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Assessing the impact of the 2007 Tax Reform on poverty and inequality in Uruguay

Final draft for comments

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Abstract

In the context of a sharp rise in poverty incidence and an increase in inequality since the end of the last decade, a major Tax Reform was enforced by the middle of 2007, with the explicit goals of promoting greater efficiency and equity in the Uruguayan tax system. Overall, the Reform substantially increased direct taxation on personal income with increasing marginal rates, lowered indirect taxes and direct taxes on firms, uniformed the employer contribution to social security across sectors of activity and eliminated some highly distortive taxes.

We asses the joint effect of these main changes on macro balances, labour market, poverty and inequality using a top down static CGE – microsimulation approach. We find that the full implementation of the Tax Reform has significant general equilibrium effects, which jointly reinforce the observed "next day" reduction of poverty incidence, poverty gap and severity of poverty due to the implementation of its main policy, the introduction of a dual direct personal income tax. General equilibrium effects provoke a minor additional reduction of inequality. The full reform is expansive though it actually increases the tax burden, as its main changes tend to reduce price distortions of goods and factors, provoking a better reallocation of resources and stimulating activity expansion.

JEL classification: C15; D58; H20; I38

Keywords: Tax Reform; CGE models; Microsimulations; Poverty; Inequality

Introduction

Although Uruguay has historically shown low levels of poverty and inequality in comparison with the rest of the Latin-American region, recent trends of poverty incidence have not been encouraging. During the first half of the nineties poverty incidence was significantly reduced with respect to the previous decade. However, this situation reversed in 1995 and poverty incidence increased, especially during the economic recession that began in 1999 and had its climax in 2002 with a severe financial crisis. During this period wages lost more than 20% of their purchasing power, and the unemployment rate reached its historical maximum (see Table 1).

In spite of the strong post-crisis economic growth and the reduction of unemployment, poverty incidence is still very high in comparison to the levels it attained by the mid-nineties. In 2007 25.5% of urban population[1] was below the national poverty line, a percentage that was higher than the level of 1991. As for inequality, it has shown a continuous deterioration during the second half of the nineties, which continued during the crisis. Post-crisis poverty reduction did not translate into inequality reduction, but instead into a small increase, showing that the economic crisis favoured income concentration (see Graph 1).

In this context, the government that took office on March 2005 sent a tax reform bill to Congress which was approved on January 2007, and enforced by the middle of 2007[2]. It is

[1] Rural population in Uruguay represents only 6.3% of total population.

[2] Uruguayan Law Nº 18.083, known as the Tax System Reform.

the first structural tax reform after thirty years, and the government expects it to have an important role in income redistribution.

Recently, Amarante, Arim and Salas (2007) analyzed the impact on inequality and poverty of the changes introduced by the 2007 Tax Reform that affect directly household disposable incomes, i.e. the change in value added tax and direct income tax, using an arithmetical microsimulation approach. They find a redistributive effect of the tax changes they analyze. Whereas the pre-reform system was practically neutral from the point of view of inequality, the new structure turns out to be slightly progressive, though the impact on inequality is relatively low. This is explained by the lower regressiveness of the new value added tax and the greater progressiveness of new direct taxation. They also find that the changes in value added tax and direct income taxation have a slight positive impact on poverty incidence. Such impact is basically explained by price reduction due to the change in the value added tax, which they assumed is entirely translated into consumer prices.

Although this study represents an important progress in the knowledge of the tax reform impacts it is based on partial equilibrium analysis, mainly arithmetical microsimulations. However, a policy shock such as the 2007 Tax Reform could indeed provoke changes in the behaviour of agents, induce reallocation of resources and generate feedback impacts from the economic system on household income, consumption and savings. This work aims to assess the impact of the four main changes introduced by this tax reform, with a methodological approach that takes into account general equilibrium effects. These changes are: a) introduction of a new income tax on households; b) changes in the tax base and rates of the

value added tax (VAT), and elimination of two sales taxes (COFIS – *Contribución al Financiamiento de la Seguridad Social* and IMESSA- *Impuesto Específico a los Servicios de Salud*)[3]; c) modifications on labour factor tax, through the uniformization of the employer contribution rate to social security across economic activities; and d) a reduction in direct tax on firms through the introduction of the *Impuesto a la Renta de las Actividades Económicas* (IRAE)[4], substituting mainly for the *Impuesto a la Renta de Industria y Comercio,* IRIC[5].

With this purpose, we built a static computable general equilibrium model (CGE), linked to a microsimulation model to capture the macro-micro links. We assess the effects of the main tax changes on aggregate and sectoral output, aggregate and sectoral employment, fiscal balance, poverty and inequality.

Brief Description of the Uruguayan Tax System and Main Features of the Tax Reform

The pre-reform tax structure

Before the 2007 Tax Reform, the Uruguayan tax system was based on a large number of taxes; but only a few concentrated most fiscal revenues. The most important ones were the

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3 English translations are *Contribution for Social Security Financing* and *Specific Tax on Health Services*, respectively.

4 English translation is *Tax on Profits of Economic Activities*

5 English translation is *Tax on Profits of Industry and Commerce.*

value added tax (VAT), two taxes on commodities –, IMESI (*Impuesto Específico Interno)*[6] and COFIS–, and a tax on benefits –IRIC–. The joint share of VAT, IMESI and COFIS was near 70% of fiscal revenues (excluding social security taxes), while IRIC had a 13% share. The pre-reform direct income tax on labour and pensions –IRP (*Impuesto a las Retribuciones Personales*)[7] contributed 5% to total fiscal revenues.

Before the reform, Uruguay presented one of the highest value added tax rates in Latin America (Perazzo, Robino and Vigna, 2002). Nevertheless, the effective taxation differed among goods, as there were three different VAT rates: the basic rate (23%), the minimum rate (14%) and a set of exempted goods. Despite the existence of these high tax rates, exempted goods represented a large share of total consumption (near 40%, according to Amarante, Arim and Salas, 2007).

In addition, there were a large number of sales taxes, which contributed with a small proportion of fiscal revenues, most of which were eliminated in the current reform. Particularly, it is worth mentioning two of them: COFIS and IMESSA. COFIS was a sales tax on goods for intermediate consumption (with a rate of 3%), whose revenues were intended to finance the increasing social security deficit. In this way, the COFIS worked as an activity tax that increased the cost of intermediate consumption, possibly causing a cascading effect on prices. On the other hand, the IMESSA was a specific tax of 5% on

[6] English translation is *Specific Internal Tax.* It is an excise tax on certain goods (tobacco, fuel, beverages, sugar, vehicles, and cosmetics)

[7] English Translation is *Personal Income Tax*

health services, which were exempted from VAT. This treatment implied that health services could not deduct VAT paid on intermediate inputs, therefore increasing their cost.

In the international comparison, Uruguay showed a low incidence of taxes on income and revenues, whereas a high incidence of taxes on goods and services. According to Perazzo *et al (*2002) in the late nineties only 28% of revenues were collected from direct income taxes in Uruguay, while the share for developed countries was much higher. Indeed, the Uruguayan share of revenues from direct taxes was also much lower than in other South American countries like Argentina (42%) or Brazil (53%). Particularly, the incidence of the direct personal income tax (IRP) was much lower than in other countries, and it affected exclusively wages and pensions, whereas certain revenues from capital, specially financial and real-estate capital were not taxed. In this way, the system did not respect the criterion of horizontal equity (Barreix and Roca, 2003).

In terms of distributive impact, preceding studies pointed out the regressive characteristic of the pre-reform tax structure (Grau and Lagomarsino, 2002, Barreix and Roca, 2003). In spite of the fact that the IRP was defined as a progressive tax (since the average rate increased with the amount of the tax base) it was not progressive if the whole household income was taken into account. This occurred because wages and pensions have a lower share in higher income households, so the tax rate on these households' income was effectively lower. As for the VAT, the effective rate by decile of household income showed that the tax was clearly regressive, since it presented a higher incidence in lower deciles, linked to the share of consumption in total household income (see Table 2).

Finally, charges to social security consist of contributions by employers and employees, each of them with different pension and health tax rates. Particularly, the employer contribution (which was modified by the 2007 Reform) consisted of a pension tax of 12.5% of the payroll and a health tax of 5% of the same, so the overall employer contribution to social security (ECSS) was 17.5% of gross wages. The tax was discriminatory by sectors of activity, as in the pre-reform situation manufacturing industries and passenger transportation were exempted from the pension contribution; electricity and the public petroleum refinery were taxed with a rate of 6.5%; whereas the rate for public sector and public enterprises were 19,5% and 24.5%, respectively. Construction was taxed with a unified rate of 76% that included both personal and employer contributions. Finally, a special regime was considered for rural activities, with the tax applied to land extension, and not to labour.

In sum, preceding studies pointed out that the pre-reform tax structure was complex, regressive, and discriminatory by sectors of activity and sources of income. Fiscal revenues showed a high share of taxes on consumption, an incomplete taxation on different sources of income, and a high number of taxes that collected a small part of revenues. In terms of its distributive effects, preceding studies showed that there was space to use the tax structure as an instrument for redistribution.

Main features of the 2007 Tax Reform

The explicit goals of the 2007 Tax Reform are: i) to promote greater equity in the tax structure, relating the tax burden to the taxpaying capacity of each agent; ii) to promote greater efficiency of the tax scheme; and iii) to stimulate investment and employment.

On this basis, the main changes are given by: a) the introduction of a personal income tax (*Impuesto a la Renta de las Personas Físicas*, IRPF) substituting the previous IRP; b) changes in the tax base and rates of the VAT and elimination of COFIS and IMESSA; c) uniformization of the employer contribution rate to social security (ECSS) across economic activities; and d) Introduction of the direct tax on firms (IRAE), substituting mainly for the previous IRIC. In addition, in order to simplify the tax structure, twelve taxes that accumulated approximately 20% of total fiscal revenues were eliminated.

The IRPF is a dual tax, which establishes a different treatment for capital and labour income. Capital revenues are taxed with rates in a range between 3% and 12% (according to source). Labour income is taxed with a progressional scheme, with a minimum not taxable income and progressional rates in a range between 10% and 25% according to tax bases defined in terms of *Bases de Prestaciones Contributivas* (BPC).[8] The IRPF allows deductions from the tax on labour income and pensions, related to medical attention of children under 18 and of pensioners, and to payments to social security[9]. Table 3 presents the bases and rates of IRPF on labour and pensions, together with the previous IRP, whereas Table 4 shows the new IRPF rates on capital income.

Modifications in the VAT consisted of reducing its basic rate from 23% to 22% and its minimum rate from 14% to 10%. In addition, some goods that were exempted before the

[8] The BPC is a unit of account that is adjusted according to average wage growth. The nominal value of the *BPC* was 1636 Uruguayan pesos (approx. 74 dollars) in January 2007.

[9] In the first case, the contributor can deduct 6.5annual BPC for each child. In the case of pensioners, the allowed deductions for medical care are 12 annual BPC.

reform are taxed at the minimum rate (e.g. main health services, passengers transport), or at the basic rate (e.g. tobacco) in the post-reform situation. Moreover, the sales tax on health services (IMESSA) and the tax on intermediate consumption of goods (COFIS) were eliminated.

On the other hand, the reform established a uniform employer contribution rate on pensions of 7.5% for industrial, commercial and service sectors, as well as public enterprises. The 5% health rate is maintained. In this way, the overall ECSS rate is 12.5% in the post reform situation (pre –reform rate was 17.5%). The 19.5% tax rate for public sector is maintained, and so is the exemption for passenger transport. Overall ECSS rates by sector and value added tax rates by commodity pre and post reform are presented in table 5.

Finally, the previous direct tax on enterprises revenue (IRIC) was relatively high (30% of profits) and discriminatory, as some activities were exempted while others paid the entire tax. The reform intended to make a more neutral system, reducing the tax rate to 25% and generalizing it to all sectors. Profits that are then distributed to households pay an additional 7%, corresponding to the IRPF tax on capital. In this way, the reform reduced the rate for re-invested profits, fact that intended to promote investment.

Expected Effects

The implementation of IRPF has a direct effect on the household budget constraint. Households in the first eight deciles of income distribution increased their disposable income in the post-reform situation, whereas households in the two richest deciles experience a

reduction in their disposable income, particularly the richest. The progressive pattern of IRPF is more pronounced than the one in IRP, not only because of the different rates applied to labour income, but also to the fact that gross labour income of the self-employed and capital income are taxed by IRPF in the post-reform situation.[10]

The expected main behavioural responses of households to variations in their budget constraint include changes in consumption and labour supply.[11] After the shock in tax rates, new optimal consumption demand and labour supply are going to be reached by each type of household. If labour supply and consumption effects arising from the implementation of IRPF are large enough, changes in the structure of wages and prices may be expected to take place. Household consumption demand of goods and services is likely to change, both because of the different sign of the variation of disposable income and because income elasticities of demand for different goods differ among households. Also, after the shock, net wages for households in the first eight deciles will be higher, increasing the opportunity cost of leisure and (if substitution effect is larger than income effect), inducing an increase in labour supply. In the opposite direction, we would expect a reduction of labour supply in richer households. Notice that the amount of this effect depends crucially on the wage elasticity of labour supply.

The expected general equilibrium effects would be captured in variations in relative prices of commodities. Also, as sectors of activity face variations in the demand for their goods or

[10] Although strictly, self employment and professional income were taxed by IRP, tax rates were applied to a fixed, and generally, very low base.

services, they will likely change their demand of factors of production, inducing changes in wage rates and employment.

The CGE model captures the effect of value added tax on prices, so if the VAT rate is modified, new market clearing prices and quantities consistent with the optimizing behaviour of consumers and producers will be achieved, possibly modifying the sectoral structure of the economy. This is also expected because the size and the sign of the shock are different between commodities, so the VAT change will have different income effects by type of household. In principle, we would expect a larger (positive) effect on poorer households, as the shock in the minimum rate is larger than in the basic rate.

The employer contribution to social security is part of the labour cost of the activity sectors. A decrease (increase) of the cost of hiring workers should push up (down) labour demand. The magnitude of these variations will depend on the elasticities of substitution between production factors, and the share of labour in total costs for each sector of activity. Regarding the shock, we would expect labour demand to increase in the commerce and service sector and construction (as a consequence of the reduction in labour cost) and to decrease in manufacturing (for the opposite reason). The increase in labour demand in the winning sectors could push up wages. If the fall in labour demand in the manufacturing sector is outweighed by the increase in labour demand of the other sectors, an increase in overall wages or a decrease in unemployment could also be expected.

[11] In the long run, progressional tax rates on income may also induce negative effects on human capital accumulation, via lowering the wage premia of the more educated. We are not taking this effect into account, as

Finally, the implementation of IRAE could lead to changes in returns to capital, linked to the reduction of the tax rate for non distributed profits. This would affect relative prices of factors, and the level and the allocation of new investment.

It is worth mentioning that because we are keeping our model static, we will not asses the effects of IRAE in terms of capital accumulation, although it is probably the main objective of the change concerning this tax. A full account of IRAE effects would need a dynamic model, feature that could be part of further extensions of this work. In this study, we take into account the once and for all effects of the introduction of IRAE as part of the full reform, not pretending an exhaustive analysis of its own impact.

Methodology and Data

Our methodology has two main components: a static computable general equilibrium model (CGE) and a microsimulation procedure to evaluate the effects on poverty and inequality taking into account the full income distribution.

The Data

For the purpose of this study, we built a new 2006 benchmark Social Accounting Matrix (SAM) using the last Supply and Use Tables published by the Central Bank, (with a 1997 benchmark), 2006 National Accounts data, 2006 Household Survey data (that collects information of both urban and rural households), and complementary data about fiscal

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we are keeping our analysis in a static framework.

revenues. To calibrate the model, a proper disaggregation of the SAM was needed in relation to: a) households, in order to capture different consumption structures, different sources of income, and variations in the way households are affected by IRPF; b) sectors of activity, so as to catch variations in the way they are affected by changes in VAT and ECSS; and c) labour, to capture variations in the way they are affected by progressional IRPF on labour income. Obviously, a detailed modelling of taxes is required, so the data had to be disaggregated with that purpose.

Our final SAM includes 24 activities (and 24 commodities) aggregated according VAT and ECSS rates; three types of labour: those with less than completed secondary education (unskilled); those with completed secondary but incomplete tertiary education (semi-skilled) and those with completed tertiary education (skilled); and one type of capital factor, which includes land. The composition of production in Uruguay is reflected on Table 6.

There are 13 tax accounts, one for each of the taxes that were specifically considered, including those paid by institutions, commodity sales, activities and factors. Table 7 shows the different tax instruments and their share in total revenues in the pre-reform situation. The tax structure shows a clear concentration of collection in the VAT (which represents nearly 40% of total revenues and 10% of GDP), followed by the employer contribution to social security. On the other hand, taxes on household income represent a low percentage of total revenues.

Households are disaggregated in ten types, according to deciles of household income. The institution accounts include also a firm, the government and the rest of the world. The SAM includes a savings and investment account.

The decision to dissagregate households according to deciles of household income was adopted to minimize heterogeneity in income tax rates within each household group (and maximize it between groups). Note that effective income tax rates (on labor and pensions) *vary* according to income, so this was best dissagregation in order to achieve the above purpose. In the same direction, the disaggregation of labour by skill allowed to further disaggregate effective tax rates *within* types of households, as endowments of labor by skill noticeable vary across them. In spite of the fact that tax rates are not defined by skill, there is obviously a high correlation between skill and income.

In order to calibrate the model and to specify the simulated shock on labour and pension income taxes, an arithmetical microsimulation was carried out. As a result, effective labour, pension and capital tax rates were obtained for each household type. Effective rates were obtained by applying the ratio resulting of adding up all incomes to all the corresponding tax payments. Thus, effective rates include tax evasion (or informality). One important assumption made is that tax evasion does not change with the reform, although we are taking it into account at its initial level. A detailed description of our arithmetical microsimulation is presented on the Technical Appendix.

Apart from the SAM, our database includes various elasticities including production, consumption, trade, labour supply and wage elasticity to unemployment, data on stocks of

labour disaggregated by skill and sector of activity and on initial unemployment rate by skill level (from the 2006 NHS). The average unemployment rate was near 11% in 2006, and it decreased with workers' skill (see Table 8).

The General Equilibrium Model

Our CGE model is based on the Standard Model by Löfgren, Harris and Robinson (2002). Nevertheless we introduced several modifications to the Standard Model, in order to take into account the main effects of the Tax Reform. Those modifications are related to: a) the treatment of the value added tax; b) the modelling of the specific tax on intermediate consumption of goods (COFIS); c) the modelling of income taxes; d) the modelling of the employer contribution to social security; e) the choice of the production function; and e) the modelling of the labour market. In this section we describe the main aspects of the model and the above mentioned modifications. A detailed description of all the equations is included in the Technical Appendix B.

Main features of the CGE model

Our model has the following general characteristics. At the top level of the production function a Leontief specification is used to combine value added and intermediate consumption. In turn, value added is modelled by a nested CES (Constant Elasticity of Substitution) function that considers a combined labour factor and capital.

In the domestic market, domestic and imported commodities are imperfect substitutes so they follow an Armington specification. Domestic producers choose to export or to sell in the

domestic market according to a CET (Constant Elasticity of Transformation) function. The small open economy assumption is adopted, so the economy is a price-taker in foreign markets.

Household consumption expenditure is distributed between commodities and leisure according to a Stone-Geary utility function. Firms receive capital payments, pay taxes and transfer most of these payments to households, keeping only non distributed benefits. Government collects taxes and tariffs, purchases commodities, makes transfers to households (mostly related to social security), and makes interest payments for loans received from the rest of the world.

Labour market is segmented into the three categories of workers (skilled, semiskilled and unskilled). Endogenous labour supply and a wage curve are introduced. Consumer Price Index is the *numeraire*.

Treatment of the Value Added Tax (VAT) and Tax on Intermediate Consumption of Goods (COFIS)

The Standard Model by Lögfren *et al*. models a tax on value added, not a value added tax. We specify a value added tax on commodities with rebates for intermediate inputs, following Go, Kearney, Robinson and Thierfelder (2005), so there is no cascading effect on prices of VAT on intermediate goods. We assume commodities are taxed at the corresponding rate (basic or minimum), regardless if they are final or intermediate transactions. We introduced

rebates on intermediate inputs, so producers can deduct taxes paid on intermediate consumption. Import sales are taxed, while exports are not subject to VAT.

To calibrate the model, we initially assumed commodity sales pay the corresponding theoretical VAT rate. For each production activity, we compute the rebate on intermediate consumption using input –output data. Finally, we adjusted all the values with a scale factor, in order to make total VAT revenues consistent with the total value reported by the Ministry of Economy and Finance (MEF). In this way, we obtained *effective* VAT rates, which *include* tax evasion, which we assumed to be proportional within sectors of activity.

In order to carry out the simulations, effective VAT rates were specified as the product of the legal rates and a fixed factor (representing tax evasion), as described in equation 23 of Appendix B. In the corresponding simulations, we shock the legal rate and leave the scaling factor fixed. In this way, we are assuming that tax evasion does not change because of the reform, although we are taking it into account at its initial level.

The demand price of commodity *c* includes the value added tax rate and the corresponding excise tax on commodities (IMESI or IMESSA), as shown in equation 20 of Appendix B. The rebate to each activity is related to total intermediate consumption (equation 39). Finally, the price of aggregate intermediate input includes the rebate per unit of aggregate intermediate input, and the tax on intermediate goods (equation 18).

Specification of household income taxes

The Standard Model provides one direct tax on domestic institutions' total income. We split the direct tax on households according to source of income and type of labour, in five taxes: a) direct tax on household skilled labour income; b) direct tax on household semi-skilled labour income; c) direct tax on household unskilled labour income; d) direct tax on household capital income; and e) direct tax on household income from pensions. Equation 33 (see Appendix B) describes household consumption, which is obtained as household income net of transfers to other domestic institutions, savings and direct taxes.

Specification of production functions and employer contribution to social security

In the base situation the employer contribution to social security differs between activities. Therefore, we introduced the ECSS as a tax paid by activities for their total labour factor. In the production side, value added is modelled using a nested CES technology. At the bottom, the three labour factors are combined into a composite labour factor, which is in turn combined with capital. The employer contribution to social security plays a role in the CES equation that combines composite labour and capital (notice that the rate does not differ by type of labour). Factor remuneration may differ across activities by a fixed distortion factor calibrated from the SAM and the labour stock data.[12]

The treatment of the rate of ECSS is the same as the VAT rates. We specify effective rates as the product of the legal rate and a fixed scale factor representing evasion (see equation 24 of Appendix B). In this case, tax evasion is a function of the number of informal workers and

wages in each sector of activity, obtained from the National Household Survey 2006. An estimation of total tax evasion is obtained as the difference between theoretical revenues (resulting of applying legal rates) and actual revenues informed by the Social Security Bank.

Labour Market specification

The modelling of the labour market is a crucial aspect, because it provides the main link between the CGE output and the microsimulations. We are considering an endogenous labour supply in order to capture its variations due to changes on disposable income.

As shown before, unemployment rates are relatively high in the Uruguayan labour market, and they differ by type of labour. So, unemployment has to be considered in the modelling of the labour market. In this way, labour market equilibrium is not referred to its strict micro-theoretic definition. Nevertheless, the solution provided by the model guarantees that the resulting unemployment rate is consistent with the prevailing wage rate for each market, via a "wage curve" (Blanchflower and Oswald, 1995). The wage curve concept indicates a negatively sloped relationship between the unemployment rate and the real wage rate, and is associated with non-competitive labour market behaviour.

We allow the existence of a negative elasticity of wages to unemployment by introducing one wage curve for each segment of the labour market. Elasticities are taken from Bucheli and Gonzalez (2007) who provide empirical estimates for Uruguay. Estimates indicate that there is not a significant effect of unemployment on wages for skilled workers (estimated elasticity

[12] Equations 3 to 5 of the model (see Technical Appendix) specify the nested CES production function.

is -0,034, not significantly different from zero). However, a similar wage curve relation exists for unskilled and semiskilled workers. The estimated elasticity is a little higher for unskilled workers (-0,145) than the one estimated for semiskilled workers (-0,139).[13]

In order to introduce endogenous labour supply in our CGE model, the set of consumption goods must be extended to include leisure. Following Annabi (2003), we assume that leisure is a normal good with an opportunity cost equal to the wage rate. An increase in the wage raises the opportunity cost of leisure and induces the consumer to work more (substitution effect), while, on the other hand, the increase in the wage rate raises real income, thus increasing the consumption of normal goods, including leisure (income effect).

In our case, each representative household owns the three types of labour, so the problem is not only how to model the decision between labour-leisure, but also deal with which type of labour is going to vary. To do this, we assume that each household is endowed with three budgets, (one per type of labour) to be allocated between work and leisure, in the way treated by Decaluwé, Lemelin and Bahan (2006). Each household is treated as if it were composed of (a maximum of) three members (one per type of labour), where each member maximizes his own utility regardless of the decision of other members. We assume a minimum level of leisure in the utility function, together with a minimum level of consumption. Equation 35 of Appendix B describes the labour supply of *flab* type of household *h*, derived from the (Stone-Geary) utility maximization program. In the labour supply equation we replaced net wage rate by the "expected" wage rate (corrected by unemployment rate). So, we are assuming the

[13] The wage curve is specified in equation 41 of the Technical Appendix.

representative agents maximize their utility knowing that a share of their labour supply may not find employment (or in other words, adjusting for a probability of finding employment).

The Microsimulation Model

The simulation with the CGE model provides a picture of the effects of the tax reform at the macro level. To go from the counterfactual effects simulated with the CGE model to poverty and income distribution at the household level we adopted the methodology presented in Ganuza, Paes de Barros and Vos (2002), which is an adaptation of the methodology proposed by Almeida dos Reis and Paes de Barros (1991)[14]. It consists of a non parametric technique that simulates at the micro level the labour market and income structure obtained from the macro simulations with the CGE model. With that purpose, we use micro data from the 2006 National Household Survey (NHS), and obtain poverty and inequality indicators consistent with that simulated structure. Thus, the approach is of the "top-down" type; that is, from the policy shock, through changes in prices of factors, unemployment and employment structure, to poverty and inequality, assuming no additional feedback effects.

We defined the labour market structure in terms of six parameters: participation rate, unemployment rate, sectoral structure of employment, relative wages, and the average wage level. We also incorporated the counterfactual variation of household capital income, which is equal to the simulated variation of the capital factor price in the CGE model. The simulation of capital income is carried out at the household level (not at the individual level).

[14] This type of counterfactual microsimulation originates in Orcutt (1957), Oaxaca (1973) and Blinder (1973). In the case of Uruguay, this methodology has been used in Laens and Perera (2004), Terra, Laens, Bucheli and Estrades (2006) and Laens and Llambí (2007).

Individuals are defined according to skill (formal education), in the three labour categories defined in the CGE (i.e. skilled, semi-skilled and unskilled). In turn, we aggregated the 24 sectors of activity in the CGE model into 7 sectors: a) primary; b) manufacturing; c) construction; d) commerce; e) electricity, gas, water and public administration[15] f) Transport, communications and services and g) private education and health services.

The microsimulations involve the following sequential steps: i) labour supply adjustment; ii) unemployment rate adjustment; iii) sectoral employment change; iv) relative wage changes between types of labour; v) average wage change vi) capital income change. The sequence is similar to the one followed by Ganuza et al. (2002), except that they did not take into account capital income variation. Although the results obtained from this methodology are in principle path dependent, some sensitivity analysis we carried out suggests that the results are robust to the selected sequence of changes.[16]

It is important to notice that in the NHS we observe the "after tax" incomes, so at the first stage we must estimate the pre-tax incomes. Then, taking into account the new direct tax system we estimate the new after-tax incomes of individuals and therefore the new disposable incomes of households. A first picture of the effects of the reform concerning the direct income tax on households consists in a comparison of the simulated after-tax household income and the previous ones. Since this simulation does not take into account the "general equilibrium" effects (on labour status and pre-tax incomes) we can see this as the

[15] Note that electricity and water are produced by public enterprises.

[16] Results are available if interested.

"first round" or "next day" effect of the direct income tax reform (with no changes in agents behaviour); and we will refer to this as arithmetical microsimulation.

In order to introduce the general equilibrium effects arising from the CGE model, we change one parameter of the labour market at a time in the sequence indicated above. It is important to note that the simulated changes in labour remuneration refer to the *gross* or pre-tax income. To obtain information of *net or disposable* income (after direct taxes), an arithmetical microsimulation has to be carried out (again) over the new results. This procedure allows us to compute effective income tax rates incorporating the "second round" effects (labour market and factor price changes) taking into account some individual and household exogenous variables that are relevant for the tax payment and are not present in the CGE (e.g. the number of children in household).

An important issue is the imputation of informal/formal status of the new employed workers[17]. That is, if unemployment rate decreases in a specific population segment, some unemployed individuals will be randomly assigned to a job. The informal/formal attribute of this new job is crucial, since it determines if there will be an effective burden on labour income or not. To deal with this, we estimated the observed incidence of informality by sector and type of workers in the NHS and then we randomly assigned the informal/formal status on the basis of these observed specific propensities.

[17] See also that our CGE model does not endogenize this labour market dimension.

Finally, notice that labour income tax rates (IRPF –labour) vary with the level of income; they are in fact endogenous, although we treat them as exogenous in the macro CGE model. Nevertheless, we compared the "final" effective tax rates on labour income arising from the microsimulations with the initial shock on the CGE, accounting for changes in the tax bases due to changes in average nominal wages, and only slight differences were found.[18]

Simulations and CGE model closures

Several simulations were carried out. In each simulation, we introduced a shock for some (or all) of the specific tax rates involved in the reform. Firstly, we simulated the full reform, including the introduction of IRPF, the changes in value added tax rates, the elimination of COFIS and IMESSA, the changes in the rate of firms´ contribution to social security, and the introduction of IRAE substituting for IRIC. Then, each of these components of the reform was simulated separately, in order to assess the relative importance of their effects. Therefore, the list of simulations carried out is as follows:

a) REFORM – Simulation of the full reform
b) IRPF – Simulation of the new personal income tax substituting for IRP
c) VAT – Simulation of the changes introduced in value added tax plus the elimination of COFIS and IMESSA
d) ECSS– Simulation of the changes in the employers´ contribution to social security

[18] Results are available if interested.

e) IRAE- Simulation of the introduction of IRAE substituting for IRIC

In all simulations a savings driven closure was adopted, keeping constant the marginal propensity to save for domestic non government institutions. The trade balance is exogenous and the real exchange rate is the equilibrating variable.

When analyzing tax reforms, it is generally assumed that government revenue does not change (Go *et al,* 2005). Nevertheless, we choose to carry out three different government closures. In the first two, we allowed government income to vary endogenously. The reason for this is that we *first* intended to assess the impact of the *actual* reform, *including* effects derived from different assumptions in government adjustment as a result of the reform. Thus, the first two government closures adopted were guided by the rationale of studying the effects of the reform in extreme government behaviours: a) the variation in government income due to the reform is completely absorbed by government expenditure, with constant government savings, or b) quantities of government consumption are fixed and income variations alter government savings. None of these first two closures adopted are completely realistic and they are merely used to clarify the impact of the actual reform (with no compensating mechanisms) by assigning the variation of government income to either more consumption or more savings with no intermediate setting.

The budget-neutral closures usually "compensate" the simulated changes in direct taxes with a change in indirect taxes or viceversa. In our case, this type of compensation is not easy to interpret when simulating the full reform, because the latter introduces changes in all major

direct *and* indirect taxes. However, it is certainly interesting to assess the trade-off between higher (lower) value added tax and lower (higher) personal income tax, keeping government savings and real government consumption fixed. In fact, the reduction in VAT compensating for the introduction of IRPF has been one of the main features of the reform and one of the expected medium run results.

Therefore, we chose to carry out the full reform maintaining real government consumption and government savings unchanged, while some specific tax compensates for revenue losses or increases. We chose the value added tax to compensate for the full reform, the introduction of IRPF, the changes in employers contribution to social security and the changes in the direct tax on firms. For the VAT case, we chose the tax on labour income (THLAB) to be the compensating rate.

In the full reform case, we simulate the change in VAT rate (together with the rest of the tax changes) and then we allow a proportional adjustment in VAT rates to compensate for variations in government revenues. So, this simulation allows to draw the additional points in VAT rates that could be reduced (or increased) if the reform is conceived to be revenue neutral. Table 9 summarizes the simulations carried out and the closures used.

As for the labour market, we are assuming that capital and labour are perfectly mobile across sectors but the labour market is segmented by skill level. Capital supply is fixed and fully employed, so the average capital return is the equilibrating variable. Labour supply is endogenous and there is unemployment in every labour market segment. Both labour

employment and wages could vary after a shock. Wage differentials across activity sectors are kept fixed at the initial level.

Results of the CGE simulations

Government accounts

Table 10 shows the results obtained for government accounts in all the carried out simulations. The first two groups of simulations show the results of the actual reform, with two alternative uses of the additional revenue. The share of government income in GDP increases 0,6pp when the full reform is simulated, regardless of the destination of the additional revenue. The introduction of IRPF generates an increase of almost 3pp in the share of government income, but this is partly compensated by the reduction of receipts from indirect taxes, from employers´ contribution to social security and from the tax on benefits. The changes in VAT and other indirect taxes (COFIS and IMESSA) are the main source of reduction in government income.

As a result of these opposite effects, there is a significant change in the composition of tax revenue (excluding import taxes and contributions to social security). The share of direct taxes rises from 22.3% at the base scenario to 33.4% when the full reform is simulated, while the relative importance of indirect taxes declines 11 percentage points.

Table 10 also shows the different outcomes that are obtained according to the destination of the additional revenue. In the first group of simulations (fixed government consumption), the

share of government savings in GDP raises 0.5 pp. Conversely, if the additional government income were used to increase government consumption, the latter would raise 0,5pp as a share of GDP. As we will show later on, both situations generate different macro results. At the bottom of Table 10 we present the results of the "compensated" simulations. When the reform is compensated by changes in VAT rates, the share of direct taxes reaches its highest value (34% of GDP).

A relevant result is the "cost" of each component of the reform in terms of some specific tax. In particular, if the IRPF were introduced and compensated by a reduction of VAT rates, the initial legal rates (23% and 14%) could be lowered to 15% (the basic rate) and 9% (the minimum rate). In the case of the full reform (which includes changes in other taxes and a reduction VAT rates to 22% and 10%), if VAT were chosen as the compensating mechanism, the VAT rate could be lowered an additional percentage point (to 21% the basic rate and 9% the minimum rate).

Macro results

A first result that is worth remarking is that all the simulations of the implementation of the full reform show a similar positive effect on GDP, under the three alternative government closures adopted (see Table 11). Obviously, this does not mean that alternative assumptions on how the government deals with revenue gains from the actual tax reform are irrelevant. The alternative closures imply very different final results regarding absorption and public-private shares in investment, fact that has implications in a dynamic setting.

When government savings are kept fixed (upper part of the table), the positive effect on GDP is mainly explained by the application of the IRPF (which is fiscal-revenue increasing), and to a lesser extent, by the effect of the ECSS shock. The increase in government income enables a 4.1% increase in real government consumption, which means a slight increase of government consumption as a share of GDP. Under this assumption, investment and exports increase, as the relevant prices for these activities fall, due to the changes in value added tax rates and elimination of the tax on intermediate consumption of goods. Increasing government revenues tend to crowd out private consumption, which shows only a small increase (0.6%).

In the second government closure, when government consumption is kept fixed and we allow government savings to vary endogenously, GDP also increases, but slightly less than in the previous closure. All the components of the reform have positive effects on aggregate activity (except for the neutral effect of the IRAE shock). Increased government savings allow for an increase in investment (16.2% due to the revenue increasing application of IRPF). In this case, there is a moderate crowding out effect on investment (as private savings show a much moderate increase).

The most interesting result is the budget neutral simulation, allowing the changes in the tax structure to be compensated by some specific tax (value added tax or tax on labour income). In this case, no changes in government accounts are allowed, and all the variations are due to the change in the tax structure. As noted, in this case the reform is also expansive in terms of GDP, with a similar variation as the two previous simulations.

The analysis of each separate effect illustrates part of the mechanisms behind these results. As shown in the bottom part of Table 11, most of the positive effect derives in replacement of indirect taxation (VAT) for direct taxation on household income (IRPF) (see IRPF_VAT simulation in Table 11).[19] The other positive effect is the reduction of distortions on relative factor prices derived by the ECSS, by reducing its rate and making it more uniform across sectors of activity.

The elimination, reduction or uniformization of some indirect taxes (like COFIS, IMESSA or ECSS) and its replacement by an increase in direct taxation tends to reduce price distortions on goods and factor markets.[20] As factors are assumed to be (perfectly) mobile across sectors, this change induces a better reallocation of resources, and stimulates economic activity.

Direct taxation on household income could also be distortive and/or have non desirable long run effects, at least for two reasons. First, because of the efficiency loss associated with substitution effects between labour (commodities) and leisure. Nevertheless, as we show later, this effect would not be significant in our case. Second and relevant in this specific

[19] Note that the first column (simulation VAT_THLAB) also involves an increase in direct taxation (in this case on labour income) substituting a reduction in revenues from indirect taxes (VAT). The sign of the result is, as expected, the same, but the magnitude is lower because the shock in VAT rates is smaller.

[20] This result is highly dependent on the perfect competition assumption. In the case of Uruguay (a small open economy) this is a reasonable assumption for the tradable sectors (specially manufacturing and primary activities). However, imperfect competition would be probably a more realistic assumption for some non

case, progressional tax rates on household income could have negative impacts on private savings, with negative implications in dynamic capital accumulation. As said before, we are not dealing with this aspect, as we are keeping our analysis static.

Regarding aggregate household disposable income, the comparison between the first two closures (i.e. allowing the government to spend or to save the additional revenues) shows that the effects are slightly more favourable when we allow current government consumption to increase, as public services have a high value added component (i.e. public education and public health services). As public services' value added is fully composed of labour payments, it is almost completely received by households. In the simulations with flexible government savings (and fixed government consumption) the variation in disposable income is of a lower magnitude than in the previous closure. Investment rises and increases demand for construction and some tradable goods (particularly primary goods and machinery), so a part of the increased demand is absorbed by imports and not captured by domestic institutions.[21]

The budget neutral scenario shows the most favourable situation for household disposable income. In this case, the additional reduction in VAT rates is partly captured by households via lower prices.

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tradable sectors. In these cases, the reduction in VAT rates could be entirely (or greatly) absorbed by firms, thus not translating into efficiency gains.

[21] Again, notice that investment is only considered as a demand factor, as the model is static and therefore it does not capture its dynamic effect on growth.

Labour market results

The expected effects of the reform on the labour market are ambiguous, as the shocks derived from its different components are not uniform across sectors or households. In sectors where VAT and other indirect taxes were cut, prices are initially expected to fall, increasing demand for goods and services and as a result, increasing factor demand. However, the negative effect on factor demand in sectors where VAT increases could compensate for that positive effect in the former sectors. In the same way, the negative effect on demand for goods and services of high income households whose disposable income decreases due to the application of IRPF could outweigh the positive effect on demand from lower income households. Finally, changes in ECSS have also different effects across sectors.

Tables 12, 13 and 14 show the joint results of all those shocks on each factor market, with the three alternative government closures. As specified in the model, total capital supply or demand does not change in any of the simulations, so its retribution captures the whole effect of the reform. In the segmented labour market, however, the effects can be observed in supply, employment (or unemployment) and wages.

The full reform has practically no effect on labour supply. We only find a very slight increase in labour supply of skilled workers induced by a negative income effect (which more than compensates the substitution effect) provoked by IRPF. [22]

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[22] Notice that the direct tax rate is not endogenous in our model, and thus we are not capturing further variations in the marginal tax rate due to changes in labour income, fact that could affect these results.

In contrast, the full reform has a significant effect on employment (and unemployment), due to its positive result in terms of activity growth, in all three alternative government closures. There is also a substitution effect, provoked by the general reduction on the employers´ contribution to social security, which reduces labour cost and stimulates labour demand in all sectors except manufacturing (whose tax rate increased). Actually, if we only consider the ECSS shock, labour demand in the manufacturing sector declines between 3.2% and 1.7%, (depending on the government closure adopted); while it grows in practically all the other sectors of activity (see Table 15).[23] As a result of this only shock, overall employment increases between 0.6% and 1%.

The reduction of the VAT rate and the elimination of the tax on intermediate consumption of goods (COFIS) also have a positive effect on overall employment, under all alternative closures. As indicated before, the elimination and the reduction of highly distortive taxes (particularly the COFIS) induce a better reallocation of resources, stimulating activity growth. As in the ECSS shock (but for different reasons), all private sectors increase their labour demand, except construction and primary activities-when government savings is the adjustment variable-. When we adopt the budget neutral closure, -so the reduction in VAT and the elimination of COFIS is replaced by a uniform increase in the direct labour income tax, - all sectors increase their labour demand (except, of course, the public sector). In this

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Nevertheless, as stated before, only slight differences were found in the comparison of "final" effective tax rates on labour income arising from the microsimulations with the initial shock on the CGE.

[23] When we allow government consumption to decrease, responding to revenue losses caused by the ECSS shock, employment also decreases in the public service sector. When government savings is the adjustment variable, employment in the construction sector is also affected.

case, it is worth noticing that manufacturing and construction are the sectors that benefit the most, both with a high share of intermediate consumption of goods, and thus favoured by the elimination of the COFIS.

In contrast, the effect on employment of the simulation of IRPF alone is negative for the private sector, as it implies a substantial increase on the overall tax burden on households, provoking a negative effect on private consumption and savings. The adjustment via government accounts (either allowing consumption or savings to increase) compensates this negative effect, finally resulting in an increase in aggregate activity and employment. However, in this case neither closure are reasonable because the IRPF receipts are quite high and it is not realistic to consider such an increase in the tax burden without compensation. In fact, if the IRPF is not compensated by the reduction of some other tax, there would be a crowding out of private consumption and savings, probably with negative effects on future capital accumulation and growth. Therefore, in this case, it is more interesting to consider the budget neutral closure, compensating the introduction of IRPF with a uniform reduction of VAT rates. The initial negative shock on aggregate households' budget is then compensated by the positive effect of new (lower) prices, stimulating aggregate private consumption and investment, and increasing labour demand.

Although the final result of the full reform is an increase in overall employment (between 1.9% and 2.1%), the assumption for government closure is not irrelevant when considering the results in terms of labour demand by skill. Full implementation of the reform together with an increase in public services shows a skill biased scenario (as public services are skill

intensive). On the contrary, full reform with an increase in government savings is unskilled biased (because of the increased demand in construction, which is unskilled intensive). Finally, the budget neutral scenario shows a more uniform increase in labour demand by skill.

Employment growth, with a stable labour supply translates into a significant reduction (of 2 p.p.) in overall unemployment in the full reform scenario, under all alternative closures. The largest reduction in unemployment is achieved in the budget neutral scenario. It is worth noticing that this scenario is also the one where the largest reduction in unskilled unemployment is achieved.

Increased demand of the full reform scenario also translates into higher wages, for all types of labour, and under the three alternative closures. In the budget neutral scenario, increased demand of the private sector also raises demand for capital, provoking an increase in capital remuneration. Although the ECSS shock has a negative impact on return to capital (via substitution effect), its (slight) effect is more than compensated with the positive impact of the increase in aggregate demand.

Microsimulation Results

Tables 16 to 21 show the result of the microsimulations of the tax reform according to the results previously obtained in the CGE model under the three closures mentioned above. The results reported are those obtained by cumulative process and correspond to the variation of the respective indicators in each phase respect to the previous one.

As a first step, we applied the arithmetical microsimulation, which only involves the re-estimation of disposable income with the new direct income tax structure. The new direct income tax provokes a reduction of 1.2% in the mean of per capita household income, and a decrease of 1.5% on average labour income. Extreme poverty is reduced in 0.01 percentage points (pp) and moderate poverty in 0.33 pp. The poverty gap ratio and the severity of poverty also show a reduction (-0.10 pp and -0.04 pp respectively).

The arithmetical microsimulation shows a decrease on income inequality. The Gini index of per capita household income is reduced in approximately 0.01 points and the Gini of per capita labour income is reduced in 0.013 points. Average per capita household income increases moderately in the first eight deciles[24] (tables 18, 20 and 22) while it decreases in the two richest deciles (-0.7% and -4.2% respectively). Obviously, the greater progressiveness of new direct income taxation is behind these results. The distribution of household income by deciles also shows a slightly regressive profile at the bottom of income distribution. Clearly, IRPF has a smaller effect in the poorest decile, as the prior structure of labour tax already incorporated a minimum not taxable income[25].

The microsimulation results of the counterfactual changes in key parameters of the labour market correspond to the cumulative effect of labour market changes and represent the marginal variation respect to the values of the indicators obtained from the arithmetical

[24] Initial incomes brackets based on pre-reform ordering.

[25] Moreover, the poorest decile shows a higher degree of informality, and we are not modeling changes in this situation due to the reform.

microsimulation. So, these changes must be interpreted as a pure "general equilibrium" effects.

General equilibrium effects show an increase in the mean of per capita household income and in the mean of labour income that compensate the initial ("first round") reduction obtained in the arithmetical microsimulation. The most important counterfactual changes behind these results are the reduction of unemployment and average wage and capital income growth resulting in all CGE simulations.

Moreover, general equilibrium effects reinforce the observed "next day" reduction of poverty incidence, poverty gap and severity of poverty. The magnitude of these effects is significantly more important than the "next day" effect. The average increase in the wage rate and the reduction of unemployment are the more important labour market changes behind this poverty reduction. Concerning inequality indicators, general equilibrium effects provoke a minor additional reduction of Gini indexes (of total household income and of labour income) in the same direction of the arithmetical simulation.

Tables 17, 19 and 21 show the microsimulation results on per capita household income by decile. Column (d) corresponds to the percentage variation of per capita household income due to the arithmetical microsimulation ("next day" effects) and column (e) the percentage variation due to changes in labour market indicators and factor prices provided by the CGE model ("general equilibrium" effects).

The simulated household income variation along the distribution shows an interesting pattern. The "first round" effect of the tax reform results in a progressive variation of household income, with a significant reduction in the after-tax income of the richest decile. On the other hand, the "general equilibrium" effects are associated with an increase in household per capita income of all deciles of the distribution with a slightly progressive profile, under *all* CGE closures (see Graph 2).

As we mentioned above, the most important change behind this result is the reduction of unemployment rate (around 2 pp) which has a major incidence in unskilled workers that predominate in lower incomes households. The other counterfactual change that mainly explains this result is average real wage growth (around 2%). The counterfactual indicators of these key parameters of the labour market are very similar in all the three alternative government closures used in the CGE model, so the general equilibrium effects on poverty and inequality of the full reform are very similar between alternative simulations. In sum, we obtain significant general equilibrium effects that are robust to the type of government closure assumed in the CGE model, and that reinforce the observed poverty and inequality reduction obtained in the "next day" simulation.

Concluding Remarks

It is important to remark that the full implementation of the Uruguayan 2007 Tax Reform has significant general equilibrium effects, which jointly tend to reinforce the progressive pattern of the "next day" implementation of its main policy, i.e. the introduction of a direct personal income tax (IRPF) in substitution of the previous wage tax (IRP). Although expected, this

result reinforces the importance of evaluating these types of macro reforms using methodologies that account for potential reallocation of resources due to changes in prices of goods and factors due to the application of the policy.

Main results on aggregate activity, employment, poverty and inequality of the full implementation of the reform are robust to the alternative assumptions adopted regarding government closure, although there are clear differences regarding absorption structure, public-private participation and possibly, dynamic effects not captured in this work.

An important result is that the full reform is expansive in terms of aggregate activity (GDP) and employment, though it actually increases the tax burden. In other words, when we allow government revenues to increase, due to the strict application of the tax reform (either allowing government provision of public services or government savings to increase), the reform also results in employment and wage growth and unemployment reduction, generating positive general equilibrium effects on average household income and poverty. Obviously, this does not mean irrelevance of how does the government deal with revenue gains. The simulations that flex government accounts (either consumption or savings) tend to crowd out of private consumption or savings, with probable future negative effects on private capital accumulation.

Nevertheless, the main result is that when we keep the government budget fixed (and allow additional reductions of the VAT rate), the reform generates the larger positive effect on economic activity and even the best results in terms of poverty and inequality. This result is

linked to the fact that the reform tends to reduce eliminate or uniformize (highly) distortive taxes (indirect taxes like COFIS, IMESSA, VAT, ECSS), and replace the revenue loss with an increase in direct taxation. Reduction, elimination or uniformization of these taxes tend to reduce price distortions of goods and factors, and in a context of (perfect) mobility of factors it provokes a better reallocation of resources, stimulating activity expansion.

Although direct taxation on household income could also be distortive, because of the efficiency loss associated with substitution between labour (commodities) and leisure, the simulated models suggest that shift towards direct taxation is desirable from the point of view of the efficiency. In spite of the fact that the model contemplates an elastic labour supply, i.e. some labour-leisure substitution effect, the final simulated changes in participation rates were insignificant. A critical aspect concerning this result may be the nature of labour supply in our macro model which is defined in terms of representative individuals and not in terms of working hours. A future analysis that would allow us to improve this weakness is to adjust an econometric model of labour supply to the microdata of NHS and then link it to the CGE (see for example Robilliard, Bourguignon and Robinson (2001)).

Finally, is worth to mention one important result of the "compensated" macro simulations. When the reform is compensated by changes in VAT rates (considering the changes in other taxes including the reduction of VAT rates to 22% and 10%) the maximum VAT rate could be lowered an additional percentage point: up to 21% the basic rate and up to 9% the minimum rate. This is the estimate of the indirect tax rate (in percentage points of the VAT) that the government could resign in a budget-neutral closure.

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ANNEX: TABLES AND GRAPHS

Table 1: Poverty, labour market indicators and GDP
Uruguay 1990 to 2007

Year	Extreme Poverty (%) 1/	Moderate Poverty (%) 1/	Poverty Gap (%) 1/	Unemployment Rate (%) 1/	Annual growth rate of real wage (%)	Annual growth rate of GDP (%)
1990	3	29.7	30	8.5	-7.7	0.3
1991	2.1	23.4	30	8.9	4.3	3.5
1992	1.8	19.9	30	9.0	2.2	7.9
1993	1.2	17.1	30	8.3	4.8	2.7
1994	1.2	15.3	30	9.2	0.9	7.3
1995	1.6	17.4	30	10.3	-2.6	-1.5
1996	1.7	17.2	29	11.9	0.6	5.6
1997	1.2	17.2	28	11.4	0.2	5.1
1998	1.6	16.7	30	10.1	1.8	4.5
1999	1.2	15.3	29	11.3	1.6	-2.8
2000	1.5	17.8	30	13.6	-1.3	-1.4
2001	1.3	18.8	30	15.3	-0.3	-3.4
2002	2.0	24.3	31	17.0	-10.7	-11.0
2003	3.0	31.3	33	16.9	-12.4	2.2
2004	3.9	31.9	34	13.1	-0.1	11.8
2005	3.4	29.8	34	12.2	4.6	6.6
2006	2.1	26.8	32	11.4	4.4	7.0
2007	2.1	25.5	32	9.6	4.8	7.4

1/ Refers to urban population
Moderate and Extreme Poverty are official estimates, using INE-2002 methodology.
Source: National Institute of Statistics (INE), Central Bank of Uruguay (BCU).

Table 2: VAT and IRP tax payments related to income, by deciles of per capital household income. Pre-Reform situation

	VAT	IRP
Decile 1	9,1	0,6
Decile 2	8,2	1,3
Decile 3	7,7	1,4
Decile 4	7,3	1,6
Decile 5	7,1	1,8
Decile 6	6,5	1,8
Decile 7	6,9	2,1
Decile 8	6,7	1,9
Decile 9	6,5	1,7
Decile 10	5,7	1,3

Source: Grau and Lagomarsino (2002)

Table 3: Main characteristics of IRPF (on labour income and pensions) and IRP

IRPF			IRP		
Monthly Computable Income[1]	**Tax rate**	**Source Burdened**	**Monthly Computable Income**	**Tax rate**	**Source Burdened**
Labor and pensions		Wages Pensions Non-wage remunerations	**Labor**		Wages Pensions
Up to 5 BPC	Exempt		Up to 3 BPC	Exempt	
More than 5 and up to 10 BPC	10%		More than 3 and up to 6 BPC	2%	
More than 10 and up to 15 BPC	15%		More than 6 BPC	6%	
More than 15 BPC and up to 50 BPC	20%		**Pensions**		
More than 50 and up to 100 BPC	22%		Up to 6 BPC	Exempt	
More than 100 BPC	25%		More than 6 BPC	2%	

[1] Although IRPF is an annual tax, it is expressed in a monthly base to make it comparable to IRP.

Table 4: Main characteristics of IRPF on capital

Concept	Tax rate	Source Burdened
Interests from deposits in national currency, more than a year in financial institutions	3%	Pure revenues from capital
Interests on bonds and other debt securities issued to longer terms than three years	3%	
Interests on deposits of one year or less in national currency	5%	
Dividends or profits paid by IRAE contributors	7%	
Other rents	12%	

Table 5: Employer Contribution to Social Security and Value Added Tax rates Pre and Post Reform

Sector / Commodity	Employer Contribution to Social Security Rate		Value Added Tax Rate	
	Pre Reform	Post Reform	Pre Reform	Post Reform
Primary except livestock	18,0%	12,5%	10%	15%
Livestock	18,0%	12,5%	0%	0%
Meat	5,0%	12,5%	23%	22%
Fruit and vegetables industry	5,0%	12,5%	23%	22%
Vegetable Oils	5,0%	12,5%	14%	10%
Dairy	5,0%	12,5%	9%	12%
Mills	5,0%	12,5%	14%	10%
Other food industry	5,0%	12,5%	21%	20%
Sugar	5,0%	12,5%	14%	10%
Beverages	5,0%	12,5%	23%	22%
Tobacco	5,0%	12,5%	0%	22%
Textiles	5,0%	12,5%	23%	22%
Leather	5,0%	12,5%	23%	22%
Other manufactures	5,0%	12,5%	23%	22%
Paper	5,0%	12,5%	23%	22%
Press	5,0%	12,5%	0%	0%
Refinery	6,5%	7,5%	6%	4%
Chemicals except pharmacy	5,0%	12,5%	23%	22%
Pharmacy	5,0%	12,5%	14%	10%
Mineral products	5,0%	12,5%	23%	22%
Metal products and machinery	5,0%	12,5%	22%	21%
Electricity and gas	6,5%	7,5%	23%	22%
Water	24,5%	7,5%	0%	0%
Construction	32,6%	23,3%	0%	0%
Commerce	17,5%	7,5%	16%	16%
Hotels	17,5%	12,5%	14%	10%
Restaurants	17,5%	12,5%	23%	22%
Transport except passengers	17,5%	12,5%	23%	22%
Passenger transport	0,0%	0,0%	14%	10%
Communications	24,5%	7,5%	23%	22%
Financial services	17,5%	12,5%	0%	0%
Real estate	17,5%	12,5%	0%	0%
Services to enterprises	17,5%	12,5%	23%	22%
Public administration	19,5%	19,5%	0%	0%
Private Education	0,0%	0,0%	0%	0%
Health-hospitals	17,5%	12,5%	0%	10%
Other health services	17,5%	12,5%	0%	22%
Other services	17,5%	12,5%	23%	22%

Note: Rates on primary sectors correspond to the estimated tax on effective labour. Rate on construction is obtained from splitting the unified rate to take into account only the employers contributions.

Table 6: Value added share (%)

	Skilled Labour	Semiskilled Labour	Unskilled Labour	Capital
Primary except livestock	1,0%	1,7%	4,4%	1,1%
Livestock	4,8%	5,1%	11,2%	5,9%
Meat	0,2%	0,9%	1,4%	0,4%
Fruit and vegetables industry	0,0%	0,0%	0,1%	0,1%
Vegetable Oils	0,0%	0,1%	0,0%	0,1%
Dairy	0,2%	0,6%	0,6%	1,1%
Mills	0,0%	0,2%	0,3%	0,2%
Other food industry	0,5%	1,1%	2,4%	2,4%
Sugar	0,0%	0,0%	0,0%	0,1%
Beverages	0,2%	0,3%	0,3%	1,4%
Tobacco	0,1%	0,2%	0,1%	1,2%
Textiles	0,5%	1,3%	1,9%	0,5%
Leather	0,3%	0,4%	0,6%	0,7%
Other manufactures	0,3%	1,1%	2,0%	0,8%
Paper	0,2%	0,3%	0,4%	0,3%
Press	0,8%	0,9%	0,7%	0,4%
Refinery	0,5%	0,5%	0,2%	9,3%
Chemicals except pharmacy	0,7%	1,2%	0,8%	2,4%
Pharmacy	1,2%	0,9%	0,4%	0,3%
Mineral products	0,2%	0,2%	0,6%	0,4%
Metal products and machinery	0,7%	1,9%	2,1%	2,1%
Electricity and gas	1,3%	1,1%	0,7%	4,2%
Water	0,3%	0,3%	0,8%	0,4%
Construction	1,6%	2,4%	8,1%	7,3%
Commerce	6,9%	20,8%	21,4%	6,2%
Hotels	0,4%	0,8%	0,6%	2,6%
Restaurants	0,2%	1,4%	1,9%	0,1%
Transport except passengers	1,0%	4,1%	3,8%	2,7%
Passenger transport	0,3%	2,0%	3,1%	0,5%
Communications	1,4%	1,6%	1,0%	4,2%
Financial services	4,8%	5,9%	1,4%	8,8%
Real estate	0,5%	1,3%	0,6%	4,8%
Services to enterprises	20,9%	8,2%	2,6%	12,2%
Public administration	25,6%	17,5%	12,4%	0,0%
Private Education	3,6%	3,0%	0,5%	1,2%
Health-hospitals	9,0%	3,6%	1,8%	2,1%
Other health services	5,6%	1,4%	0,6%	0,3%
Other services	3,9%	5,4%	8,2%	11,4%
Total	100,0%	100,0%	100,0%	100,0%

Table 7: Taxes included in the CGE model
Share (%)

Taxes	% Tax revenue	% GDP
Labour income tax (1)	4.1%	1.0%
Capital income tax	0.0%	0.0%
Pensions tax	0.4%	0.1%
Employer contribution to social security	14.9%	3.7%
Factor tax	9.0%	2.3%
Direct tax on firms	11.5%	2.6%
Taxes on products	10.8%	2.5%
Tariffs	4.3%	1.1%
Activity Taxes	2.9%	0.7%
Value added tax	39.2%	10.0%
Tax on Intermediate consumption of goods	2.8%	0.7%
Total	**100%**	**24.7%**

(1) Includes taxes on the three types of labour

Table 8: Unemployment Rate and Participation Rate by Skill

Skill	Unemployment Rate	Participation Rate
Unskilled	12.0%	56.2%
Semiskilled	10.1%	73.8%
Skilled	4.4%	80.4%
Total	**10.9%**	**60.8%**

Source: Elaboration based on data from the National Household Survey, INE

Table 9
Simulations and macro closures

Simulations carried out	Gov. Closure	Foreign closure	S –I closure
REFORM_GADJ IRPF_GADJ VAT_GADJ ECSS_GADJ IRAE_GADJ	Fixed GSAV Flexible GADJ	Fixed FSAV	Fixed MPS Fixed DMPS
REFORM_GSAV IRPF_GSAV VAT_GSAV ECSS_GSAV IRAE_GSAV	Flexible GSAV Fixed GADJ	Fixed FSAV	Fixed MPS Fixed DMPS
REFORM_VAT IRPF_VAT ECSS_VAT IRAE_VAT	Flexible VAT Fixed GSAV Fixed GADJ	Fixed FSAV	Fixed MPS Fixed DMPS
VAT_THLAB	Flexible THLAB Fixed GSAV Fixed GADJ	Fixed FSAV	Fixed MPS Fixed DMPS

GSAV: Government Savings
GADJ: Adjustment factor for flexing government consumption
FSAV: Foreign savings
MPS: Marginal propensity to save of households and firm
DMPS: Adjustment factor for flexing marginal propensity to save of households and firm

Table 10. Simulation results for government accounts

	Nominal shares of GDP			Revenue composition*	
	Total gov. income	Gov. consumpt.	Gov. savings	Direct taxes	Indirect taxes
BASE	*25,0*	*11,4*	*1,6*	*22.3*	*77.7*
Simulations with flexible gov. savings and fixed real gov. consumption					
VAT_GSAV	23,9	11,4	0,4	24.2	75.8
IRPF_GSAV	27,9	11,4	4,5	32.5	67.5
ECSS_GSAV	24,3	11,4	0,8	22.4	77.6
IRAE_GSAV	24,5	11,4	1,0	20.1	79.9
REFORM_GSAV	25,6	11,4	2,1	33.4	66.6
Simulations with fixed gov. savings and flexible real gov. consumption					
VAT_GADJ	23,9	10,3	1,6	24.1	75.9
IRPF_GADJ	27,8	14,1	1,6	32.7	67.3
ECSS_GADJ	24,3	10,7	1,6	22.4	77.6
IRAE_GADJ	24,5	10,9	1,6	20.1	79.9
REFORM_GADJ	25,6	11,9	1,6	33.4	66.6
Simulations compensated by value added tax					
IRPF_VAT	25,1	11,5	1,6	39,2	60,8
ECSS_VAT	25,0	11,4	1,6	21,3	78,7
IRAE_VAT	25,0	11,4	1,6	19,4	80,6
REFORM_VAT	25,2	11,5	1,6	34,5	65,5
Simulations compensated by a tax on labour income					
VAT_THLAB	25,1	11,4	1,6	28,9	71,1

* Excluding social security contributions and import taxes

Table 11. Real variations of macro variables. Percentages

Simulations with fixed gov. savings and flexible real gov. consumption					
	VAT_ GADJ	IRPF_ GADJ	ECSS_ GADJ	IRAE_ GADJ	REFORM_GADJ
Absorption	0.0%	0.9%	0.3%	-0.2%	1.1%
Priv.Cons.	1.2%	-2.0%	1.2%	0.3%	0.6%
Fix. Invest.	1.4%	-1.3%	0.3%	0.6%	1.2%
Gov. cons.	-9.5%	22.4%	-5.9%	-4.2%	4.1%
Exports	1.1%	-0.8%	0.6%	0.2%	1.1%
Imports	1.2%	-0.9%	0.6%	0.2%	1.2%
GDP mp	0.0%	0.9%	0.3%	-0.2%	1.1%
Net ind. Taxes	0.9%	-0.9%	0.8%	0.2%	0.9%
GDP fc	-0.2%	1.2%	0.2%	-0.3%	1.1%
HH disp.income	1.2%	-2.2%	1.2%	0.3%	0.3%
Simulations with flexible gov. savings and fixed real gov. consumption					
	VAT_ GSAV	IRPF_ GSAV	ECSS_ GSAV	IRAE_ GSAV	REFORM_GSAV
Absorption	0.3%	0.1%	0.5%	0.0%	0.9%
Priv.Cons.	1.7%	-3.4%	1.6%	0.5%	0.3%
Fix. Invest.	-5.6%	16.2%	-4.1%	-2.5%	4.5%
Gov. cons.	0.0%	0.0%	0.0%	0.0%	0.0%
Exports	-0.3%	2.7%	-0.3%	-0.4%	1.8%
Imports	-0.3%	2.8%	-0.3%	-0.4%	1.8%
GDP mp	0.3%	0.1%	0.5%	0.0%	0.9%
Net ind. Taxes	0.4%	0.2%	0.5%	0.0%	1.1%
GDP fc	0.3%	0.1%	0.5%	0.0%	0.9%
HH disp.income	1.7%	-3.6%	1.6%	0.5%	0.1%
Simulations with budget neutral assumption					
	VAT_ THLAB	IRPF_ VAT	ECSS_ VAT	IRAE_ VAT	REFORM_VAT
Absorption	0.4%	1.0%	0.3%	-0.2%	1.1%
Priv.Cons.	0.2%	0.9%	0.5%	-0.3%	1.1%
Fix. Invest.	1.4%	2.0%	-0.4%	0.1%	1.8%
Gov. cons.	0.0%	0.0%	0.0%	0.0%	0.0%
Exports	0.7%	1.6%	0.0%	-0.2%	1.5%
Imports	0.7%	1.6%	0.0%	-0.2%	1.6%
GDP mp	0.3%	1.0%	0.3%	-0.2%	1.1%
Net ind. taxes	0.4%	1.3%	0.2%	-0.2%	1.1%
GDP fc	0.3%	0.9%	0.3%	-0.2%	1.3%
HH disp.income	0.2%	0.8%	0.4%	-0.3%	0.9%

Table 12. Labour market variables and factor prices. Simulations with fixed government savings and flexible government consumption

Employment by labour type (% change w.r.t BASE)					
	REFORM_GADJ	IRPF_GADJ	ECSS_GADJ	VAT_GADJ	IRAE_GADJ
Skilled	2,5	3,9	-0,1	-1,3	-0,9
Semiskilled	1,9	1,9	0,5	-0,1	-0,4
Unskilled	2,0	0,7	0,9	0,5	-0,1
Total	2,0	1,3	0,7	0,2	-0,3
Unemployment rate by labour type (% of active pop)					
	BASE	REFORM_GADJ	IRPF_GADJ	ECSS_GADJ	VAT_GADJ	IRAE_GADJ
Skilled	4,4	2,2	1,3	4,3	5,4	5,2
Semiskilled	10,1	8,4	8,6	9,6	10,1	10,4
Unskilled	12,0	10,2	11,4	11,2	11,5	12,1
Participation rate by labour type (% of pop in age)					
	BASE	REFORM_GADJ	IRPF_GADJ	ECSS_GADJ	VAT_GADJ	IRAE_GADJ
Skilled	81,6	81,8	82,2	81,5	81,4	81,5
Semiskilled	74,8	74,9	75,1	74,8	74,8	74,8
Unskilled	58,2	58,1	58,2	58,2	58,2	58,2
Factor payments (% change w.r.t BASE)					
	REFORM_GADJ	IRPF_GADJ	ECSS_GADJ	VAT_GADJ	IRAE_GADJ
Skilled	2,4	4,2	0,1	-0,7	-0,5
Semiskilled	2,6	2,2	0,7	0,0	-0,4
Unskilled	2,4	0,8	1,0	0,6	-0,1
Capital	2,8	-1,9	1,5	2,9	0,3

Table 13. Labour market variables and factor prices. Simulations with fixed government consumption and flexible government savings

Employment by labour type (% change w.r.t BASE)					
	REFORM_GSAV	IRPF_GSAV	ECSS_GSAV	VAT_GSAV	IRAE_GSAV
Skilled	1,7	-0,5	1,2	0,9	0,1
Semiskilled	1,6	-0,1	1,0	0,7	0,0
Unskilled	2,0	0,6	0,9	0,6	-0,1
Total	1,9	0,3	1,0	0,7	0,0

Unemployment rate by labour type (% of active pop)						
	BASE	REFORM_GSAV	IRPF_GSAV	ECSS_GSAV	VAT_GSAV	IRAE_GSAV
Skilled	4,4	2,9	5,4	3,1	3,4	4,3
Semiskilled	10,1	8,7	10,4	9,2	9,4	10,0
Unskilled	12,0	10,2	11,6	11,1	11,4	12,0

Participation rate by labour type (% of pop in age)						
	BASE	REFORM_GSAV	IRPF_GSAV	ECSS_GSAV	VAT_GSAV	IRAE_GSAV
Skilled	81,6	81,8	82,0	81,6	81,5	81,6
Semiskilled	74,8	74,9	75,1	74,8	74,8	74,8
Unskilled	58,2	58,1	58,2	58,1	58,1	58,2

Factor payments (% change w.r.t BASE)					
	REFORM_GSAV	IRPF_GSAV	ECSS_GSAV	VAT_GSAV	IRAE_GSAV
Skilled	1,4	-0,7	1,2	0,9	0,1
Semiskilled	2,1	-0,4	1,4	1,1	0,1
Unskilled	2,4	0,5	1,1	0,7	-0,1
Capital	3,2	0,3	1,0	2,1	-0,1

Table 14. Labour market variables and factor prices. Simulations with fixed government income

Employment by labour type (% change w.r.t BASE)					
	REFORM_VAT	IRPF_VAT	ECSS_VAT	VAT_THLAB	IRAE_VAT
Skilled	2,1	1,8	0,7	0,6	-0,4
Semiskilled	1,9	1,7	0,5	0,6	-0,3
Unskilled	2,2	2,0	0,6	0,8	-0,4
Total	2,1	1,9	0,6	0,7	-0,4

Unemployment rate by labour type (% of active pop)						
	BASE	REFORM_VAT	IRPF_VAT	ECSS_VAT	VAT_THLAB	IRAE_VAT
Skilled	4,4	2,5	2,8	3,8	3,7	4,7
Semiskilled	10,1	8,4	8,6	9,6	9,5	10,4
Unskilled	12,0	9,9	10,1	11,5	11,3	12,3

Participation rate by labour type (% of pop in age)						
	BASE	REFORM_VAT	IRPF_VAT	ECSS_VAT	VAT_THLAB	IRAE_VAT
Skilled	81,6	81,7	81,7	81,6	81,5	81,6
Semiskilled	74,8	74,8	74,8	74,8	74,8	74,9
Unskilled	58,2	58,1	58,1	58,2	58,2	58,2

Factor payments (% change w.r.t BASE)					
	REFORM_VAT	IRPF_VAT	ECSS_VAT	VAT_THLAB	IRAE_VAT
Skilled	1,9	1,6	0,5	0,6	-0,2
Semiskilled	2,6	2,3	0,7	0,9	-0,4
Unskilled	2,8	2,5	0,6	0,9	-0,4
Capital	4,3	6,2	-0,5	2,2	-1,1

Table 15 Labour Demand by Aggregate Sector of Activity (Change w.r.t base (%))

Simulations with fixed government savings and flexible government consumption					
Sector of Activity	REFORM_GADJ	IRPF _GADJ	ECSS _GADJ	VAT_GADJ	IRAE_GADJ
Primary	2,4	-1,4	2,4	1,1	0,3
Manufacturing	0,5	-1,5	-1,7	3,4	0,4
Construction	3,1	-2,2	2,4	2,1	0,7
Public Administration & Public Services	4,0	21,2	-5,5	-8,9	-4,0
Commerce	2,0	-2,1	2,5	1,4	0,3
Services	1,4	-2,4	2,4	1,2	0,3
Private Education and Health	2,1	-1,6	1,7	1,9	0,3
Total	2,0	1,3	0,7	0,2	-0,3
Simulations with fixed government consumption and flexible government savings					
	REFORM_GSAV	IRPF_GSAV	ECSS_GSAV	VAT_GSAV	IRAE_GSAV
Primary	3,1	2,1	1,4	-0,3	-0,3
Manufacturing	1,6	4,6	-3,2	0,9	-0,7
Construction	5,9	12,4	-1,4	-3,8	-1,9
Public Administration & Public Services	0,1	-0,2	0,1	0,1	0,0
Commerce	2,1	-1,6	2,3	1,2	0,3
Services	1,4	-2,6	2,5	1,3	0,4
Private Education and Health	1,9	-2,8	2,0	2,4	0,5
Total	1,9	0,3	1,0	0,7	0,0
Simulations with fixed government revenues					
	REFORM_VAT	IRPF_VAT	ECSS_VAT	VAT_THLAB	IRAE_VAT
Primary	3,3	3,3	1,2	0,2	-0,5
Manufacturing	1,2	2,5	-2,6	2,7	-0,3
Construction	4,1	3,2	1,1	1,7	-0,3
Public Administration & Public Services	0,1	0,1	0,0	0,0	0,0
Commerce	2,8	1,9	1,4	0,5	-0,4
Services	2,2	2,0	1,3	0,3	-0,5
Private Education and Health	2,6	1,2	0,9	0,8	-0,3
Total	2,1	1,9	0,6	0,7	-0,4

Table 16. Microsimulation results of the Full Reform: Government Closure: *Simulations compensated by value added tax***.**

	Mean of PCHI (after direct taxes)	Mean of LI (after direct taxes)	Extreme Poverty (incidence)	Moderate Poverty: FGT(a) indicators			Inequality	
				Incidence: FGT(0)	Poverty Gap Ratio: FGT(1)	Severity of Poverty: FGT(2)	Gini of PCHI	GINI of LI
Base Indicators	***6,425***	***8,148***	***2.29***	***27.88***	***9.34***	***4.31***	***0.453***	***0.498***
(a) **Arithmetical Microsimulation**	**-1.2%**	**-1.5%**	**-0.01**	**-0.33**	**-0.10**	**-0.04**	**-0.009**	**-0.013**
(b) **Labour Market Changes (Gen. Equilib. Effects)**	**1.8%**	**2.2%**	**-0.17**	**-0.77**	**-0.38**	**-0.21**	**-0.001**	**0.001**
i) Participation Rate Change	0.0%	0.0%	0.00	0.00	0.00	0.00	0.000	0.000
ii) Unemployment Rate Change	0.5%	0.0%	-0.11	-0.32	-0.16	-0.10	-0.001	0.002
iii) Employment Structure Change	0.0%	0.0%	0.01	0.06	0.02	0.01	0.000	0.001
iv) Wage Structure Change	0.0%	0.0%	0.00	-0.03	-0.01	-0.01	0.000	-0.001
v) Wage Rate Change	1.2%	2.2%	-0.07	-0.49	-0.22	-0.11	0.000	-0.001
vi) Capital Price Change	0.1%	0.0%	0.00	0.00	0.00	0.00	0.000	0.000
(c) **Total Microsimulation Effects** = (a)+(b)	**0.6%**	**0.8%**	**-0.18**	**-1.10**	**-0.48**	**-0.25**	**-0.010**	**-0.012**
Final Counterfactual Indicators	***6,464***	***8,207***	***2.11***	***26.78***	***8.85***	***4.06***	***0.443***	***0.486***

PCHI = Per Capita Household Income; LI = Labour Income

Table 17. Counterfactual changes of the mean of per capita household income by decile. Full Reform. Gov. Closure: *Simulations compensated by value added tax*

Decile	Base (a)	Arithmetical Microsim. (b)	Cumulative Changes (Arith. + GE effects) (c)	**% Arith./Base** (d)=(b)/(a)	**% Cum./Arith.** (e)=(c)/(b)	**Total Variation (%)** (f)=(c)/(a)
1	1,448	1,452	1488.223	**0.2%**	**2.5%**	**2.8%**
2	2,386	2,401	2459.335	**0.6%**	**2.4%**	**3.1%**
3	3,216	3,241	3310.567	**0.8%**	**2.2%**	**2.9%**
4	4,064	4,095	4178.791	**0.8%**	**2.0%**	**2.8%**
5	4,996	5,029	5119.71	**0.7%**	**1.8%**	**2.5%**
6	6,091	6,125	6238.156	**0.6%**	**1.8%**	**2.4%**
7	7,480	7,510	7634.773	**0.4%**	**1.7%**	**2.1%**
8	9,455	9,460	9599.199	**0.1%**	**1.5%**	**1.5%**
9	12,883	12,792	12975.07	**-0.7%**	**1.4%**	**0.7%**
10	26,441	25,320	25685.56	**-4.2%**	**1.4%**	**-2.9%**

Table 18. Microsimulation results of the Full Reform: Government Closure: *Simulations with flexible gov. savings and fixed real gov. consumption*. **Effects on Income, Poverty and Inequality**

	Mean of PCHI (after direct taxes)	Mean of LI (after direct taxes)	Extreme Poverty (incidence)	Moderate Poverty: FGT(a) indicators			Inequality	
				Incidence: FGT(0)	Poverty Gap Ratio: FGT(1)	Severity of Poverty: FGT(2)	Gini of PCHI	GINI of LI
Base Indicators	***6,425***	***8,148***	***2.29***	***27.88***	***9.34***	***4.31***	***0.453***	***0.498***
(a) **Arithmetical Microsimulation**	**-1.2%**	**-1.5%**	**-0.01**	**-0.33**	**-0.10**	**-0.04**	**-0.009**	**-0.013**
(b) **Labour Market Changes (Gen. Equilib. Effects)**	**1.5%**	**1.8%**	**-0.15**	**-0.73**	**-0.33**	**-0.17**	**-0.001**	**0.001**
i) Participation Rate Change	0.0%	0.0%	0.00	0.00	0.00	0.00	0.000	0.000
ii) Unemployment Rate Change	0.4%	0.0%	-0.08	-0.35	-0.15	-0.08	-0.001	0.002
iii) Employment Structure Change	0.0%	-0.1%	0.01	0.01	0.01	0.01	0.000	0.000
iv) Wage Structure Change	0.0%	0.0%	-0.01	-0.04	-0.02	-0.01	0.000	-0.001
v) Wage Rate Change	1.0%	1.8%	-0.07	-0.35	-0.18	-0.09	0.000	-0.001
vi) Capital Price Change	0.1%	0.0%	0.00	0.00	0.00	0.00	0.000	0.000
(c) **Total Microsimulation Effects** = (a)+(b)	**0.3%**	**0.3%**	**-0.16**	**-1.06**	**-0.44**	**-0.21**	**-0.010**	**-0.012**
Final Counterfactual Indicators	***6,441***	***8,170***	***2.13***	***26.82***	***8.90***	***4.09***	***0.443***	***0.486***

PCHI = Per Capita Household Income; LI = Labour Income

Table 19. Counterfactual changes of the mean of per capita household income by decile. Full Reform. Gov. Closure:
Simulations with flexible gov. savings and fixed real gov. consumption

Decile	Base (a)	Arithmetical Microsim. (b)	Cumulative Changes (Arith. + GE effects) (c)	**% Arith./Base** (d)=(b)/(a)	**% Cum./Arith.** (e)=(c)/(b)	**Total Variation (%)** (f)=(c)/(a)
1	1,448	1,452	1,483	**0.2%**	**2.1%**	**2.4%**
2	2,386	2,401	2,452	**0.6%**	**2.1%**	**2.7%**
3	3,216	3,241	3,302	**0.8%**	**1.9%**	**2.7%**
4	4,064	4,095	4,174	**0.8%**	**1.9%**	**2.7%**
5	4,996	5,029	5,102	**0.7%**	**1.5%**	**2.1%**
6	6,091	6,125	6,216	**0.6%**	**1.5%**	**2.1%**
7	7,480	7,510	7,610	**0.4%**	**1.3%**	**1.7%**
8	9,455	9,460	9,570	**0.1%**	**1.2%**	**1.2%**
9	12,883	12,792	12,938	**-0.7%**	**1.1%**	**0.4%**
10	26,441	25,320	25,585	**-4.2%**	**1.0%**	**-3.2%**

Table 20. Microsimulation results of the Full reform: Government Closure: *Simulations with fixed gov savings and flexible real gov. consumption*. **Effects on Incomes, Poverty and Inequality**

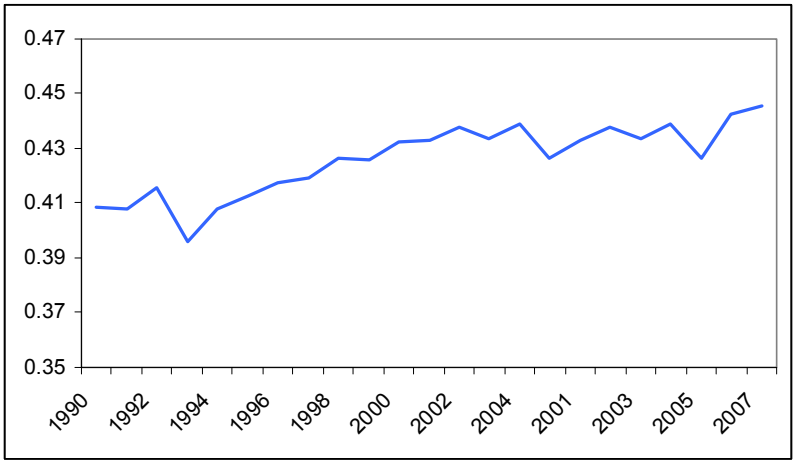
	Mean of PCHI (after direct taxes)	Mean of LI (after direct taxes)	Extreme Poverty (incidence)	Moderate Poverty: FGT(a) indicators			Inequality	
				Incidence: FGT(0)	Poverty Gap Ratio: FGT(1)	Severity of Poverty: FGT(2)	Gini of PCHI	GINI of LI
Base Indicators	***6,425***	***8,148***	***2.29***	***27.88***	***9.34***	***4.31***	***0.453***	***0.498***
(a) **Arithmetical Microsimulation**	**-1.2%**	**-1.5%**	**-0.01**	**-0.33**	**-0.10**	**-0.04**	**-0.009**	**-0.013**
(b) **Labour Market Changes (Gen. Equilib. Effects)**	**1.8%**	**2.3%**	**-0.17**	**-0.75**	**-0.38**	**-0.20**	**-0.001**	**0.001**
i) Participation Rate Change	0.0%	0.0%	0.00	0.00	0.00	0.00	0.000	0.000
ii) Unemployment Rate Change	0.5%	0.0%	-0.11	-0.26	-0.15	-0.09	-0.001	0.002
iii) Employment Structure Change	0.0%	0.0%	0.00	-0.04	-0.02	-0.01	0.000	0.000
iv) Wage Structure Change	0.0%	0.0%	0.00	0.01	0.00	0.00	0.000	0.000
v) Wage Rate Change	1.2%	2.3%	-0.06	-0.46	-0.22	-0.11	0.000	-0.001
vi) Capital Price Change	0.1%	0.0%	0.00	0.00	0.00	0.00	0.000	0.000
(c) **Total Microsimulation Effects** = (a)+(b)	**0.7%**	**0.8%**	**-0.18**	**-1.08**	**-0.48**	**-0.25**	**-0.009**	**-0.013**
Final Counterfactual Indicators	***6,466***	***8,214***	***2.11***	***26.80***	***8.85***	***4.06***	***0.443***	***0.486***

PCHI = Per Capita Household Income; LI = Labour Income

Table 21. Counterfactual changes of the mean of per capita household income by decile. Full Reform. Gov. Closure: *Simulations with fixed gov. savings and flexible real gov. consumption*

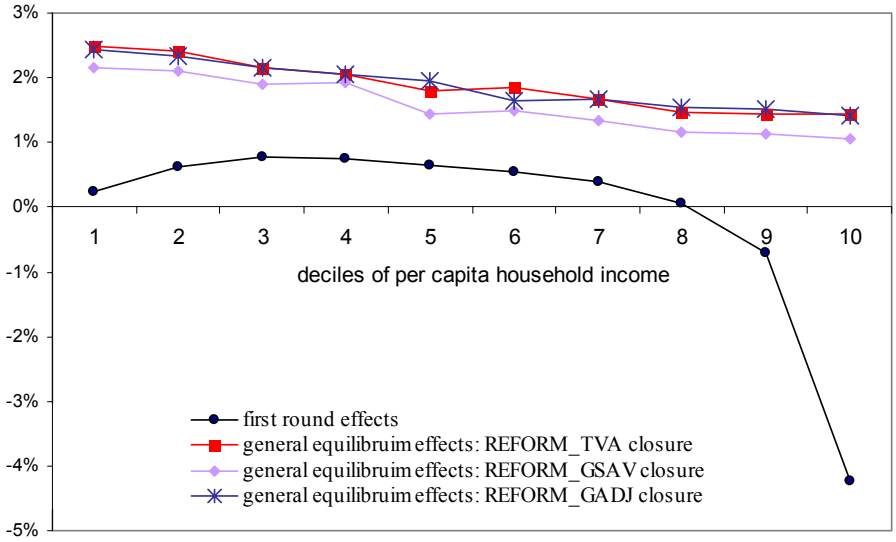
Decile	Base (a)	Arithmetical Microsim. (b)	Cumulative Changes (Arith. + GE effects) (c)	**% Arith./Base** (d)=(b)/(a)	**% Cum./Arith.** (e)=(c)/(b)	**Total Variation (%)** (f)=(c)/(a)
1	1,448	1,452	1,487	**0.2%**	**2.4%**	**2.7%**
2	2,386	2,401	2,458	**0.6%**	**2.3%**	**3.0%**
3	3,216	3,241	3,311	**0.8%**	**2.2%**	**2.9%**
4	4,064	4,095	4,179	**0.8%**	**2.0%**	**2.8%**
5	4,996	5,029	5,127	**0.7%**	**1.9%**	**2.6%**
6	6,091	6,125	6,226	**0.6%**	**1.7%**	**2.2%**
7	7,480	7,510	7,635	**0.4%**	**1.7%**	**2.1%**
8	9,455	9,460	9,607	**0.1%**	**1.6%**	**1.6%**
9	12,883	12,792	12,985	**-0.7%**	**1.5%**	**0.8%**
10	26,441	25,320	25,677	**-4.2%**	**1.4%**	**-2.9%**

Graph 1: Gini Index



Source: Elaboration based in National Household Survey, National Institute of Statistics (INE).

Graph 2. After-tax per capita household income by decile and type of microsimulation. Full reform (variation w.r.t base)



APPENDIX A: ARITHMETICAL MICROSIMULATION

The arithmetical microsimulation applies a specified tax, -involving as many as possible of the complexities of the tax structure-, to each individual in the NHS (i.e. a large cross-sectional representative sample of micro-data), without taking into account any change in their market income.

Based on (observed) market incomes and the socio-demographic characteristics of a household, this analysis arithmetically derives its disposable income and net tax payments given the rules for the computation of taxes in the new tax system. Then, the effect of a reform of the income tax is the change in the real disposable income that is generated for constant market income from labour and capital factor. It simply provides the impact or 'next-day' effects of specified changes in direct personal taxation of the reform implemented in July 2007.

The goal of our arithmetical microsimulation is just to identify the effective shocks in income taxes by type of household to be introduced in the CGE model. In addition, this microsimulation will enable us to compare the impact of the new income tax (IRPF) estimated by two different methodologies; the partial equilibrium methodology assuming that labour supply does not change, and the CGE – Microsimulation methodology.

For the arithmetical microsimulation we use the National Household Survey (NHS) 2006. The key information for our analysis is individual labour income, which is the tax base of the IRP and of the IRPF on labour. The NHS collects only net (after-tax) wages, so gross wages

needed to be obtained, by adding up all social security contributions and taxes to after-tax wages. This procedure was carried out only for formal workers (i.e. workers who declare they contribute to social security). We assumed that informal workers do not pay any direct income tax (i.e. their effective tax rate is zero).

The social security system in Uruguay has multiple schemes of contribution (depending on the occupational category), all of which were taken into account for the estimation of gross earnings.

Taxed earnings of workers in the private sector were calculated by adding up wages, commissions, overtime pay, Christmas bonus and tips (all of which are included in the tax base). In 2006, taxes included were the employee social security tax (15%), health coverage tax (3%) and the *Fondo de Reconversión Laboral* (FRL)[26] (0.125%). Workers from the banking sector had a specific social security tax rate of 17.5% on gross wage.

Workers in the public sector were only taxed with the employee social security tax and the FRL. Military and police workers are taxed with a different social security tax rate (13%). Another special case are workers in cooperatives, whose gross income was obtained by adding up wages, commissions, overtime pay, distributions for expenses and profits. They are taxed with the 15% social security rate plus the FRL.

[26] English translation is *Fund for labor training*. The FRL is a tax administered by The Ministry of Labor and Social Security (MTSS) for training courses oriented to unemployed workers.

Social security and IRP contributions of non-wage earners are based on a pre-determined amount according to a scale of categories regarding experience (or starting working age). In the case of self-employed workers with less than completed tertiary education, the starting working age is assumed to be 20. For workers with completed tertiary, potential experience was estimated.[27] In all cases we assume that change of category occurs every 3 years (i.e. a 20 year old self-employed worker is taxed on a fixed tax base corresponding to the first category; a 23 year old self-employed worker is taxed according to the second category; an so on).

Once gross income is obtained, the IRP tax of every formal worker is computed applying the corresponding tax rate. The same procedure was directly applied on retirement and old-age pensions with their respective taxes (see table 3).

For the estimation of the IRPF, a set of items that were not taxed by IRP, are now incorporated to the tax base, (as non-monetary payments), so they needed to be added to the gross taxed income. In the case of non-wage earners, the contribution of IRPF is not based on a pre-determined amount, but directly on 70% of gross income (since the regulation allows a deduction of 30% for expenses).

The IRPF tax allows for a set of deductions with their specific progressional tax rates (see Table A.1), all of which were taken into account in order to estimate the tax payment. Workers can deduct contributions to social security and health coverage. Self employed

[27] Potential experience is calculated as age minus years of schooling minus 6 (entrance to primary education age).

workers with tertiary education are allowed to deduct the contributions for the Solidarity Fund[28]. We also took into account deductions allowed for medical attention of children under 18 years old (up to 6.5 annual BPC), for which we made the following assumptions: that the deductions are made by the household head unless the children that live in the household are not his own; in the latter case, the deduction is made by his/her spouse. Finally, deductions for pensioners regarding health coverage are allowed up to 12 annual BPC.

Table A.1: Rates of Deductions of IRPF

Annual computable income	*Rate*
Up to 60 BPC	10%
More than 60 and up to 120 BPC	15%
More than 120 and up to 540 BPC	20%
More than 540 and up to 1,140 BPC	22%
More than 1,140 BPC	25%

In order to estimate IRPF payments, all annual incomes from labour and pensions were added up for each person, and the corresponding progressive rates were applied. For such estimation, the deductions previously estimated were subtracted.

When we analyze the effect on income distribution, the elimination of IRP and the implementation of IRPF shows a clear progressive pattern. The first eight deciles are "winners" because the effective direct tax rate on their total income is lower than the prior tax rate (IRP) (see table A.2).

[28] It is a tax destined to finance a subsidy for low income students in the public system of tertiary education.

Table A.2: Effective rate on household income by deciles

	IRP			IRPF			
deciles	**Labour**	**Pensions**	**Total**	**Labour**	**Pensions**	**Capital**	**Total**
1	0.7%	0.0%	0.6%	0.0%	0.0%	2.4%	0.0%
2	1.5%	0.1%	1.3%	0.3%	0.1%	2.3%	0.2%
3	2.0%	0.1%	1.7%	0.6%	0.1%	1.6%	0.5%
4	2.3%	0.2%	1.9%	1.0%	0.3%	3.3%	0.8%
5	2.6%	0.3%	2.1%	1.4%	0.5%	2.2%	1.2%
6	2.9%	0.4%	2.4%	2.0%	0.6%	2.7%	1.7%
7	3.2%	0.7%	2.6%	2.7%	1.4%	3.2%	2.3%
8	3.5%	1.0%	3.0%	3.8%	2.1%	4.8%	3.4%
9	3.7%	1.4%	3.3%	5.4%	3.7%	5.5%	5.0%
10	3.6%	1.8%	3.2%	8.6%	8.5%	8.8%	8.6%

APPENDIX B: CGE MODEL MATHEMATICAL STATEMENT

SETS

ac	all accounts
a(ac)	activities
c(ac)	commodities
cgood(c)	goods
cngood(c)	services
fact(ac)	factors
f (fact)	labour and capital factors
flab(f)	labour factors
fcap(f)	capital factor
fkl(fact)	composite labour (“L-AGG”) and capital factor (“CAP”)
ins(ac)	institutions
insd(ins)	domestic institutions
insdng(insd)	domestic non-government institutions
h(insdng)	households

Specific elements of a set are indicated with inverted commas, ie: ‘gov’, ‘firms’, etc.

VARIABLES

CPI	consumer price index (PQ-based)
DPI	index for domestic producer prices (PDS-based)
DMPS	change in marginal propensity to save for selected inst
EG	total current government expenditure
EH_h	household consumption expenditure
EXR	exchange rate
FSAV	foreign savings
GADJ	government demand scaling factor
GOVSHR	govt consumption share of absorption
GSAV	government savings
IADJ	investment scaling factor
INVSHR	investment share of absorption
MPS_{ins}	marginal propensity to save for dom non-gov inst ins
MPSADJ	savings rate scaling factor
PA_a	output price of activity a
PDS_c	supply price for com c produced & sold domestically
PE_c	price of exports
$PINTA_a$	price of intermediate aggregate inputs
PM_c	price of imports
PQS_c	supply price of composite good c
PQD_c	demand price of composite good c
PVA_a	value added price

PWE_c	world price of exports
PWM_c	world price of imports
PX_c	average output price
QA_a	level of domestic activity
QD_c	quantity of domestic sales
QE_c	quantity of exports
$QF_{fact,a}$	quantity demanded of factor f from activity a
$QFACINS_{ins,f}$	quantity of factor supply by institution
QG_c	quantity of government consumption
$QH_{c,h}$	quantity consumed of commodity c by household h
$QINT_{c,a}$	quantity of intermediate demand for c from activity a
$QINTA_a$	quantity of aggregate intermediate input
$QINV_c$	quantity of fixed investment demand
QM_c	quantity of imports
QQ_c	quantity of composite goods supply
QVA_a	quantity of aggregate value added
QX_c	quantity of aggregate commodity output
$REBATE_a$	value added rebate for intermediate consumption of activity a
$SAVHH(H)$	savings from households
$SAVFIRM$	savings from firms
$TABS$	total absorption
$THLAB_{flab,h}$	rate of direct tax on labour income of household h
$THLABADJ_{flab,h}$	direct tax on labour income scaling factor

$THLABFLEX$	flexibilization factor for direct tax on labour income
$THCAP_h$	rate of direct tax on capital income of household h
$THCAPADJ_h$	direct tax on capital income scaling factor
$THPEN_h$	rate of direct tax on pensions of household h
$THPENADJ_h$	direct tax on pensions scaling factor
$TRII_{ins,\ ins}$	transfers between domestic non government institutions
$TVAADJ_c$	value added tax scaling factor
TVA_c	rate of value added tax
$TVAFLEX$	flexibilization factor for value added tax
$TS_{flab,\ a}$	rate of employer contribution to social security tax
$TSADJ_{flab,\ a}$	employer contribution to social security tax sclaing factor
$TSFLEX$	flexibilization factor for social security tax
UN_f	unemployment rate
$WALRAS$	savings-investment imbalance
WF_{fact}	economy-wide wage (rent) for factor f
$WFDIST_{fact,a}$	factor wage distortion variable
YF_f	factor income
YG	total current government income
$YIF_{ins,f}$	income of institution ins from factor f
YI_{ins}	income of (domestic non-governmental) institution ins

PARAMETERS OTHER THAN TAX RATES

αq_c	shift parameter for Armington function
αt_c	shift parameter for CET function
αva_a	shift parameter for CES activity production function
αll_a	shift parameter for CES function for labour
awc_f	scale parameter in wage curve
β_{ch}	marg share of hhd cons on commodity c
$cwts_c$	consumer price index weights
δq_c	share parameter for Armington function
δt_c	share parameter for CET function
$\delta va_{flk,a}$	share parameter for CES activity production function
$\delta ll_{flab,a}$	share parameter for CES production for labour
$dwts_c$	domestic sales price weights
$\gamma_{c,h}$	per-cap subsist consumption of com c for hhd h
$ica_{c,a}$	intermediate input c per unit of aggregate intermediate
$inta_a$	aggregate intermediate input coefficient
iva_a	aggregate value added coefficient
$maxhour_{h,f}$	maximal disposable level of work time by f and hh
$mps01_{ins}$	0-1 parameter for potential flexing of savings rates
$\overline{mps}_{insdng}$	marg. prop to save for dom non-gov inst ins (exog part)

$\overline{qg}_c$	exogenous (unscaled) government demand
$\overline{qinv}_c$	exogenous (unscaled) investment demand
ρq_c	Armington function exponent
ρt_c	CET function exponent
ρva_a	CES activity production function exponent
ρll_a	CES labour function exponent
$shif_{ins,f}$	share of dom. institution i in income of factor f
$shii_{ins,insp}$	share of institution i in post-tax post-sav income of institution ip
$\theta_{a,c}$	yield of commodity C per unit of activity A
$trnsfr_{ins,ac}$	transfers from inst. or factor ac to institution ins
$welas_f$	elasticity of wages to unemployment (wage curve)
$zeta_{f,h}$	share of leisure utility by factor and household

TAX RATES

ta_a	tax rate for activity a
te_c	export tax rate
tf_f	rate of direct tax on factors
tm_c	import tax rate
tq_c	rate of sales tax
$\overline{tva}_c$	rate of (exog. part of) value-added tax
$tcofis_a$	tax rate on intermediate consumption of goods

$\overline{ts}_{f,a}$	rate of (exog. part of) employer social security tax on labour
$tdirf_{insd}$	rate of direct tax on firms
$\overline{thlab}_{flab,h}$	rate of (exog part of) direct tax on labour income of households
$\overline{thcap}_{h}$	rate of (exog. part of) direct tax on capital income of households
$\overline{thpen}_{h}$	rate of (exog. part of) direct tax on pensions of households

EQUATIONS

A. Production and Trade Block

$$QINTA_a = inta_a\, QA_a \tag{1}$$

$$QVA_a = iva_a\, QA_a \tag{2}$$

$$QVA_a = \alpha va_a \sum_{fkl} \left(\delta va_{fkl,a} QF_{fkl,a}^{-\rho va_a}\right)^{-\frac{1}{\rho va_a}} \tag{3}$$

$$WF_{fkl} WFDIST_{fkl,a}\left(1+TS_{fkl,a}\right) = PVA_a QVA_a \left(\sum_{fkl} \delta va_{fkl,a} QF_{fkl,a}^{-\rho va_a}\right)^{-1} \delta va_{fkl,a} QF_{fkl,a}^{(-\rho va_a-1)} \tag{4}$$

$$QF_{flab} = \frac{\delta ll_a^{\xi_a} \left(WF_{flab} WFDIST_{flab,a}\right)^{-\rho ll_a} QF_{'l-agg',a}}{\alpha ll_a \left(\sum_{flab} \delta ll_{flab}^{\rho ll_a} \left(WF_{flab} WFDIST_{flab,a}\right)^{(1-\rho ll_a)}\right)^{\frac{\rho ll_a}{\rho ll_a - 1}}} \tag{5}$$

$$WF_{l-agg} = \frac{\sum_{flab,a} \left(WF_{flab} QF_{flab,a}\right)}{\sum_{flab,a} QF_{flab,a}} \tag{6}$$

$$QINT_{ca} = ica_{ca}\, QINTA_a \tag{7}$$

$$QX_c = \sum_a \theta_{ac} QA_a \tag{8}$$

$$QX_c = \alpha t_c (\delta t_c QE_c^{\rho t_c} + (1-\delta t_c) QD_c^{\rho t_c})^{\frac{1}{\rho t_c}} \quad (9)$$

$$\frac{QE_c}{QD_c} = \left(\frac{PE_c}{PDS_c} \frac{(1-\delta t_c)}{\delta t_c} \right)^{\frac{1}{\rho t_c - 1}} \quad (10)$$

$$QQ_c = \alpha q_c (\delta q_c QM_c^{-\rho q_c} + (1-\delta q_c) QD_c^{-\rho q_c})^{-\frac{1}{\rho q_c}} \quad (11)$$

$$\frac{QM_c}{QD_c} = \left(\frac{PDS_c}{PM_c} \frac{\delta q_c}{(1-\delta q_c)} \right)^{\frac{1}{1+\rho q_c}} \quad (12)$$

B. Price Block

$$PM_c = PWM_c(1+tm_c)\ EXR \quad (13)$$

$$PE_c = PWE_c(1-te_c)\ EXR \quad (14)$$

$$PQS_cQQ_c = PDS_cQD_c + PM_cQM_c \quad (15)$$

$$PX_cQX_c = PDS_cQD_c + PE_cQE_c \quad (16)$$

$$PA_a = \sum_C PX_c\, \theta_{a,c} \quad (17)$$

$$PINTA_a = (\sum_{cgood} PQD_{cgood}\, ica_{cgood,a})(1 + \frac{tcofis_a}{1+TVA_{cgood}}) + \sum_{cngood} PQD_{cngood} ica_{cngood,a} - \frac{REBATE_a}{QINTA_a} \quad (18)$$

$$PA_a(1-ta_a)QA_a = PVA_aQVA_a + PINTA_aQINTA_a \quad (19)$$

$$PQD_c = PQS_c(1+tq_c)(1+TVA_c) \quad (20)$$

$$\sum_c PQD_c cwts_c = CPI \quad (21)$$

$$\sum_C PDS_c dwts_c = DPI \quad (22)$$

C. Effective tax rates

$$TVA_c = (1+TVAFLEX)\ TVAADJ_c\ \overline{tva}_c \tag{23}$$

$$TS_{fact,a} = (1+TSFLEX)\ TSADJ_{fact,a}\ \overline{ts}_{fact,a} \tag{24}$$

$$THLAB_{flab,h} = (1+THLABFLEX)\ THLABADJ_{flab,h}\ \overline{thlab}_{flab,h} \tag{25}$$

$$THCAP_h = THCAPADJ_h\ \overline{thcap}_h \tag{26}$$

$$THPEN_h = THPENADJ_h\ \overline{thpen}_h \tag{27}$$

D. Institution block

$$YF_f = \sum_a WF_f WFDIST_{fa} QF_{fa} \tag{28}$$

$$YIF_{insd,f} = shif_{insd,f}\left(1 - tf_f\right)YF_f - trnsfr_{'row',f} EXR \tag{29}$$

$$YI_h = \sum_f YIF_{h,f} + \sum_h TRII_{hh'} + shii_{h,'firms'}(1 - tdirf_{'firms'})(1 - MPS_{'firms'})YI_{'firms'}$$
$$+ trnsfr_{h,'gov'} WF_{'l-agg'} + trnsfr_{h,'row'} EXR \tag{30}$$

$$YI_{'firms'} = YIF_{'firms','cap'} \tag{31}$$

$$TRII_{h,h} = shii_{h,h}(1 - MPS_h)(YI_h - \sum_{flab} THLAB_{flab,h} YIF_{h,flab}$$
$$- THPEN_h trnsfr_{h,'gov'} WF_{'l-agg'} - THCAP_h shii_{h,'firms'}(1 - tdirf_{'firms'})\left(1 - MPS_{'firms'}\right)YI_{'firms'} \tag{32}$$

$$EH_h = \left(1 - \sum_{insdng} shii_{insdng,h}\right)(1 - MPS_h)(YI_h - \sum_{flab} THLAB_{flab,h} YIF_{h,flab}$$
$$- THPEN_h trnsfr_{h,'gov'} WF_{'l-agg'} - THCAP_h shii_{h,'firms'}(1 - tdirf_{'firms'})\left(1 - MPS_{'firms'}\right)YI_{'firms'}) \tag{33}$$

$$QH_{ch}PQD_c = \gamma_{ch}PQD_c + \frac{\beta_{ch}}{\left(1 - \sum_{flab} zeta_{flab,h}\right)}\left(EH_h - \sum_c \gamma_{ch}PQD_c\right) \quad (34)$$

$$QFACINS_{h,flab} = \max hour_{h,flab}$$
$$- \frac{zeta_{flab,h}}{\left(1 - \sum_{flab} zeta_{flab,h}\right)(1 - THLAB_{flab,h})(1 - UN_{flab})WF_{flab}}\left(EH_h - \sum_c \gamma_{ch}PQD_c\right) \quad (35)$$

$$QINV_c = \overline{qinv}_c IADJ \quad (36)$$

$$QG_c = \overline{qg}_c GADJ \quad (37)$$

$$
\begin{aligned}
YG = & \sum_{h}\sum_{flab} THLAB_{flab,h} YIF_{h,flab} \\
& + \sum_{h} THPEN_{h} \; trnsfr_{h,'gov'} WF_{'l-agg'} \\
& + \sum_{h} THCAP_{h} shii_{h,'firms'} (1 - tdirf_{'firms'})(1 - MPS_{'firms'}) YI_{'firms'} \\
& + \sum_{f} tf_{f} YF_{f} \\
& + \sum_{c} TVA_{c} PQS_{c} (1 + tq_{c}) QQ_{c} \\
& + \sum_{a} ta_{a} PA_{a} QA_{a} \\
& + \sum_{c} tm_{c} pwm_{c} QM_{c} EXR \\
& + \sum_{c} te_{c} pwe_{c} QE_{c} EXR \\
& + \sum_{c} tq_{c} PQS_{c} QQ_{c} \\
& + \sum_{f}\sum_{a} TS_{f,a} WF_{f} WFDIST_{f} QF_{f,a} \\
& + tdirf_{'firms'} YI_{'firms'} \\
& + \sum_{Cgood,a} PQD_{cgood} \; QINT_{cgood,a} \frac{tcofis_{a}}{1 + TVA_{cgood}} \\
& - \sum_{a} REBATE_{a} \\
& + \sum_{f} YIF_{'gov',f} \\
& + trnsfr_{'gov','row'} EXR
\end{aligned}
\tag{38}
$$

$$
REBATE_{a} = \sum_{c} PQS_{c} (1 + tq_{c}) QINT_{c,a} TVA_{c} \tag{39}
$$

$$
EG = \sum_{c} PQD_{c} QG_{c} + \sum_{insdng} trnsfr_{insdng,'gov'} WF_{'l-agg'} \tag{40}
$$

E. System constraint block

Factor Market

$$\frac{WF_f}{CPI} = \left(awc_f\, UN_f\right)^{-welasf} \tag{41}$$

$$\sum_a QF_{f,a} = \left(\sum_{ins} QFACINS_{ins,f}\right)(1 - UN_f) \tag{42}$$

Composite Commodity Market Equil.

$$\sum_h QH_{ch} + \sum_a QINT_{ca} + QINV_c + QG_c = QQ_c \tag{43}$$

Current account balance for the ROW, in foreign currency

$$\sum_c pwe_c QE_c + \sum_{insd} trnsfr_{insd,'row'} + FSAV = \sum_c pwm_c QM_c + \sum_f trnsfr_{'row',f} \tag{44}$$

Government balance

$$YG = EG + GSAV \tag{45}$$

Institutional savings rates

$$MPS_{insdng} = \overline{mps}_{insdng}\left(1 + MPSADJ_t \,.mps01_{insdng}\right) + DMPS\,.mps01_{insdng} \tag{46}$$

Savings-Investment Balance

$$SAVHH_h = MPS_h\,(YI_h - (\sum_{flab} THLAB_{h,flab}\, YIF_{insdng,flab}) - THPEN_h\, trnsfr_{h,'gov'}\, WF_{'l-agg'}$$
$$- THCAP_h\, shii_{h,'firms'}\,(1 - tdirf_{'firms'})(1 - \overline{mps}_{'firms'})\, YI_{'firms'} \tag{47}$$

$$SAVFIRM = MPS_{'firms'}\left(1 - tdirf_{'firms'}\right)YI_{'firms'} \tag{48}$$

$$\sum_h SAVHH_h + SAVFIRM + GSAV + FSAV * EXR = \sum_c PQD_c QINV_c + WALRAS \tag{49}$$

Total Absorption

$$TABS = \sum_{ch} PQD_c QH_{ch} + \sum_c PQD_c QG_c + \sum_c PQD_c QINV_c \tag{50}$$

Ratio of Investment to Absorption

$$INVSHR = \frac{\sum_c PQD_c QINV_c}{TABS} \tag{51}$$

Ratio of Government Consumption to Absorption

$$GOVSHR = \frac{\sum_c PQD_c QG_c}{TABS} \tag{52}$$