As in other Latin American countries, labor informality in Uruguay mainly affects less educated workers, who are also more vulnerable to poverty. We analyze the impact of some policies against informality in Uruguay, applying a general equilibrium model with a segmented labor market specification. We simulate two sets of policies: payroll tax cuts and increased enforcement in the informal sector. Both sets of policies are effective in reducing informality, but the effect on poverty is not straightforward. Poverty falls as informality is reduced; however, as enforcement policies increase hiring costs for informal firms, wages of low-skilled workers decline and poverty increases.

**JEL classification:** D58, I32, J08, J42

**Keywords:** Informality, labor market, general equilibrium model, policies, poverty

1. **Introduction**

Labor informality in Latin America, although not higher than in other regions, is still a source of concern for policymakers, since it is usually associated with less favorable working conditions, lower productivity and weak enforcement of the rule of law (Perry et al., 2007). Informality rates increased in most countries of the region during the 1990s and continued to be high during the 2000s. In this sense, Uruguay is not an exception. The financial and trade opening of the Uruguayan economy, together with the creation of MERCOSUR in 1991 and the implementation of stabilization policies during the 1990s, deeply affected the country’s economy. The labor market was also transformed: the sectoral distribution of employment changed, unemployment and informality rose, the female labor supply increased and relative factor remunerations changed. Unemployment and informality rose during the second half of the decade, and increased even more with the recession of the economy that began in 1999.
By 2005, informal workers represented 45% of total private workers in Uruguay (Amarante and Espino, 2007).

Although informality is a complex phenomenon that affects workers with very different characteristics in Latin America, informal workers tend, on average, to be less educated and younger, while certain sectors such as construction, agriculture, retail and transport show higher informality rates (Perry et al., 2007). In Uruguay, informality affects mainly low-skilled workers: in 2004, 55% of workers with fewer than eight years of schooling were employed in the informal sector, while 20% of skilled workers with 12 or more years of schooling were informal workers.¹

Informal workers also earn on average less than formal workers, and this wage gap increased in the region between 1990 and 2002 (Cimoli et al., 2006). Several authors (Amarante and Arim, 2005; Amarante and Espino, 2007; Cassoni, 2001; Terra et al., 2006) estimate wage gaps between formal and informal workers in Uruguay, and even when they differ in terms of the time frame of the analysis and the methodology applied, they find evidence of an earnings gap between formal and informal workers with identical characteristics. Furthermore, information from the Continuous Household Survey shows that the most vulnerable workers in terms of poverty are at the greatest disadvantage in the labor market. For this reason, implementing policies against unemployment and informality may indirectly contribute to the reduction of poverty.

Although informality in Uruguay’s labor market has been widely analyzed, there are no studies that evaluate specific policy options to reduce it. With this in mind, in this paper we discuss specific policy options to reduce informality in labor markets in Uruguay, we provide policy scenarios and we analyze their impact on the labor market and the economy. Even though this research focuses on the Uruguayan case, the discussion and evaluation of different policy options may be relevant for other countries as well, since informality is usually associated with common causes, particularly within the region.

Specifically, we simulate two different policy options—reduction in labor tax rates and enforcement policies—using a single-country computable general equilibrium (CGE) model which includes a detailed specification of the labor market. Our results suggest that even when both types of

¹. The percentage of informal jobs for medium-skilled workers was 40% in the same year, according to data from the Continuous Household Survey 2004.
policies are effective in reducing informality, they may also produce other unwanted effects on wages and poverty. Specifically, enforcing policies on informal firms increases their hiring costs, causing wages to fall with the consequent negative effect on poverty.

In the next section we present the operational definition of informality applied in this paper and a review of literature on the causes of informality and policies designed to reduce it. Section 3 presents the methodology applied in the paper, while Section 4 presents our results and Section 5 our conclusions.

2. INFORMALITY: ORIGIN AND POLICIES TO REDUCE IT

Informality is a complex concept for which there are numerous theoretical explanations and operational definitions. The traditional ILO-PREALC conception of informality is that of dual labor markets. It suggests that in an economy there is a sector which encompasses all activities that are marginal to the main economic activities and presents lower productivity levels (Hart, 1973; ILO, 1972; Sethuraman, 1976; Tokman, 1978).

On the other hand, according to the structuralist approach—developed by Moser (1978) and Portes et al. (1989), among others—the informal sector is considered part of the structure of the economy. According to this approach, the informal sector consists of all remunerated activities that are not regulated by the State, and which coexist with other similar activities in the formal sector. Following this approach, the informal sector is measured by the percentage of jobs that do not comply with existing regulations, such as providing social security or healthcare benefits. In Uruguay, this means that informal workers are defined as those who do not contribute to the social security system, regardless of the size of the firm in which they are employed. This definition of informality stresses the fact that the labor conditions of a job are more important than the type of firm that provides the job.²

We apply this last definition of informality, but we also consider some aspects of the dual labor market theory. This theory states that two sectors coexist in the labor market: the primary sector, or formal sector, pays higher wages and offers better labor conditions,

² A third theoretical approach, known as “legalist,” considers that informality is a consequence of excessive State regulation. The presentation of theoretical approaches on informality follows Portes and Shauffler (1992).
while the secondary sector, or informal sector, offers jobs that do not comply with regulations. We assume that the differential between the wages paid in the formal and the informal sectors is an efficiency wage that firms in the formal sector pay in order to boost worker performance or to maintain employees once training costs have been assumed by the firm. The secondary or informal sector presents lower productivity levels, which are associated, among other factors, with credit and public services restriction (Braun and Loayza, 1994). We also assume that in the informal sector there are workers and firms that choose to be part of the informal sector in order to avoid the costs and regulations of the formal sector. This hypothesis follows Agénor and Aizenman (1999) and Fugazza and Jacques (2003), and corresponds to an integrated approach to informality that combines the dual economy approach with the structuralist and legalist approaches.

The theoretical approach adopted and the diagnosis of the causes of an informal sector in the labor market will determine the policy suggestions to reduce it. The most frequently mentioned cause of informality in the labor market is the existence of high tax levels borne by the formal sector (Braun and Loayza, 1994; Fugazza and Jacques, 2003; Ihrig and Moe, 2004; Sanches, 2005; Schneider and Klingmair, 2004; among many other authors). The costs of formalizing a business can be understood as high tax rates and onerous social security contributions (Gërxhani, 2004; Schneider and Enste, 2000).

The second most mentioned cause of informality is overregulation in the labor market (Gërxhani, 2004; Schneider and Enste, 2000). Overregulation can be measured through the existence of high minimum wage levels (Loayza 1994), high entry costs to the formal sector—the number of permits required and the ease with which they are obtained (Braun and Loayza, 1994; Friedman et al., 2000), or labor restrictions on foreigners (Schneider and Enste, 2000). How government controls overregulation is also important. Therefore, the way in which the government controls and enforces compliance with regulations and penalizes firms which do not comply is also associated with informality levels (Ihrig and Moe, 2004). According to Schneider and Enste (2000), the studies tend to show that what matters is how regulations are enforced, rather than their quantity or quality. There may be cases where many regulations are not followed. Thus, corruption becomes a factor associated with informality (Braun and Loayza, 1994; Friedman et al., 2000).
Other factors that are mentioned less frequently in the literature are social security plans for unemployed or precarious workers; changes in labor market regulations, such as a reduction of working hours and incentives for early retirement; the deterioration of public services from which the formal sector benefits (Schneider and Enste, 2000); the presence of powerful unions that firms and workers prefer to avoid; and the impact of international competition (Gërxhani, 2004).

Which specific policies can be implemented to reduce informality? Many authors suggest tax reduction policies, and this goes along with the opinion that high costs in the formal sector lead to a bigger informal sector. Related to the efficiency wage theory, several authors suggest that in order to increase formal employment and improve welfare, government should subsidize wages paid in the primary (formal) sector (Thierfelder and Shiells, 1997). Studies that analyze the impact of fiscal policies on informality fall into two groups: those that develop theoretical models and those that use empirical data from developed and/or developing countries.

In the first group, Ihrig and Moe (2004) work with a dynamic model and consider two main causes of informality: high taxes (positive relationship) and regulation compliance (negative relationship). The authors evaluate different policies aimed at reducing the size of the informal sector: decreasing the tax rate for businesses operating in the formal sector and increasing enforcement in addition to higher penalties. They find that reducing the tax rate has a greater impact on the size of the informal sector, although maintaining government revenue requires better enforcement and higher penalty rates for firms found to be operating informally.

Albrecht et al. (2006), using a search and matching model that considers a large informal sector, simulate an increase in tax rates for both severance taxes and payroll taxes. Their results show that increasing the rates of these two taxes reduces the rate at which workers find formal jobs, but higher payroll taxes generate a deeper impact on informality; the duration of tenure in formal jobs falls and unemployment increases.

Among those in the second group, Sanches (2005) analyzes the effect of a payroll tax cut on informality, using data from the United States and Brazil and employing a neoclassical model with two sectors. In order to keep the fiscal balance unchanged, the decrease in payroll tax rates is compensated for by an increase in the value added tax rate. The author draws similar conclusions for the two countries. In the short term, the lower
overall tax level has a negative impact on informality in both economies and a positive impact on GDP. In the long term the conclusions are the opposite: informality falls at the beginning when the initial level of taxes is high, and GDP falls in the long term because of the major decline in capital stock. In spite of that, both in the short and long term, general welfare increases as a consequence of substituting taxes.

Fugazza and Jacques (2003) analyze the impact of fiscal policies on informality in Italy and Canada using a dual labor market approach within a continuous matching model framework, which considers unemployment for both segments of workers. They simulate a reduction in payroll taxes in the formal sector. They consider different tax rates: payroll taxes imposed on firms and taxes imposed on workers (social contributions). They also consider other parameters related to taxes: informality detection probability and penalty rates for firms committing infractions; and they evaluate how a reduction in both of the tax rates, an increase in detection probability and a higher penalty rate affect informality in Italy and Canada. They find that even when each of the three policies is effective in reducing informality and increasing the size of the formal sector, the increase in detection probability reduces worker welfare and thus worsens social welfare. Given this result, the tax rate reduction policy seems to be more effective in reducing informality.

Applying a CGE model with data from Cameroon, Fortin et al. (1997) simulate different reforms of the tax and regulatory system and analyze the differentiated effects on model specifications with and without an informal sector. They find that in an economy with an informal sector and unemployment, a rise in the payroll tax rate, government-set wage rate or tax rate on profits increase the size of the informal sector, boost the unemployment rate and have a negative effect on GDP, more significant than in a model without an informal sector. This happens because as costs increase for firms, labor demand and production fall. If the economy operates with an informal sector, firms move to the less efficient informal sector and the decline in GDP is reinforced. Unemployment rates, however, decrease to a lesser extent because the unemployed are absorbed by the informal sector. In spite of this, the negative effect on GDP triggered by expansion of the informal sector exceeds the positive effect on GDP of a less pronounced increase in unemployment.

Braun and Loayza (1994) conclude that in order to reduce informality, authorities should impose higher penalty rates on firms caught
operating informally. The authors develop a dynamic model with endogenous growth in which there is an optimum tax rate for the production of public services. If the tax rate is below the optimum, and at a sufficiently low level, the informal sector might not exist, because there would be no incentives to operate informally and thus avoid paying taxes. However, a low tax rate also results in low-quality public services. When the tax rate is increased, social welfare rises, but there is a risk that informality may increase. In order to avoid that, the authors suggest an increase in penalty rates for firms in the informal sector and greater enforcement in order to prevent those firms from obtaining access to public services. Similarly, Schneider and Enste (2000) agree that governments should pay more attention to the density of regulations and to ways in which authorities can increase regulatory compliance in order to tackle informality.

Some studies for Uruguay find that hiring costs are high in the Uruguayan labor market, particularly in some sectors such as domestic service and the construction sector (Cassoni and Ferre, 1997). Therefore, a tax reduction policy would reduce informality in the Uruguayan labor market, although policies focused on specific sectors may have a greater impact on the creation of new formal jobs (Cassoni, 2005). Informality in Uruguay is also associated with a low enforcement level of current regulations (Forteza, 1999). Increasing enforcement and penalizing firms caught in the informal sector may also reduce informality. However, this type of policy may also increase unemployment, as informality and unemployment affect the same segment of workers (Boeri and Garibaldi, 2006).

3. Methodology

In order to evaluate the impact on the labor market and the economy of certain policies aimed at reducing informality, we chose to apply a computable general equilibrium (CGE) analysis. General equilibrium models are a suitable methodological tool for evaluating policy options, because they take into account the direct and indirect effects of the policies on the economy. They have been more extensively used to analyze different trade and tax policies than labor policies; however, as Fortin et al. (1997) conclude, general equilibrium models are an important tool for evaluating tax reforms and regulatory policies, especially when they explicitly incorporate an informal sector. To capture the effect of the simulated policies on poverty and income distribution, we also ran microsimulations.
3.1. Theoretical model

We apply a single country, static CGE model for the Uruguayan economy, following Laens and Terra (2000) and Terra et al. (2006), and introduce some changes, mostly in the labor market. In this subsection we first present the general characteristics of the model and then turn to the labor market. The full model and its equations are presented at the Appendix.

General characteristics

The model has a conventional structure in terms of the analysis of trade-related issues. It assumes perfect competition in good markets, although goods are not homogenous: they differ according to geographical origin, in line with an Armington (1969) specification. In international markets, Uruguay faces a perfectly elastic supply of imports, while in its export markets, the country is a price maker, following an “almost small open economy” assumption (Harris, 1984). The demand for exports is a function of the relative prices and real income of Uruguay’s trade partners, which is considered exogenous. The country has three trade partners: Argentina, Brazil and the Rest of the World. The trade balance is fixed.

There are 23 sectors. One of them is the public sector with fixed employment (it does not hire or dismiss workers). Another is the informal sector, which encompasses all of the informal activities in the economy. The informal sector produces one good destined for final consumption in the domestic market and operates with lower levels of productivity, hiring only unskilled and medium-skilled workers. The other 21 sectors are formal sectors, distributed among primary, manufacturing and service sectors.

Firms produce for the domestic and international markets, for both intermediate and final consumption. The production function of firms is nested in three levels. At the upper level, firms combine intermediate inputs and value added following a Cobb-Douglas function. Value added is obtained through a nested CES (constant elasticity of substitution) function: at the upper level the firm combines composite labor and capital, and at the lower level it combines labor by different skills, which means there is imperfect substitution among different types of labor by skills. The firm production function is shown in Figure 1. Firms must pay a tax on labor ($t_{fac}$) that negatively affects labor demand. There is also
an income tax that households pay ($t_{lab}$). This tax does not affect labor demand. It could affect labor supply, but in our model this is assumed to be constant. At equilibrium, labor supply equals labor demand.

Our model considers three labor categories: unskilled labor (eight or fewer years of schooling), medium-skilled labor (between nine and eleven years of schooling) and skilled labor (12 or more years of schooling), as suggested by some authors for analysis of Latin American labor markets (Wood, 1994). Since our model is static, the supply of each type of workers is fixed and workers do not change their education status. Each labor category is perfectly mobile between formal sectors, and thus there is one wage per skill category for all sectors (except in the public sector where employment is fixed). The level of employment in each sector will depend on the demand for labor in each sector.
Final goods demand functions are derived from maximizing the households’ utility function (Cobb-Douglas function) subject to their income constraints. There are ten types of households in line with income deciles. The government collects taxes, buys goods and services and makes transfers to households. The investment level of the economy is determined by savings, which are made up of private savings, public savings and external savings. The equilibrium in the model is reached through simultaneous equilibrium in the good market, in the factor market and in the external sector. In all simulations the numerary of the model is the consumer price index of the economy.

Labor market

In order to introduce the informal sector into the labor market, we consider the dual labor market hypothesis, under the assumption that informality affects only unskilled and medium-skilled workers, whereas skilled workers are fully employed in the formal sector. Unskilled and medium-skilled workers are employed in the informal sector, which works under perfect competition, or in the formal sector, where they earn an efficiency wage, which is explained by monitoring or training costs. If low-skilled workers are dismissed from the formal sector, they move to the informal sector, where no efficiency wages are paid and equilibrium is reached through wages. Since wages are higher in the efficiency wage sector, formal workers make greater effort and formal sectors show higher productivity.

Wage differentials are endogenously determined in the model. Following Thierfelder and Shiells (1997), the wage differential is specified through the equation below, in which we see that efficiency wages are positively determined by the labor demand in each sector and negatively correlated to the quitting rate in the sector. When the economy expands and production rises, formal labor demand increases, and formal firms are willing to pay a higher wage differential to promote higher productivity and retain workers. On the other hand, when the economy contracts, formal labor demand falls and informality increases, and therefore the quitting rate in each sector is reduced (workers are not willing to jeopardize their jobs in a formal firm). In this scenario, firms have no incentive to pay high wage differentials.

\[
\frac{wd_{labne,i}}{wd_{labn,c}} - 1 = \frac{\kappa \cdot rd}{(D2 - D1)} + \frac{\kappa (D1 + S)LU_{labnc}}{(D2 - D1)(LU_{labnc} - \sum_i LU_{labnc,i})}, \quad i = \{1, \ldots , I\}
\]
where $\kappa$ is the utility of shirking, \( rd \) is the discount rate, \( D1 \) is the probability of firing workers who were not shirking, \( D2 \) is the probability of being caught shirking and therefore fired and \( S \) is the quitting rate in the formal sector. $LU_{labnc}$ refers to labor supply by category of labor (fixed) and $lu_{labnc,i}$ represents labor demand by sector \( i \) for each type of labor \( labnc \). Note that \( i \) are all the efficiency wage sectors, that is all the formal sectors in the economy, not including the public sector, and \( labnc \) includes unskilled labor and medium-skilled labor. The wage differential at the benchmark is set at 60\% for both types of workers, following estimates by Terra et al. (2006).

3.2. Data and calibration

Data used in a general equilibrium model is assumed to reflect equilibrium for the economy at the benchmark, and it is represented in a Social Accounting Matrix (SAM). In this paper we use the same SAM as in Terra et al. (2006), which is a modified version of the one developed by Barrenechea et al. (2004) for 2000 with some minor changes. In our model there are three types of labor corresponding to the skill levels of workers, and thus we needed to introduce this change to the SAM. We divided unskilled labor into unskilled and medium-skilled labor, using data from the Continuous Household Survey (CHS) for 2001.

Second, we divided taxes on labor into two types: taxes on labor demand, which are paid by firms, and taxes on worker income, paid by households. Although both taxes are considered in the model, in the original SAM they were lumped into a single payment. In this paper the differentiation of the two taxes in the model and in the SAM is extremely important because, since the model assumes a fixed labor supply, changes in the tax rate applied to labor supply do not affect labor demand and have no impact on employment. Therefore, a second modification was made to the SAM to differentiate taxes on factors from taxes on firms. To do this we used data from the Central Bank of Uruguay (National Accounts, 2005) and the Social Security Bank (Banco de Previsión Social).

3.3. Microsimulations

General equilibrium models may capture the effects of simulated policies on income distribution through changes in the relative price of production factors and changes in relative household income. However,
this is a partial distribution and does not measure the impact on poverty and income distribution at a micro level. In order to analyze the effect of the simulated policies on poverty and inequality, the CGE analysis can be complemented with microsimulations. Several microsimulation techniques can be applied as a complement to CGE analysis. One of the most common ones is the so-called “top-down approach,” which is applied in a sequential fashion, taking parameters from the CGE model and feeding them into the micro module, without any further interaction between the macro and the micro level. Roughly, this approach has two variants: a) modeling the income generation process of the households; b) random assignment of changes in parameters to households in the survey. In this paper we apply the latter technique, developed by Ganuza et al. (2002) and applied in Vos et al. (2006) and other studies.

This approach assumes that occupational shifts can be proxied by a random selection procedure within a segmented labor market structure. This procedure allows the imposition of counterfactual changes in key labor market parameters (participation rate, unemployment, employment composition by sector, wage structure, and so on) on a given distribution derived from household survey data, and the estimation of the impact of each change on poverty and income distribution at the household level. That is to say, random numbers are used to determine which persons at working age change their labor force status; who will change occupational category; which employed persons obtain a different level of education; and how new mean labor incomes are assigned to individuals in the sample. Hence, the assumption is that, on average, the effect of the random changes correctly reflects the impact of the actual changes in the labor market. Because of the introduction of a process of random assignment, the microsimulations are repeated numerous times in Monte Carlo fashion. This allows for construction of 95 percent confidence intervals for the indices of inequality and poverty, except in the case of the simulations of the effect of change in the structure and level of remuneration, which do not involve random numbers.

Given the characteristics of our CGE model, in this paper we take the following parameters from the CGE results and feed them into the microsimulation module: share of informal workers by category of education, wages in the formal and informal sector and by category of education, average wage in the economy and share of workers by skill by sector of activity. We feed changes in these parameters into the CHS database for 2001 to obtain the average value and confidence intervals for the relevant indicators. Specifically, we obtain the most
typical poverty and inequality indicators: the poverty index (the percentage of households below the poverty line), taking as a reference the poverty line suggested by the National Institute of Statistics for the year 2001; the extreme poverty index (the percentage of households below the extreme poverty line); and the Gini coefficient, calculated with per capita income by household. Comparing the average level of the indicators with their value at the benchmark, we can draw conclusions about the impact of the simulated policies on poverty and income distribution. Microsimulations were run using STATA software, following programming by Cicowiez (2006).

3.4. Simulation of policy scenarios

We design simulations taking into account the main objective of this paper: to evaluate policy options to combat informality and to analyze their impact on the labor market and the economy. As we have noted, there are two sets of policies mentioned in the literature. On the one hand, informality may be a consequence of high tax rates, and therefore a policy to reduce it would be a tax rate decrease or a subsidy for formal employment; on the other hand, the government can fight informality through enforcement policies that increase control of the informal sector and force firms/individuals operating informally to pay taxes and comply with regulations.

First we simulate five policy scenarios involving payroll tax rate reductions. We should remember that in our model this tax is paid by the firm that demands formal labor, although firms are able to transfer costs to workers through wages. In the five scenarios the tax reduction simulated is the same, a 20% decrease with respect to the level at the benchmark. However, the scenarios differ in two aspects, namely the sectors that benefit from the tax reduction and the type of labor affected.

The first scenario (TAX1) is the most restrictive in that it simulates a 20% tax cut for unskilled labor and benefits only those sectors intensive in this factor. Specifically, the sectors which benefit are agriculture, livestock-rearing, other primary sectors, rice, ceramics and the construction sector. The second scenario (TAX2) simulates a tax cut for both unskilled and medium-skilled labor, which benefits sectors intensive in unskilled labor as well. The TAX3 scenario simulates a 20% tax cut for unskilled labor, but one which benefits all efficiency wage sectors. Lastly, we simulate a 20% tax cut for unskilled and medium-skilled labor in all efficiency wage sectors (TAX4). This last policy
could have a significant impact on government revenue and therefore on public investment, and in the long term on investment and human capital accumulation (Terra et al., 2006). Thus, we simulate a fifth policy scenario (TAX5) which adds a new tax on capital income of 0.75% in order to maintain the fiscal deficit unchanged.

The second set of simulations considers an enforcement policy in the informal sector. In this case, three alternative scenarios are simulated. The first considers a less effective enforcement policy and the second a more effective enforcement policy. Both of them assume that the enforcement policies are applied to both unskilled and medium-skilled workers. In the third scenario only unskilled workers are compelled to pay taxes, on the assumption that the enforcement policy is applied only to those sectors that hire unskilled labor. Because the enforcement policies require informal sectors to start paying taxes, they become part of the formal sector. Therefore, we simulate an increase in taxes specifically for the informal sector. If the probability of detecting firms in the informal sector increases, the tax rate increases as well.

The theoretical revenue from labor tax \( R \) would be \( R = tW \), that is tax rate \( t \) times the tax base, which in this case is made up of wages paid to workers \( W \).

In fact, there are two types of wages: those paid in the formal sector and those paid in the informal sector. In the latter, revenue is zero because we assume no government enforcement at the benchmark:

\[
R = tW_f + p\tau (tW_{inf}),
\]

where \( p \) is the probability of catching an infracting firm and forcing it to pay taxes, \( W_f \) and \( W_{inf} \) are wages in the formal and informal sector respectively and \( \tau \) is the penalization rate paid by the infracting firm.

At the benchmark \( p = 0 \). If government increases enforcement in the informal sector, then \( p \) adopts a positive value. In the first simulation scenario (ENF1), \( p \) is 50%; that is, enforcement of the informal sector is 50% effective, while the second scenario considers 85% effectiveness (ENF2). Firms in the informal sector that are caught not only have to pay taxes but also a fine, which is simulated by increasing tax rates by a few percentage points that differ according to the type of worker and the scenario simulated.

As a consequence, the payroll tax rate in the informal sector is now positive, but has a lower value than the tax rate paid in the formal sector,
because not all firms and workers are caught infringing regulations. In the first scenario (ENF1), the tax rate in the informal sector is 4.0% for unskilled labor and 4.1% for medium-skilled labor. In the second scenario (ENF2) the tax rates are 6.8% and 7.0%, respectively. In the third scenario (ENF3), only the tax rate for unskilled labor rises to 7.2%, which represents a 90% effective enforcement policy.

Table 1 presents the eight simulation scenarios:

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Policy</th>
<th>Factors affected</th>
<th>Sectors affected</th>
<th>Parameter</th>
<th>New parameter value</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAX1</td>
<td>20% decrease in tax on labor</td>
<td>Unskilled labor</td>
<td>Unskilled labor-intensive sectors*</td>
<td>tfac</td>
<td>Depends on sector</td>
</tr>
<tr>
<td>TAX2</td>
<td>20% decrease in tax on labor</td>
<td>Medium-skilled and unskilled labor</td>
<td>Unskilled labor-intensive sectors*</td>
<td>tfac</td>
<td>Depends on sector</td>
</tr>
<tr>
<td>TAX3</td>
<td>20% decrease in tax on labor</td>
<td>Unskilled labor</td>
<td>Efficiency wage sectors</td>
<td>tfac</td>
<td>Depends on sector</td>
</tr>
<tr>
<td>TAX4</td>
<td>20% decrease in tax on labor</td>
<td>Medium-skilled and unskilled labor</td>
<td>Efficiency wage sectors</td>
<td>tfac</td>
<td>Depends on sector</td>
</tr>
<tr>
<td>TAX5</td>
<td>20% decrease in tax on labor, Increase in capital tax.</td>
<td>Medium-skilled and unskilled labor, Capital</td>
<td>Efficiency wage sectors</td>
<td>tfac</td>
<td>Depends on sector</td>
</tr>
<tr>
<td>tcap</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.75%</td>
</tr>
<tr>
<td>ENF1</td>
<td>50% increase in enforcement of informal firms</td>
<td>Medium-skilled and unskilled labor</td>
<td>Informal sector</td>
<td>tfac (tncal)</td>
<td>4.0%</td>
</tr>
<tr>
<td>ENF2</td>
<td>85% increase in enforcement of informal firms</td>
<td>Medium-skilled and unskilled labor</td>
<td>Informal sector</td>
<td>tfac (tncal)</td>
<td>6.8%</td>
</tr>
<tr>
<td>ENF3</td>
<td>90% increase in enforcement of informal firms</td>
<td>Unskilled labor</td>
<td>Informal sector</td>
<td>tfac (tncal)</td>
<td>7.2%</td>
</tr>
</tbody>
</table>

*Agriculture, livestock-rearing, other primary activities, dairy production, rice, ceramics and construction
4. **RESULTS**

In this section we present the results of the simulations. First we present the results of tax cut policies on the labor market, and then the effect of enforcement policies on the labor market. Next we analyze the effect of the two sets of policies on macroeconomic variables, household income and poverty, and income distribution. Finally, we present a sensitivity analysis of the value of the elasticity of substitution among workers by skills.

4.1. **Effects of payroll tax cuts on labor market**

Table 2 shows the impact of a reduction in payroll tax rates on informal and formal employment for unskilled and medium-skilled workers, since highly-skilled employment and public employment is fixed. First, we can see that the five policies simulated are effective in reducing total informality and informality among unskilled workers. However, the policies that simulate a tax cut only for unskilled workers (TAX1 and TAX3) cause informality among medium-skilled workers to increase. This is due to a substitution effect among medium-skilled workers to increase. This is due to a substitution effect among medium-skilled workers to increase.

Table 2. Effects of tax-cut policies on employment and informality

<table>
<thead>
<tr>
<th></th>
<th>TAX1</th>
<th>TAX2</th>
<th>TAX3</th>
<th>TAX4</th>
<th>TAX5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Informal employment</td>
<td>-0.09</td>
<td>-0.15</td>
<td>-0.25</td>
<td>-0.53</td>
<td>-0.74</td>
</tr>
<tr>
<td>Unskilled informal employment</td>
<td>-0.26</td>
<td>-0.21</td>
<td>-0.69</td>
<td>-0.46</td>
<td>-0.69</td>
</tr>
<tr>
<td>Medium-skilled informal employment</td>
<td>0.08</td>
<td>-0.09</td>
<td>0.19</td>
<td>-0.60</td>
<td>-0.79</td>
</tr>
<tr>
<td>Unskilled formal employment</td>
<td>0.15</td>
<td>0.12</td>
<td>0.39</td>
<td>0.26</td>
<td>0.39</td>
</tr>
<tr>
<td>Medium-skilled formal employment</td>
<td>-0.03</td>
<td>0.04</td>
<td>-0.07</td>
<td>0.23</td>
<td>0.30</td>
</tr>
</tbody>
</table>

The sectors that benefit from the tax cuts increase their labor demand. In scenario TAX1, these correspond to the sectors intensive in unskilled labor, whereas in scenario TAX3 they correspond to the efficiency wage sectors. When the cost of hiring formal workers is reduced, there are two possible effects. First, firms may increase labor demand, creating new formal jobs. Nevertheless, a second effect is that firms may also substitute different categories of labor, without creating new jobs. When
the firms substitute high- and medium-skilled workers for unskilled workers, informality among this last group of workers is reduced, but it increases for medium-skilled workers.

Therefore, reducing payroll tax rates on one type of labor generates substitution among different types of workers and has an unwanted effect on medium-skilled informality. Even though the policy reduces total informality, it harms medium-skilled workers. The magnitude of the substitution depends on the possibility of the firm to make the substitution, which in our model is represented by the value of the elasticity of substitution in the firm production function. In the last section of this paper we analyze the sensitivity of the results to modification of the value of this parameter.

On the other hand, a reduction in tax rates on unskilled and medium-skilled labor that benefits unskilled labor-intensive sectors (TAX2) generates a decrease in informality among all types of workers. Obviously, the decline in informality among unskilled workers is less pronounced because there is less substitution among different types of workers. In this scenario, informality falls because labor demand increases for both categories of workers.

The most effective policy against informality is that which reduces payroll taxes in all efficiency wage sectors and for both types of workers (TAX4). In this scenario, informality decreases for both types of workers, leading to an overall informality reduction of 0.5%. However, since this policy may have a significant negative impact on the fiscal deficit, we simulate it combined with an increase in taxes on capital income in order to keep the fiscal deficit constant (TAX5). In this scenario, informality falls even more: 0.7%. This outcome is associated with the behavior of the construction sector, which is highly dependent on the investment level of the economy\(^3\). As we will show below and in Table 6, the fiscal deficit increases in the four previous scenarios analyzed, but not in scenario TAX5. When the fiscal deficit increases, public investment falls, resulting in lower total investment as well, and this has a negative effect on the construction sector, which is intensive in unskilled labor. In fact, in the TAX4 scenario, in which investment experiences the greatest increase, formal employment in the construction sector declines 1.07% for unskilled workers and 1.34% for medium-skilled workers, even as the sector benefits from the tax reduction. Formal employment in the other sectors still rises when

---

3. Construction accounts for almost 60% of investment at the benchmark.
labor demand from the construction sector falls, but this result reveals that those policies that negatively affect the fiscal deficit may have a negative effect on informality. In contrast, in the TAX5 scenario public investment does not fall and labor demand in the construction sector increases. Thus, the decline in informality is greater.

Table 3 shows the effect of tax policies on wages. In the model, the consumer price index is fixed as the numerary, so wage variation is expressed in real terms. When firms see their hiring costs for unskilled workers fall, they increase their demand for this type of worker. This in turn drives up wages because the labor supply is fixed. This happens in the five tax cut scenarios.

Table 3. Effect of tax cuts on wages

<table>
<thead>
<tr>
<th></th>
<th>TAX1</th>
<th>TAX2</th>
<th>TAX3</th>
<th>TAX4</th>
<th>TAX5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unskilled wage in the informal sector</td>
<td>0.25</td>
<td>0.26</td>
<td>0.70</td>
<td>0.81</td>
<td>0.76</td>
</tr>
<tr>
<td>Medium-skilled wage in the informal sector</td>
<td>0.03</td>
<td>0.18</td>
<td>0.11</td>
<td>0.91</td>
<td>0.83</td>
</tr>
<tr>
<td>Unskilled wage differential</td>
<td>0.41</td>
<td>0.32</td>
<td>1.08</td>
<td>0.72</td>
<td>1.09</td>
</tr>
<tr>
<td>Medium-skilled wage differential</td>
<td>-0.12</td>
<td>0.15</td>
<td>-0.30</td>
<td>0.95</td>
<td>1.26</td>
</tr>
<tr>
<td>Unskilled wage in the formal sector</td>
<td>0.41</td>
<td>0.38</td>
<td>1.11</td>
<td>1.08</td>
<td>1.17</td>
</tr>
<tr>
<td>Medium-skilled wage in the formal sector</td>
<td>-0.02</td>
<td>0.24</td>
<td>-0.01</td>
<td>1.26</td>
<td>1.31</td>
</tr>
<tr>
<td>Skilled wage</td>
<td>0.00</td>
<td>-0.01</td>
<td>0.00</td>
<td>0.01</td>
<td>-0.02</td>
</tr>
<tr>
<td>Public wage</td>
<td>-0.01</td>
<td>-0.01</td>
<td>0.02</td>
<td>0.04</td>
<td>0.00</td>
</tr>
<tr>
<td>Average wage</td>
<td>0.08</td>
<td>0.13</td>
<td>0.23</td>
<td>0.52</td>
<td>0.53</td>
</tr>
</tbody>
</table>

Skilled wage variation depends on the possibility of firms substituting workers with different skills. Because skilled employment is fixed, when firms substitute skilled workers informality cannot increase, as is the case of medium-skilled workers in scenarios TAX1 and TAX3, but wages are negatively affected. As Table 4 shows, in the scenarios that simulate tax cuts for all the efficiency wage sectors (TAX3 and TAX4), wages of highly skilled workers increase slightly because as labor costs for efficiency wage sectors are reduced, production increases and all types of workers benefit. With the value of the elasticity of substitution assumed in the model, the positive production effect on wages of highly skilled workers prevails over the negative effect derived
from the substitution effect. As substitution among workers becomes more imperfect, wages of highly skilled workers increase more.

On the other hand, wages of highly skilled workers fall slightly in the TAX1 and TAX2 scenarios. In these cases, the substitution effect prevails. It is important to remember that in these scenarios only unskilled intensive sectors benefit, and some of these do not employ highly skilled workers at all. Thus, an increase in their production does not benefit highly skilled workers.

The wage gap between highly skilled and medium-skilled and unskilled workers falls in all five tax reduction scenarios. Even when the wages of highly skilled workers increase in some scenarios, medium-skilled and unskilled wages increase more. This may lead to more equitable income distribution.

However, the wage gap between formal and informal workers increases. The wage differential paid in the formal sector depends negatively in the difference between labor supply and labor demand in the formal sector. Therefore, when informality declines, wage differentials increase. When the informal sector is reduced, the probability of being dismissed in the formal sector falls, and workers shirk more. Thus, firms in the formal sector are willing to pay a higher wage differential to promote effort among employees.

This explains the increase in the wage differential paid to unskilled workers in the five scenarios considered. Wages for lower-skilled workers present the highest increase in scenario TAX4, where wages for unskilled workers increase 0.8%, wages for medium-skilled workers increase 0.9% and wage differentials increase for both types of workers. It is important to bear in mind that efficiency wages mean an efficiency loss for the economy, which increases when wage differentials are higher. If wage differentials were exogenous and did not depend on employment, the efficiency loss would be lower and formal labor demand would increase more (Thierfelder and Shiells, 1997).

The average wage increases in all five policy scenarios, leading to improved general welfare.

4.2. Effects of enforcement policies on the labor market

Enforcement policies applied to informal firms are even more effective in reducing informality because they are designed to attack the problem directly—informal sectors must pay taxes once they are
found to be in violation of the law—and not indirectly as tax cuts do. Also, informality decreases because tax cuts promote an increase in labor demand. Table 4 shows the effect of enforcement policies on informality and formal employment for unskilled and medium-skilled workers. We can see that a 50% effective enforcement policy reduces total informality by 2.2%. A more efficient enforcement policy has an even greater impact: total informality falls 3.6% under the ENF2 scenario. Promoting enforcement only among unskilled workers also has a big impact on total informality, and generates a very significant decline in informality among unskilled workers: 3.9%. In the first two scenarios, the decrease in informality occurs along with a rise in formal employment for both unskilled and medium-skilled workers.

However, as can be seen in Table 5, enforcement policies negatively affect wages, especially for unskilled workers. In the three scenarios, wages for unskilled workers in the informal sector fall sharply and wage differentials increase significantly. In spite of this, wages for unskilled and medium-skilled workers in the formal sector also decrease, although less. Wages for skilled workers and public sector workers fall even less, and there is a decline in average wages in the economy.

When firms in the informal sector are caught evading and are forced to pay taxes, their costs increase substantially. Because the model does not consider unemployment, firms cannot dismiss workers and an adjustment is made in wages. If there were unemployment, we might expect that enforcement policies would lead to an increase in unemployment among lower-skilled workers (Boeri and Garibaldi, 2006).

4.3. Effect of simulated policies on macroeconomic variables and welfare

Taking account only the effect of the simulated policies on the labor market, the policies that benefit unskilled workers most are those that simulate a tax reduction, because they lead to a decline in informality and an increase in wages at the same time. However, these policies have a significant impact on public finances and public investment, as is shown in Table 6. Tax cut policies actually increase the fiscal deficit and reduce government income, whereas enforcement policies increase government income as a consequence of higher tax collection. Under the

4. The decrease in the fiscal deficit caused by the enforcement policies is overestimated because we are not simulating the cost of implementing these policies, which increases government expenditure.
Table 4. Effects of enforcement policies on employment and informality

\[(Percentage\ change)\]

<table>
<thead>
<tr>
<th></th>
<th>ENF1</th>
<th>ENF2</th>
<th>ENF3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Informal employment</td>
<td>-2.17</td>
<td>-3.61</td>
<td>-1.78</td>
</tr>
<tr>
<td>Unskilled informal employment</td>
<td>-2.08</td>
<td>-3.46</td>
<td>-3.90</td>
</tr>
<tr>
<td>Medium-skilled informal employment</td>
<td>-2.26</td>
<td>-3.76</td>
<td>0.34</td>
</tr>
<tr>
<td>Unskilled formal employment</td>
<td>1.17</td>
<td>1.95</td>
<td>2.20</td>
</tr>
<tr>
<td>Medium-skilled formal employment</td>
<td>0.85</td>
<td>1.42</td>
<td>-0.13</td>
</tr>
</tbody>
</table>

Table 5. Effect of enforcement policies on wages

\[(Percentage\ change)\]

<table>
<thead>
<tr>
<th></th>
<th>ENF1</th>
<th>ENF2</th>
<th>ENF3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unskilled wage in the informal sector</td>
<td>-1.95</td>
<td>-3.26</td>
<td>-3.73</td>
</tr>
<tr>
<td>Medium-skilled wage in the informal sector</td>
<td>-1.93</td>
<td>-3.24</td>
<td>0.27</td>
</tr>
<tr>
<td>Unskilled wage differential</td>
<td>3.34</td>
<td>5.69</td>
<td>6.46</td>
</tr>
<tr>
<td>Medium-skilled wage differential</td>
<td>3.66</td>
<td>6.26</td>
<td>-0.53</td>
</tr>
<tr>
<td>Unskilled wage in the formal sector</td>
<td>-0.72</td>
<td>-1.19</td>
<td>-1.40</td>
</tr>
<tr>
<td>Medium-skilled wage in the formal sector</td>
<td>-0.58</td>
<td>-0.96</td>
<td>0.07</td>
</tr>
<tr>
<td>Skilled wage</td>
<td>-0.09</td>
<td>-0.14</td>
<td>-0.08</td>
</tr>
<tr>
<td>Public wage</td>
<td>-0.03</td>
<td>-0.06</td>
<td>-0.04</td>
</tr>
<tr>
<td>Average wage</td>
<td>-0.31</td>
<td>-0.51</td>
<td>-0.30</td>
</tr>
</tbody>
</table>

Table 6. Effect on macroeconomic variables

\[(Percentage\ change)\]

<table>
<thead>
<tr>
<th></th>
<th>TAX1</th>
<th>TAX2</th>
<th>TAX3</th>
<th>TAX4</th>
<th>TAX5</th>
<th>ENF1</th>
<th>ENF2</th>
<th>ENF3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absorption</td>
<td>0.00</td>
<td>0.00</td>
<td>0.01</td>
<td>0.02</td>
<td>0.03</td>
<td>0.08</td>
<td>0.13</td>
<td>0.07</td>
</tr>
<tr>
<td>Private consumption</td>
<td>0.04</td>
<td>0.07</td>
<td>0.14</td>
<td>0.33</td>
<td>0.05</td>
<td>-0.18</td>
<td>-0.30</td>
<td>-0.18</td>
</tr>
<tr>
<td>Investment</td>
<td>-0.24</td>
<td>-0.41</td>
<td>-0.75</td>
<td>-1.78</td>
<td>-0.07</td>
<td>1.67</td>
<td>2.77</td>
<td>1.58</td>
</tr>
<tr>
<td>Real GDP</td>
<td>0.00</td>
<td>0.00</td>
<td>0.01</td>
<td>0.02</td>
<td>0.03</td>
<td>0.08</td>
<td>0.14</td>
<td>0.08</td>
</tr>
<tr>
<td>Government income</td>
<td>-0.14</td>
<td>-0.24</td>
<td>-0.33</td>
<td>-0.77</td>
<td>0.28</td>
<td>0.63</td>
<td>1.04</td>
<td>0.59</td>
</tr>
<tr>
<td>Fiscal deficit</td>
<td>3.05</td>
<td>5.18</td>
<td>7.63</td>
<td>17.70</td>
<td>0.00</td>
<td>-14.16</td>
<td>-23.45</td>
<td>-13.26</td>
</tr>
</tbody>
</table>
TAX5 scenario, government income increases 0.28% because government collects more payroll taxes as well as taxes on capital income.

Investment reacts to the fiscal deficit: when the latter increases, the former falls (the first four tax cut scenarios), and when government income increases, investment rises as well, because public savings increase, as Table 6 shows. Under the TAX5 scenario, investment falls slightly, due to lower private investment, which reacts negatively to the increase in the capital income tax rate.

The effect of the simulated policies on real GDP, absorption and private consumption is less marked. Real GDP increases in all the scenarios considered. In fact, the policies simulated may have two contradictory effects on GDP. On the one hand, they have a positive effect because they increase efficiency in the economy by raising employment in formal sectors, which work with higher productivity levels. On the other hand, they produce a negative effect derived from the efficiency loss that is implicit in wage differentials.

Total absorption does not change significantly in the simulated scenarios, while private consumption falls when enforcement policies are implemented. This is a consequence of the decline in wages previously analyzed, which means a decrease of income in all types of households.

In principle, we would expect poverty and inequality to fall as a result of tax cut policies, because these policies generate an increase in wages for unskilled and medium-skilled workers and reduce informality, which mainly affects unskilled workers. Enforcement policies, on the other hand, may have an ambiguous effect on poverty and inequality: under these scenarios, informality falls, but so do wages for unskilled workers.

Table 7 shows the impact of the simulated policies on poverty and income distribution. The results were obtained through microsimulations. We present the changes in three indicators: the poverty index (percentage of population below the poverty line), the extreme poverty index (percentage of population below the extreme poverty line) and the Gini coefficient. We also present the value of the indicators at the benchmark (year 2000).

The five payroll tax cut policies generate a decline in poverty and extreme poverty. The effect is greater when the tax cut benefits more sectors and workers: under the TAX5 scenario, poverty falls 1.4% and extreme poverty 1.6%. The same happens with inequality: under the same scenario, the Gini coefficient falls 0.2%. The decrease
in income concentration in this case is associated not only with the improvement in income of poorer households but also with lower income in wealthier households, due to the lower wages paid to skilled workers. Microsimulations only incorporate changes in the labor market, and therefore the impact on income distribution is underestimated. We might expect a greater decrease in income concentration as a result of the imposition of a tax on capital income.

Enforcement policies have different effects on poverty and income distribution. A 50% efficient enforcement policy increases poverty, whereas an 85% efficient policy reduces poverty indexes. The less efficient policy leads to a decrease in the income of poorer households and does not have a significant impact on informality, which does occur in the 85% efficient policy scenario. Under this policy, the positive effect of a reduced informality is greater than the negative effect of a decrease in wages.

The increase in the enforcement level for sectors which are intensive in unskilled labor produces an increase in poverty and extreme poverty. In this scenario, the large decline in wages leads to a worsening of working conditions, and the effect is not reverted by the reduced informality which the policy promotes. And although wages paid to skilled workers also fall in this scenario, inequality increases.

4.4. Sensitivity analysis of the substitution elasticity among skill categories $\theta_i$

Demand for labor in the CGE model follows a CES function, through which firms combine different categories of workers by skills. Therefore, substitution between workers of different skill level is imperfect, that is,

<table>
<thead>
<tr>
<th>Table 7. Effects of policies simulated on poverty and income distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Percentage change)</td>
</tr>
<tr>
<td>Benchmark value</td>
</tr>
<tr>
<td>-----------------------</td>
</tr>
<tr>
<td>Poverty index</td>
</tr>
<tr>
<td>Extreme poverty index</td>
</tr>
<tr>
<td>Gini coefficient</td>
</tr>
</tbody>
</table>
firms have preferences on hiring workers with certain skills, according to the characteristics of the job. We assume the same value (1.5) of the substitution elasticity among skill categories \( \theta_i \) for all sectors in the model.

It is very important to carry out an analysis of the sensitivity of the results of the CGE model to this parameter because, as we have already indicated, in some of the simulated scenarios, economic sectors replace skilled and medium-skilled labor with unskilled labor, leading to an increase in informality among medium-skilled workers. It would therefore be pertinent to carry out the sensitivity analysis using estimated values of the parameter. However, there are no estimations for Uruguay of the elasticity of substitution among workers with the skill categories considered in this paper\(^5\). Therefore, we carry out the sensitivity analysis using arbitrary values between 0.1 and 2. These two extreme values represent a very imperfect substitution (0.1) and a very perfect substitution (2). We present results from the sensitivity analysis in some of the policy scenarios simulated.

We might expect that the greater the possibility of substitution among workers, the more informality falls. Effectively, a decrease in payroll tax rates reduces the cost of hiring unskilled workers in the formal sector and stimulates firms to replace workers from other skill categories, leading to a greater increase in labor demand for unskilled workers and a more significant reduction in informality. This is what actually happens in scenario TAX4 for unskilled and medium-skilled workers, as Figure 2 shows.

In this scenario, firms in the formal sector face lower hiring costs and substitute skilled workers with unskilled and medium-skilled workers who come from the informal sector. In this case, the greater the possibility of substituting workers from different labor categories, the higher the increase in labor demand for lower-skilled workers and the more significant the reduction in informality.

In the TAX2 scenario, which simulates a fall in hiring costs for a small group of formal sector firms, the opposite happens. In this case, as shown in Figure 3, when the possibility of substituting workers is greater, the reduction in informality is lower. The sectors intensive in unskilled labor that benefit from a tax rate reduction act like all

\(^5\) Cassoni (1999) provides estimates of the elasticity of substitution among white-collar workers and blue-collar workers. However, the worker categories used in this paper are quite different.
the sectors in the previous scenario: they substitute skilled labor with lower-skilled labor, and the demand for unskilled and medium-skilled labor increases more. In this case, however, the rise in labor demand is restricted to a few sectors, and the new workers they hire come not only from the informal sector but also from other formal sectors in the
economy. This is possible as long as the sectors that do not benefit from the tax reduction policy can substitute labor as well. When the substitution is less imperfect, those sectors demand more skilled labor, and so increase their wages. When firms face imperfect substitution among workers, those sectors cannot substitute unskilled labor with skilled labor, and the sectors that benefit and demand more unskilled labor must hire unskilled workers who come from the informal sector. Thus, informality decreases more when substitution among workers with different skills is more imperfect.

In Figure 4 we show what happens when the tax rate is reduced only for hiring unskilled workers. In this case, the value of the substitution elasticity is crucial to determining the decrease in informality for each group of workers, although not for determining the total decline in informality. Changes in total informality are practically the same regardless of the value of the substitution elasticity: the tax rate reduction on unskilled labor which benefits all of the formal sectors leads to an increase in unskilled labor demand and a decline in informality. When firms face restrictions in substituting workers from different skill categories, unskilled formal employment increases less and informality falls only slightly, while informality among medium-skilled workers rises marginally. However,
when the substitution becomes more perfect, firms substitute medium-skilled labor with unskilled labor, and informality among medium-skilled workers rises. The higher the value of the substitution elasticity, the more informality among unskilled workers falls and the more informality among medium-skilled workers increases. Hence, this type of policy should be carefully implemented, because if firms can substitute workers with different skills, the effect of the policy on medium-skilled workers may be quite negative and government may be addressing one problem but generating a similar one in the process.

5. Final remarks

Informality in Uruguay, as in most Latin American countries, mainly affects lower-skilled workers, who are also more vulnerable to poverty. This paper analyzes the impact of certain policies aimed at reducing informality on the labor market on macroeconomic variables, poverty and income distribution in Uruguay. To do this, we apply a static general equilibrium model with a dual labor market, segmented by skills. We simulate two sets of policies: reducing the payroll tax on formal employment, and enforcement policies on informal firms. These two policies are aimed at tackling two of the most common causes of informality, as stated in literature for developing countries. We also apply microsimulations in order to analyze the impact of the policies on poverty and income distribution.

Our results show that policies to reduce taxes on labor are effective in reducing informal employment because they reduce the cost of hiring lower-skilled workers and increase demand for those workers. However, they may have a significant negative affect on government revenue. In order to minimize the cost of these policies, they can be targeted at a specific group of workers or specific sectors. They may also be implemented jointly with an increase in other tax rates in order to compensate for the loss of government revenue.

A reduction in the tax rate on a specific segment of workers has an unwanted effect on other segments of workers. This happens when we simulate a reduction in taxes on unskilled workers: informality among medium-skilled workers increases and wages among skilled workers fall. These results depend on the ability of firms to substitute labor with workers with different skills. When the substitution among workers is more imperfect, it is more efficient to implement such focused
policies and thus minimize government expenditure. Therefore, having appropriate estimates of the substitution elasticity for Uruguayan firms may provide richer results.

We simulated an increase in the tax on capital in order to avoid an increase in the fiscal deficit. Although it is a tax that distorts the economy, negatively affects investment and discriminates in favor of labor, in the current Uruguayan tax system there is no margin to increase other taxes. A policy that combines a reduction in the tax on labor with an increase in capital tax reduces informality even more and has a greater impact on poverty and inequality because it reverts the negative effect of fiscal deficit on public investment. Investment in Uruguay is concentrated in the construction sector, which is intensive in unskilled labor. Therefore, the implementation of policies that negatively affect investment may increase inequality.

On the other hand, simulations of policies which increase enforcement levels for firms in the informal sector produce a considerable reduction in informality because they tackle the problem directly. However, these types of policies have a negative impact on wages paid to low-skilled workers because firms face higher hiring costs. For this reason, enforcement policies have a negative impact on the income of poorer households, while the income of wealthier households falls but not as markedly. As a consequence, poverty increases and income distribution becomes less equitable. We may expect that these policies would also have a negative impact on unemployment if this were considered in the model. Even when enforcement policies cannot be avoided because they improve the pension system and rule out administrator abuse, the results show that they should not be implemented as policies to reduce informality.

These results emphasize the importance of having appropriate methodological tools that allows for a quantitative evaluation of a certain labor market policy which takes into consideration both its direct and indirect effects on the economy. In this sense, general equilibrium models can be a useful resource for policymakers in developing countries.
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Cassoni, A. (2005), “¿Cuánto empleo están generando las exoneraciones fiscales?,” Working Paper 16/05, Departamento de Economía, Universidad de la República.


APPENDIX. The CGE Model

Lowercase fonts indicate endogenous variables, uppercase fonts are used for exogenous variables and Greek letters indicate parameters. Subscripts $i, j$ refer to sectors, with $i_{for}$ representing formal sectors—all sectors except the informal one. Subscript $z$ refers to geographic zones (Uruguay, Argentina, Brazil and the rest of the world), while $t$ refers to trade partners ($z$ minus Uruguay). Subscript $h$ refers to representative households grouped according to income levels, and subscript $k$ refers to $h$ plus government. $f$ is the subset of factors of production (unskilled labor, medium-skilled labor, skilled labor and capital); $sf$ is the set of simple factors (composite labor and capital), $labnc$ is the subset of medium-skilled and unskilled labor and $lab$ includes the three categories of labor.

Demand

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), so that 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:

$$c_{ih} = \mu_{ih} \cdot \frac{y_h (1 - td_h)(1 - msav_h)}{pf_i} \quad (A1)$$

where $c_{ih}$ is the demand for a composite final good $i$ by household $h$, $y_h$ is the total income of a representative household $h$, $td_h$ is the direct tax rate, $msav_h$ is the marginal propensity to save and $pf_i$ is the composite final price index. This index is defined as:

$$pf_i = \left( \sum_z \lambda_{zi}^\Phi (p_{zi})^{1-\Phi_i} \right)^{1/(1-\Phi_i)} \quad (A2)$$

where $\lambda_{zi}$ is the share parameter in the Armington function, $\Phi_i$ is the elasticity of substitution between goods of different origin and $p_{zi}$ is the market price of good $i$ in market $z$. 
Investment demand for good $i$ is a fixed share of total investment $I$:

$$c_{i,\text{inv}} = \mu_{i,\text{inv}} \frac{I}{pf_i} \quad (A3)$$

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

$$d_{zik} = \lambda_{zi}^{\Phi_i} \left( \frac{p_{zi}}{pf_i} \right)^{-\Phi_i} \cdot c_{ik} \quad (A4)$$

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:

$$e_{iz} = \frac{\varepsilon_{iz} p_{iz}^{-\eta_i} \cdot \text{REV}_t}{ER \cdot pd_{zi}^{-\eta_i}} \quad (A5)$$

where $e_{iz}$ is the demand for a variety of the differentiated good $i$ in market $z$, $p_{iz}$ is the local export price, $pd_{zi}$ is the domestic price index of good $i$ in market $z$, $\text{REV}_t$ is the real income of the partner $t$, $ER$ is the exchange rate and $\varepsilon_{iz}$ is a parameter and $\eta_i$ is the export demand elasticity.

Production

Each sector combines primary factors and intermediate inputs following a Cobb-Douglas production function. Value added is obtained through a nested CES production function combining composite labor and capital at the upper level, and different labor categories at the lower level.

Cost

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

$$v_i = \omega_i \left( vc_i \left( 1 + tv a_i \right) \right)^{1-\sum_j \alpha_j} \prod_j w_{ij}^{\alpha_j} \quad (A6)$$
where \( v_i \) is the variable unit cost, \( vc_i \) is the value added cost and \( vi_{ij} \) is the composite price of intermediate inputs. \( \alpha_{ij} \) is the distribution parameter of a Cobb-Douglas production function, \( tv_{ai} \) is the value added tax rate and \( \omega_i \) is a parameter.

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

\[
v_{ci} = \left[ \sum \delta^\sigma . w_{sf,i}^{(1-\sigma)} \right]^{1/(1-\sigma)}
\]

(A7)

where \( w_{sf,i} \) are returns to factors (rental rate of capital and the average wage) paid in sector \( i \), \( \delta \) is the distribution parameter of the CES function for value added, while \( \sigma \) is the elasticity of substitution between capital and labor.

As the model considers three types of labor, the average wage is a combination of wages paid to skilled, medium-skilled and unskilled workers. It is assumed that the different labor types are combined following a CES function, so that the average wage is:

\[
w_{lab,i} = \frac{1}{\varphi_i} \left[ \sum_{lab} \xi_i^\theta_i \cdot (w_{lab} \cdot wd_i (1 + tfac_i)) \right]^{1/(1-\theta_i)}
\]

(A8)

where \( w_{lab,i} \) is the average wage, \( w_{lab} \) is the wage paid to labor type \( lab \), \( wd_i \) is the wage differential, \( tfac_i \) is the labor tax paid by employers, \( \xi \) and \( \varphi \) are the distribution and scale parameters, respectively and \( \theta_i \) is the elasticity of substitution between different labor types.

Wage differential is determined by the following equation:

\[
\frac{wd_{labnc,i} - 1}{wd_{labnc,i}} = \frac{\kappa . rd}{(D^2 - D)} + \frac{\kappa (D1 + S) \bar{LU}_{labnc}}{(D2 - D1)(\bar{LU}_{labnc} - \sum_i lu_{labnc,i})}
\]

(A9)

where \( \kappa \) is the utility of shirking, \( rd \) is the discount rate, \( D1 \) is the probability of firing workers who were not shirking, \( D2 \) is the probability of being caught shirking and therefore fired and \( S \) is the quitting rate in the formal sector. \( \bar{LU}_{labnc} \) refers to labor supply by category of labor (fixed) and \( lu_{labnc,i} \) represents labor demand by sector \( i \) for each type of labor \( labnc \).
Intermediate inputs are differentiated by geographic origin with an Armington formulation. The composite price of intermediate inputs is:

\[ v_{ji} = \left( \sum_z \gamma_{zji} \cdot (p_{zj})^{1-\phi_j} \right)^{1/(1-\phi_j)} \]  

(A10)

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

**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:

\[ x_{zji} = \frac{\alpha_{ji} v_i}{v_{ji}} \frac{p_{zj}}{\left( \frac{\gamma_{zji}}{v_{ji}} \right)^{1-\phi_i}} \]  

(A11)

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:

\[ va_i = \alpha v_i q_i \frac{v_i}{vc_i (1 + tv_{ai})} \]  

(A12)

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

\[ fd_{sf,i} = \left( \frac{w_{sf,i}}{\delta_{sf,i} \cdot vc_i} \right)^{-\sigma_i} \cdot va \]  

(A13)
Finally, the labor demand equations are the following:

\[ l_{lab,i} = \left( \frac{w_{lab} \cdot wd_i \cdot (1 + tfac_{lab})}{\xi_i \cdot w_{lab,i}} \right)^{-\frac{1}{\rho_i}} \cdot fd_{lab,i} \]  

(A14)

**Domestic pricing**

Since all sectors operate in perfect competition, the equilibrium price of output is equal to its variable unit cost \((v_i)\):

\[ p_{ui} = v_i (1 + tex_i) \]  

(A15)

where the lowercase \(u\) refers to Uruguay and \(tex_i\) is the sales tax rate. The firms charge the same price in domestic and foreign markets.

The consumption price index is defined as:

\[ pind = \frac{\sum_{i,h} c_{ih} \cdot p_i}{\sum_{i,h} c_{ih}} \]  

(A16)

In all scenarios \(pind\) is set as the numeraire.

**General equilibrium**

Household income is endogenous and is the sum of the returns to factors of production (net of taxes) and transfers from the government:

\[ y_h = \sum_{lab,i} (w_{lab} \cdot wd_i \cdot (1 - tlab_{lab})) + cap.wf_{cap,i} + tr_h \]  

(A17)

Government income is the sum of tariff and tax collection receipts:

\[ y_{gov} = \sum_i va_i, vc_i, tva_i + \sum_i tex_i, q_{i,ar} \cdot p_{ar,i} + \sum_i tex_i, z_{i,ar} \cdot p_{ar,i} \]

\[ + \sum_i \left( \sum_z \tau_z d_z n_z p_{zi} + n_{ui} \sum_z \sum_j \tau_j x_{zj} n_{zj} p_{zj} \right) \]

\[ + \sum_h tdh_h : y_h + \sum_{lab} \sum_{ifor} tlab_{lab, i} \cdot w_{lab, wd_i} \cdot fd_{lab, wd_i} \]

\[ + \sum_{ifor} tcap, fd_{cap, wf_{cap}} \]  

(A18)
Government expenditure is the sum of transfers to households, government consumption and public wages:

$$GE = \sum_h t\gamma_h + \sum_z d_{zg}p_{zg} + \lambda_p w_l$$  \hspace{1cm} (A19)

Government savings, assumed to be constant, are obtained as the difference between government income and expenditure:

$$SG = y_G - GE$$  \hspace{1cm} (A20)

At equilibrium, labor supply (fixed) equals labor demand:

$$LS_{lab} = \sum_i l_{lab,i}$$  \hspace{1cm} (A21)

And the same condition clears the capital market:

$$CAP_i = cap_i$$  \hspace{1cm} (A22)

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

$$q_i = d_{ui} + \sum_j x_{uij} + \sum_l e_{it}$$  \hspace{1cm} (A23)

The external equilibrium is:

$$\sum_i \sum_t e_{it} \cdot p_{ui} \cdot ER - \sum_i \sum_t d_{ti} \cdot p_{zi} - \sum_i n_{ui} \sum_j \sum_l x_{tji} \cdot p_{tj} = B$$  \hspace{1cm} (A24)

Finally, at equilibrium investment equals total savings:

$$I = \sum_h (msav_h \cdot y_h \cdot (1 - tdh_h)) + SG - SCCB.ER$$  \hspace{1cm} (A25)