Uruguayan exports and this brings about an increase in specialization in goods intensive in unskilled labour (see table 7). In 2000, 62% of total exports to Argentina were services (tourism, financial services, transportation, etc.), many of them intensive in the use of skilled labour (especially, financial services).

Table 5 shows the corresponding effects of these shocks on the labour market. In perfect competition, a change in relative prices with Argentina generates the opposite effect than the same change in Brazil. Labour demand increases and so does the wage of unskilled labour, relative to skilled labour wage. In the version of the model with efficiency wages something similar occurs.

The experiment that assumes an external savings restriction, due to the uncertainty prevailing in the region, generates a very significant decline in imports and investment, while there is an increase in exports. The results on the labour market are similar to those obtained in the case of a Brazilian change in relative prices, but their size is bigger. In this case, there is also a reallocation of resources towards the traditional exporting sectors, which are intensive in unskilled labour. Sectors like meat packing, dairy products, rice and other typical exporters, increase their unskilled labour demand in more than 5 percent points. However, the reduction of investment brings about a 25% decrease in unskilled

labour demand in construction as 75% of this sector's output is destined to investment. This leads to a reduction of the service sector, but this reduction is concentrated in service sectors that are intensive in unskilled labour. Therefore, the unskilled labour demand falls, increasing informality. In addition, the external savings decline generates a fall in the payments to all factors (see table 5).

4.3 Simulation of MERCOSUR deepening and results

The simulation of the full enforcement of the MERCOSUR common external tariff (CET) implies an increase in protection in the Uruguayan domestic market. Its global impact is scarce (see table 4 again). Absorption, household consumption, trade and GDP fall, and this happens in the two versions of the model. There is a reallocation of resources towards the manufacturing sector (chemicals and other import substituting industries), which makes more intensive use of capital, but the specialization changes are slight (see table 8 again). The increase in protection brings about an anti-export bias, so agriculture falls. Within the services, the sectors that grow are commerce and transportation, but other services fall and so does health services, hotels and gas.

In the labour market a wage decrease is observed, mainly for skilled workers. In the efficiency wage model, there is an increase in informal employment (see table 5 again). Therefore, the CET approved by the MERCOSUR would not have a positive effect on employment in Uruguay. It would protect workers in the manufacturing sector (where employment increases) but it would harm global employment.

4.4 Impact of employment policies

We tried to analyse the impact of some policies that could compensate for the negative effects on unskilled labour wages and informal workers, which were found in the previous experiments. Thus, a 10% subsidy was simulated in the case of formal employment of unskilled workers (DIRTAX). The rationale for this type of policy stems from the existence of efficiency wages, which leads to lower employment of unskilled workers.

This policy would have a low impact on absorption and trade and it would increase household consumption, but investment would fall (see table 4 again). Even though global income increases, savings do not increase in the same proportion, because this policy favors lower income households, increasing their income more than proportionately and these households have lower propensity to save. On the other hand, it has a strong fiscal impact, as government expenditure and deficit increase. This explains the investment decline. Table 9 shows the evolution of income for every agent. In the poorest households income increase by 3%, while in the richest households, it only increases 0.5%. In turn, net government income (revenue minus the subsidy cost) fall almost 6%.

Table 9

Income variation as a result of subsidy on unskilled labour
Percentages

	Perfect Competition	Efficiency Wage
Household average	1,5	1,7
First decile	2,4	3
Second decile	2,6	3,1
Third decile	3,2	3,6
Fourth decile	2,6	2,9
Fifth decile	2,3	2,6
Sixth decile	2,3	2,6
Seventh decile	2,4	2,6
Eight decile	2,1	2,3
Nineth decile	1,2	1,3
Tenth decile	0,4	0,5
Government	-5,9	-5,7

In the perfect competition model, this policy has a negative effect on GDP, due to its negative effects on efficiency and resource allocation, but there is a positive effect on GDP in the model with efficiency wages, because this policy tackles the core of the market imperfection: the demand for unskilled workers is below the optimum because there is a cost associated to monitoring, hiring or training.

In the labour market, a very significant increase of unskilled labour demand is observed, which is translated into higher employment of unskilled workers in the formal sector and a rise in their wage (see table 5 again). In perfect competition, the wage of unskilled workers rises 7%, while this rise is 9.4% in the efficiency wage model. This is consistent with the informality decline of -2% in the efficiency wage case. In addition, these changes increase the relative wage of unskilled workers.

Consequently, even though this type of policy seems appropriate to increase efficiency and improve income distribution, when the efficiency wage hypothesis is valid, it may have perverse long run effects. This is so, because investment falls and because there is a disincentive to human capital accumulation. Both aspects might hinder economic growth in the long run.

4.5 Impact on income distribution and poverty

In order to analyse the impact on poverty and income distribution of the shocks simulated with the CGE, we ran microsimulations for two cases: the external savings restriction (EXTSAV) and the subsidy to formal employment of unskilled labour (DIRTAX). In both cases the microsimulations were run from the CGE results obtained with the two different versions of the model. We chose these two cases because they are those with the greatest impact on employment, informality and wages.

For each microsimulation, changes on poverty are measured by two indicators: the percentage of people under the poverty line and the poverty gap that shows the average distance between their income and the poverty line. Income distribution is measured with two well-known indicators: the Gini coefficient and the Theil coefficient. Table 10 shows the results obtained from these microsimulations. As it can be observed, all the results are significant with a 95% confidence interval.

Table 10

Microsimulation results*
Percentage variations

	Base year values (%)	Perfect competition model		Efficiency wage model	
		External savings restriction	Subsidy on unskilled employment	External savings restriction	Subsidy on unskilled employment
Population below poverty line (P0)	17,8	1,9	-8,3	1,1	-7,7
Poverty gap (P1)	5,6	1	-9,5	1,3	-7,7
Gini coefficient	44,2	0,1	-1,4	0,2	-1,9
Theil coefficient	35,5	0,3	-2,8	0,7	-3,9

*All results are significant with a 95% confidence interval

The restriction on external savings increases the share of the population below the poverty line and the inequality in income distribution, whereas a subsidy on unskilled labour employment in the formal sector has the opposite result. This is consistent with the changes in relative wages between skilled and unskilled labour found in the CGE results.

In the efficiency wage model, a reduction in external savings leads to an increase in poverty: the population below the poverty line increases 1,1%. In addition, income distribution deteriorates, as the Gini coefficient increases by 0,2% and the Theil coefficient 0,7%. The results obtained with the perfect competition model are very similar.

The microsimulations based on the CGE results for the subsidy on formal employment of unskilled labor, show a positive impact on poverty and income distribution. The population below the poverty line declines -8,3% in the perfect competition model –7,7% in the case of the efficiency wage model. Income distribution also improves, as the Gini coefficient is reduced by -1,4% and -1,9%, respectively. This might be explained by the significant rise of unskilled wage when this type of policy is implemented: in the efficiency wage model, unskilled wage rises 6,50% while the wage differential between formal and informal unskilled workers rises 2,75%.

5. Conclusions

The analysis of the Uruguayan labour market shows clear evidence of the existence of wage differentials between sectors and labour categories. These differentials are wider between workers employed in the formal or in the informal sector and between skilled and unskilled labour. These characteristics of the Uruguayan labour market indicate the need to incorporate labour market imperfections in the analysis of external shocks and trade policies with a CGE model.

Minimum wage is not effective in Uruguay and labour unions are not strong enough to explain those differentials, except in a few activities, mainly the public sector. Therefore, based on this evidence, we assumed the existence of efficiency wage behavior in the private formal sector.

In this context, we constructed a CGE model in which we distinguished for kind of workers. First, we distinguished between skilled and unskilled workers. Second, there is a group of workers in a fixed employment sector, mainly public sector. Then, as informality is not important for skilled workers, we considered that duality affects only unskilled workers. When unskilled workers are fired from the efficiency wage sectors, they go to the informal sector where they receive a lower wage.

Different simulations were carried out with two versions of the CGE model: perfect competition and efficiency wage. In the second model it was assumed that the labour market segment for skilled labour operates without distorsions, while unskilled labor behaves in an efficiency wage mode. This assumption is reasonable, as both unemployment and informality are low for skilled labour. The perfect competition model was run as a reference.

In the efficiency wage model, an extreme assumption was adopted concerning the displacement of unskilled workers. It was assumed that all displaced unskilled workers went to the informal sector. In fact, some of them remain unemployed.

One clear conclusion of the simulations carried out in this paper is that the MERCOSUR economies deeply affect the Uruguayan economy through changes in relative prices. The study shows that the same shocks on relative prices are more important for Uruguay when they originate in Argentina than when they occur in Brazil. However, this result should be taken cautiously because it is highly dependent on the composition of trade with each of those partners. In the benchmark year trade of goods and services was more important with Argentina, which explains the greater impact of shocks from that origin.

Similarly, a restriction on external savings as a consequence of the instability in the region has significant effects on the Uruguayan labour market. On the contrary, the full enforcement of the common external tariff approved by the MERCOSUR does not have an impact of relevance.

The four first simulations show the impact that macroeconomic instability of the region can have on Uruguayan economy. Both the effect of changes in relative prices with Argentina and Brazil and an external savings restriction are significantly larger than a tariff change. Therefore, it is important for Uruguay the implementation of policies that tend to reduce the share of the region in total trade, such as the reduction of the CET, or free trade agreements with third markets (FTTA, EU-MERCOSUR agreement). At the same time, a main objective of Uruguayan macroeconomic policies should be to avoid significant changes in relative prices with the main trading partners.

The consideration of labour market imperfections is particularly important in the cases where the simulations lead to a reallocation of resources towards sectors intensive in the use of unskilled labour. In that case, the increase in the wage premium implies an efficiency loss, which is larger the more specialized is the economy in sectors intensive in unskilled labour.

The simulation of a subsidy on formal employment of unskilled workers shows that despite the increase in the wage premium, there is an increase in GDP due to the efficiency gain derived from the decline of informal employment or unemployment. The introduction of a

subsidy stimulates demand for unskilled labour, thus compensating the demand reduction caused by the inefficiency derived from the wage premium. Even though this policy leads to an improvement in employment and income distribution, it generates a decline in investment and a disincentive to human capital accumulation, which could be harmful for long run growth.

However, this kind of policy could be implemented but more focused on specific workers and with a lower tax rate. In this way, adverse macroeconomic effects in the long run could be avoided, and informal, low productivity employment could be reduced. With this purposes, a more disaggregated CGE model could contribute to evaluate the impact of more focused policies in the future.

Finally, the effects on poverty and income distribution obtained through microsimulations are consistent with the results of the CGE experiments. A restriction in foreign savings has a negative effect on both. On the contrary a policy that introduces a subsidy on formal employment of unskilled labour, reduces the percentage of population under the poverty line and improves income distribution.

The evidence presented in this paper show the importance of taking into account the existence of imperfections in the labour market. The effects of external shocks, as well as the impact of some policies, are clearly different in the presence of those imperfections. This fact emphasizes the need to make an appropriate diagnosis of the labour market when modeling the economy of a particular country.

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Appendix 1

Wage gap between formal and informal workers

Even if there is not an accepted accurate definition of informality, the term is often used to refer to economic activities that are no illegal but avoid government regulations. From the labour perspective, workers are considered to be informal when they are not covered –in practice- by labour regulations. These regulations include the different aspects of the labour legislation, taxation and the entitlement to certain benefits as the paid sick leave or the retirement pension.

Because of the broad set of aspects covered by labour regulations, it is necessary to choose an operational definition. Four our purpose, workers are considered informal when they have a job but are not contributors of the social security system. This contribution is the only regulation that is mandatory to the whole labour force regardless the occupation. In turn, it entitles to receive a pension during retirement. Besides, the system provides other benefits -less important in coverage and spending- to some contributors during their working life, as health benefits, family allowances, pensions for the widow and children in case of decease, among other ones.

The data

To estimate the wage gap between formal and informal workers, we used the Continuous Household Survey (*CHS*) collected by the National Statistics Institute (*INE*) in 2003. The *CHS* is a survey carried out in urban areas that inquires about personal and labour characteristics (age, sex, marital status, schooling, hours of work, occupation, industry, etc.) and income received the preceding month classified by sources (wages, pensions, interest payments, etc).

We restricted the sample to the wage earners and self-employed. This means that, in one hand, we dropped: people who work in a family enterprise without receiving a pay, owners of the firms (regardless the size) and members of cooperative units. These groups represent around 5% of the active population.

We also constrained the sample to workers of 18 to 59 years old, who represent 10% of the labour force. The bottom border was chosen because there are specific regulations for younger than 18 years old (the minimum legal work age is 14). Respect to the top border, 60 years old is the minimum required retirement age.

In order to classify a worker as formal or informal we used his status of contributor to the security system reported for the main occupation's information. Accordingly, we worked with the earnings and characteristics of the main job.

The earnings were calculated as the sum of in-cash and in-kind monthly regular labour income divided by 4.2 (number of weeks in a month) times the hours worked the preceding week. The monthly regular labour income included: i) the regular earnings reported in the CHS, ii) the monthly in-the-job health benefits estimated by INE and informed in the CHS, iii) an estimation of the so-called thirteenth wage and iv) an estimation of a pecuniary benefit perceived in holidays.

Respect to the estimation of the health benefits, the CHS inquires if the worker receives the fee required to be assisted in the private health system; it also reports if the employer receives another fees. For the estimation, the fee is valued as the price of the ordinary one.
The thirteenth wage is the right of private and public wage earners to receive an extra-monthly-wage during a year. The CHS reports if the worker receives this benefit in his main job. In the case of positive answer, we added an amount equivalent to 1/12 of the reported monthly in-cash regular wage.

Specifically for wage earners of the private sector, the law establishes a pecuniary benefit to be received for holidays. The CHS does not collect information about this benefit. To estimate it, we added an amount equivalent to 1/18 of the reported monthly in-cash regular wage when the worker was a private wage earner and reported to receive a thirteenth wage.
We made different estimations of the wage gap between formal and informal workers.

First, we used a very simple econometric model: we regressed by OLS the log hourly wage on individual and labour characteristics, including a dummy variable that identified if the worker was formally employed. Let W be the wage of a worker, X its observable characteristics and F a variable than has value1 when the worker is formal (contributes to the social security system):

$$\ln W = \beta X + G1F + \varepsilon \quad (1)$$

The estimated dummy' parameter *G1* reflects the wage gap among formal and informal workers.

Secondly, we used the usual way of decomposing wage differences proposed by Oaxaca (1973) and Blinder (1973). We split the sample in two sub-samples, one of formal workers and other one of informal workers and we estimated an earning equation for each one. Let W be the wage of a worker, X its observable characteristics and *f,i* two sub-indexes that denote respectively formality and informality:

$$\ln W_f = \beta_f X_f + \varepsilon_f \quad (2)$$

$$\ln W_i = \beta_i X_i + \varepsilon_i \quad (3)$$

We assume that ε_j *(j=i, f)* is an error term with a normal distribution with zero-mean and we estimate both equations by OLS. Denoting the mean of the variables with a bar and making some calculations, we can decompose the raw gap between sectors as:

$$\left(\ln \overline{W}_f - \ln \overline{W}_i\right) = \left(\overline{X}_f - \overline{X}_i\right)' \hat{\beta}_f + \overline{X_i}' \left(\hat{\beta}_f - \hat{\beta}_i\right) = \left(\overline{X}_f - \overline{X}_i\right)' \hat{\beta}_i + \overline{X}_f' \left(\hat{\beta}_f - \hat{\beta}_i\right) \quad (4)$$

Th e last of the components reflects the wage difference that is not explained by independent variables but by the coefficients of the earnings equations. It may be interpreted as the wage gap valuated in the mean of the formal worker's characteristics. An analogous decomposition allows estimating the wage gap as the difference between coefficients but weighted by the average characteristics of informal workers.

$$G2 = \overline{X}_i' \left(\hat{\beta}_f - \hat{\beta}_i\right)$$

$$G3 = \overline{X}_f' \left(\hat{\beta}_f - \hat{\beta}_i\right)$$

This estimation ignores the endogeneity of the selection decision of being formal o informal. We expect unobservable individual characteristics to be correlated with being

formal or informal (i.e. people with easy access to informal networks or to informal benefits could have more potential gains on being informal). One strategy to deal with this kind of problems consists on estimating a switching regression model.

A latent variable F* defines a variable F that takes value 1 when the worker is formal and 0 when he is informal. The variable *F** depends of two different types of characteristics: those that affect the level of earnings and hence the choice of being formal or informal (*X*) and those that have a direct effect on this choice (*Z*). The model is completed with two wage equations:

$$F^* = \mu X + \pi Z + \eta \quad (5)$$

$$F = 1 \ \ if \ \ F^* > 0 \ ; \ F = 0 \ \ otherwise$$

$$\ln W_i = \alpha_i X_i + \omega_i \quad if \ \ F = 0 \quad (6)$$

$$\ln W_f = \alpha_f X_f + \omega_f \quad if \ \ F = 1 \quad (7)$$

The disturbances η are potentially correlated with ω_i and ω_f. We assume that they have a trivariate normal distribution and we do a jointly estimation using the full-information maximum likelihood method. The wage gap between formal and informal workers is estimated by calculating the predicted difference in earnings. Similarly to the OLS estimations, we estimate two gaps:

$$G4 = \overline{X}_i \, ' \left(\hat{\alpha}_f - \hat{\alpha}_i \right)$$

$$G5 = \overline{X}_f \, ' \left(\hat{\alpha}_f - \hat{\alpha}_i \right)$$

Results

The results of the earning equation proposed in equation (1) are reported in column (A) of Table 1. We controlled personal characteristics (age, education, gender, marital status, geographical region), the type of occupation (public servants, size of the establishment of the private wage earners, self-employed who own some property and self-employed who does not) and other labour characteristics (part-time and industry). In columns (B) and (C) we report the results of the estimation of equations (2) and (3). Finally, the results of the switching regression model estimations appear in the last columns. The signs of the effect of the usual explanatory variables included in the earning equation are the expected ones:

labour income increases with education, rises with age at decreasing rates and is higher for married people and for men.

We report the predicted difference in earnings in Table 2. The five alternative estimations suggest that the formal workers are highly remunerated.

Table 1. Regression estimates results.

	OLS regression estimates			Switching regression estimates		
	Whole sample (A)	Formal workers (B)	Informal workers (C)	Sector allocation (D)	Formal workers (E)	Informal workers (F)
Formal	0,592					
	(41.63)**					
6 to 8 years of schooling	0,163	0,07	0,182	0,263	0,093	0,162
	(6.49)**	(2.37)*	(5.12)**	(29.62)**	(19.76)**	(31.67)**
9 to 11 years of schooling	0,294	0,212	0,296	0,563	0,256	0,247
	(11.07)**	(6.98)**	(7.39)**	(60.39)**	(52.92)**	(42.64)**
12 years of schooling	0,446	0,379	0,421	0,811	0,434	0,343
	(16.47)**	(12.31)**	(9.84)**	(84.04)**	(88.70)**	(52.96)**
Tertiary level incomplete	0,662	0,56	0,788	0,977	0,626	0,689
	(21.35)**	(16.51)**	(12.33)**	(78.10)**	(116.85)**	(75.02)**
Tertiary level complete	0,902	0,805	1,118	1.601	0,894	0,925
	(30.54)**	(24.59)**	(13.28)**	(127.72)**	(170.94)**	(75.36)**
Age	0,051	0,059	0,048	0,055	0,063	0,043
	(14.93)**	(16.46)**	(7.68)**	(39.09)**	(110.35)**	(46.43)**
Age squared (/100)	-0,05	-0,057	-0,053	-0,044	-0,061	-0,048
	(11.54)**	(12.50)**	(6.36)**	(24.75)**	(85.66)**	(40.83)**
Civil status (Married=1)	0,119	0,093	0,149	0,22	0,108	0,125
	(11.28)**	(8.33)**	(7.33)**	(38.10)**	(61.73)**	(39.91)**
Gender (Female=1)	-0,217	-0,209	-0,243	0,038	-0,209	-0,247
	(20.14)**	(19.06)**	(9.94)**	(6.93)**	(125.31)**	(70.99)**
Agriculture	-0,06	-0,127	0,016	0,234	-0,115	-0,005
	(2.11)*	(3.67)**	-0,35	(23.80)**	(23.99)**	-0,68
Electricity, water & gas	0,352	0,262	-0,19	0,542	0,276	-0,296
	(9.79)**	(7.35)**	-0,42	(8.80)**	(41.80)**	(3.17)**
Construction	0,128	0,037	0,194	-0,312	0,011	0,206
	(4.85)**	-1,36	(4.81)**	(30.42)**	(2.16)*	(34.97)**
Commerce	-0,055	-0,068	-0,011	0,254	-0,05	-0,034
	(3.32)**	(3.96)**	-0,35	(39.83)**	(17.29)**	(7.26)**
Transport	0,076	0,055	0,025	0,395	0,079	-0,026
	(3.38)**	(2.46)*	-0,44	(40.92)**	(22.12)**	(3.23)**
Finance	0,241	0,234	0,163	0,556	0,273	0,101
	(10.37)**	(9.27)**	(3.37)**	(62.69)**	(80.96)**	(14.17)**
Services	0,102	0,007	0,248	0,084	0,018	0,24
	(6.08)**	-0,39	(7.53)**	(12.19)**	(6.27)**	(48.38)**
Partial time (less than 30 hours=1)	0,416	0,395	0,427	-0,863	0,334	0,504
	(28.03)**	(20.86)**	(20.12)**	(163.92)**	(120.11)**	(129.86)**
Region (Montevideo=1)	0,209	0,169	0,271	0,196	0,181	0,251
	(21.09)**	(16.30)**	(13.83)**	(47.65)**	(111.85)**	(84.36)**
Public servant	0,231	-0,007	0,167	3.382	0,32	-0,29
	(8.09)**	-0,1	-1,49	(258.43)**	(33.93)**	(13.65)**
Self-employed with property	0,137	-0,08	0,129	0,7	0,052	0,094
	(4.88)**	-1,09	(3.92)**	(72.13)**	(6.40)**	(20.92)**
Private - micro-enterprise (< 5)	0,117	-0,21	0,132	1.352	-0,034	0,032
	(4.56)**	(2.95)**	(4.46)**	(141.40)**	(4.03)**	(5.95)**
Private - little enterprise (5-9)	0,163	-0,163	0,25	1.865	0,084	0,08
	(5.76)**	(2.29)*	(6.45)**	(178.31)**	(9.43)**	(9.74)**

Private – another size (>9)	0,289 (10.73)**	0,027 -0,38	0,231 (5.84)**	2.619 (271.86)**	0,33 (36.27)**	-0,067 (6.01)**
Household head				0,022 (3.37)**		
Household head's spouse				0,031 (3.82)**		
School attendance (attendance=1)				0,058 (6.33)**		
Retirement pension (recipient =1)				-0,306 (31.14)**		
Household income (log)				-10^4 x 4.7 (-0.53)		
Constant	1,057 (15.24)**	1,87 (18.91)**	1,068 (9.09)**	-3,613 (123.27)**	1,362 (84.85)**	1,219 (67.54)**
Observations	17767	11450	6317			
R-squared	0,48	0,4	0,23			
Correlation between η and ω_f				0,41314*		
Correlation between η and ω_i				-0,30800*		

* Denotes significance at 5%; ** denotes significance at 1%

Table 2. Estimated mean difference in earnings between formal and informal workers (log Wf – log Wi)

Raw gap	0,85
Estimated gap	
G1	0,59
G2	0,65
G3	0,60
G4	0,52

Appendix 2: The model

Equations

The equations of the CGE model are presented in this appendix. Three versions of the model were specifiad: perfect competition in labor market, efficiency wages for non skilled workers and wage curve. Lower fonts indicate endogenous variables, capital fonts exogenous variables and Greek letters indicate parameters. The subscripts *i, j* refer to sectors, the subscripts *z, t* refer to geographic zones and the subscripts f refers to representative households grouped according the income levelas 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)

1. Demand Structure

Demand functions derive from a Cobb Douglas utility function which is an increasing function of consumption of composite goods that combine 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. Then, demand for each good is:

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

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

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

being λ_{zi} the share parameter in the Armington function, ϕ_i the elasticity of substitution between goods from different origin, p_{zi} the market price of good *i* from market *z*.

Investment demand of good i is a fix share of total investment:

$$c_{iinv} = \mu_{iinv} \frac{I}{pf_i}$$

being I total investment.

Final demand of a differentiated good *i* produced in country *z* by a representative household f is:

$$d_{zik} = \lambda_{zi}^{\phi_i} . \left(\frac{p_{zi}}{pf_i} \right)^{-\phi_i} . c_{ik} \qquad (3)$$

where d_{zih} is the final domestic demand of the ia<znstitution f.

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

$$e_{iz} = \frac{e_{0iz} . p_{iz}^{-\eta_i} . R_t}{ER . pd_{zi}^{-\eta_i}} \qquad (4)$$

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 is the real income of the partner z, 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.

2.1 Cost

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

$$v_i = \omega_i \left(vc_i \left(1 + tind_i \right) \right)^{1-\sum_j \alpha_{ji}} . \prod_j vi_{ji}^{\alpha_{ji}} \qquad (7)$$

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 and ϖ_i is a parameter.

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

$$vc_i = \left[\left(1-\delta_i\right)^{\sigma_i} .r_i^{(1-\sigma_i)} + \delta^{\sigma_i} .w_i^{(1-\sigma_i)} \right]^{1/(1-\sigma_i)} \qquad (8)$$

where r_i y $w_{i,}$ are the rental rate of capital and the average wage. δ is distribution parameters 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 and unskilled labor are combined following a CES function, so the average wage is:

$$w_{li} = \frac{1}{\varphi_i} .\left[\left(1-\xi_i\right)^{\theta_i} .\left(wu.wd\right)^{1-\theta_i} + \xi_i^{\ \theta_i} .ws_i^{1-\theta_i} \right]^{1/(1-\theta_i)} \qquad (9)$$

where w_{li} is the average wage, wu y ws_i are the unskilled and the skilled wage, respectively, ξ y φ are the distribution and scale parameters and θ_i is the elasticity of substitution between skilled and unskilled labor.

The efficiency wage is endogenous. It is assumed that the workers caught from the efficiency wages sectors go to the informal sector, where the labor market is competitive and there are not wage premium. To model the efficiency wage premium we follow Thierfelder and Shiells (1997):

$$\frac{wd_i - 1}{wd} = \frac{\kappa.rd}{\left((D2 - D1)\right)} + \frac{\kappa\left(D1 + S\right)\overline{LU}}{\left((D2 - D1\right)\left(\overline{LU} - \sum_{i \mp \inf ormal} lu_i\right)}$$

where κ is the utility of shirking, rd is the discount rate, D! is the probability that no-shirking worked will be falsely accused and fired from the efficiency wage sector, D2 is the probability to be caught shirking and therefore fired, S is the rate of quit the efficiency wage sector. Other specification of the model do not consider informal sector, then, when a worker is fired from the efficiency wage sector he remain unemployed. The estimation of the wage cuve will be used to calibrate the parameters.

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

$$vi_{ji} = \left(\sum_{z} \gamma_{zji}^{\phi_j} .. \left(p_{zj} \right)^{1-\phi_j} \right)^{1/(1-\phi_j)} \qquad (10)$$

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

2.2 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:

$$x_{zji} = \frac{\alpha_{ji} . v_i \, q_i}{vi_{ji}} \left(\frac{p_{zj}}{\gamma_{zji} . vi_{ji}} \right)^{-\phi_j} \qquad (11)$$

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 increasing function of the unitary cost and output in each sector:

$$va_i = \alpha v_i q_i \frac{v_i}{vc_i \left(1 + tind_i \right)} \qquad (12)$$

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

$$fd_i = \left(\frac{w_i}{\delta_{fi} . vc_i} \right)^{-\sigma_i} . va_i \qquad (13)$$

Finally, the skilled and unskilled labor demand equations are the following:

$$ls_i = .\left(\frac{ws_i(1+tfac_f}{\xi_i.w_i}\right)^{-\theta_i}.fd_{li} \qquad (15)$$

$$lu_i = \left(\frac{wu.wd_i(1+tfac_f)}{(1-\xi_i)w_i}\right)^{-\theta_i}.fd_{li} \qquad (16)$$

2.3 Domestic pricing

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

$p_{ui} = v_i(1+tex_i$ when i= competitive sectors (17)

where the lower case *"u"* refers to Uruguay. The firms charge the same price in domestic and foreign markets.

3. General Equilibrium

Public services fix prices, wages and employments 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:

$$y_f = \sum_i (l_i.w_i + k_i.r_i + f_i). + tr_f + \overline{wg}\,\overline{\lg} \qquad (20)$$

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

$$y_g = \sum_i (l_i.w_i + k_i.r_i + f_i).tind_i + \sum_i (\pi_i). + \sum_i \left(\sum_z \tau_{zi} d_{zi} n_{zi} p_{zi}. + n_{ui} \sum_z \sum_j \tau_{zj} x_{zji}.n_{zj}.p_{zj} \right) \qquad (21)$$

Government expenditure are the sum of households transfer, public wages and government consumption:

$$GE = \sum_f \overline{tr}_f + \sum \overline{d}_{zig} p_{zi} + \overline{wg}\,\overline{\lg} \qquad (22)$$

were GE is the government expenditure, d is the government consumption of good I, which is a fix coefficient, wg is the public wage and lg is public employment, both fix.

Government save is the difference between government income and expenditure:

$$SG = y_G - GE \quad (23)$$

it is assumed as a constant.

The equilibrium conditions in the labor market are:

$$LS_i = ls_i + fs_i.n_i \quad (24)$$

where LS_i is the supply of skilled labor and

$$LU = \sum_i (lu_i + fu_i.n_i) \quad (25)$$

where LU is the supply of unskilled labor. Both variables are exogenous.

The equilibrium equation for capital is:

$$K_i = k_i + fk_i.n_i \quad (26)$$

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 requires that supply equals demand in each sector:

$$q_i = d_{ui} + \sum_j x_{uij} + \sum_t e_{it} \quad (27)$$

Finally, the external equilibrium is:

$$\sum_i \sum_t e_{it}.p_{ui} ER - \sum_i \sum_t d_{ti} p_{ZI} - \sum_i n_{ui} \sum_j \sum_t x_{tji}..p_{tj} = B \quad (28)$$

In all the simulations B is fixed in terms of the numerarie.