The Impacts of Income Transfer Programs on Income Distribution and Poverty in Brazil: An Integrated Microsimulation and Computable General Equilibrium Analysis.♣♦♠

Samir Cury [1]
Allexandro Mori Coelho [2]
Euclides Pedrozo [3]

ABSTRACT

A persistent and very high-income inequality is well known feature of the Brazilian economy. However, from 2001 to 2005 the Gini index presented an unprecedented fall of –4.6% combined with a significant poverty reduction. Former studies using partial equilibrium analysis have pointed out the importance of federal government transfer programs for this inequality reduction. The aiming of this research was to evaluate the efficiency of the two most important cash transfer programs, "Bolsa Família" and "BPC", in achieving their purposes of alleviating poverty and reducing the inequality in Brazil's income distribution using an integrated modeling approach, CGE-MS model. The simulation results confirm the importance of these programs to reduce inequality during 2003-2005. But, the effect on poverty alleviation was not strong. Finally, the methodological approach allows the identification of some important economic facts that were not presented in previous analysis, such as the issue of taxation structure that finances these policies.

Key words: computable general equilibrium model, micro-simulation model, income distribution, cash transfer program, fiscal policy, Brazil.
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[1] Professor at Fundação Getulio Vargas, Dept. of Economics, São Paulo, Brazil. E-mail: samir@fgvsp.br

[2] Professor at Fundação Escola de Comércio Álvares Penteado (FECAP), Universidade Cruzeiro do Sul (UNICSUL) and Faculdades Oswaldo Cruz, São Paulo, Brazil. E-mail: allexandro_coelho@yahoo.com.br

[3] Researcher at Fundação Getulio Vargas and Professor at Universidade Paulista (Unip), São Paulo, Brazil. PhD candidate in Economics at Fundação Getulio Vargas. E-mail: euclides.pedrozo@fgvsp.br

1. Introduction

Brazil has historically presented a high inequality of income distribution,[4] which is the main determinant of the high poverty level in the country, being the average income level a secondary determinant, that is, the poverty level does not decline in a significant way when the country grows because the income gains are mostly appropriated by non-poor families.[5] *Barros et al* (2007b) show that without changes of the income inequality, the country should have presented a balanced growth of 14.5% and of 22.0% to achieve the same observed reductions of poverty and extreme poverty levels from 2001 to 2005. Also, each decline of 1% in the inequality degree (Gini index) has the same impact on the poverty and extreme poverty levels that balanced growth rates of 2.4% and 4.0%, respectively. Thus, the falls in income inequality have stronger effects on poverty than the economic growth.

Brazil also presents significant levels of poverty and severe poverty. In 2005, around 34% (60 millions) and 13% (23 millions) of its population were poor and extremely poor.[6] Due to the income inequality and the large number of people under poverty condition, the Federal Government has been transferring income to these people as a way of a broad poverty alleviation strategy.

There are many kinds of income transfer programs in Brazil, such as *Bolsa Família* (BF), *Benefício de Prestação Continuada* (BPC),[7] several retirement benefits and pensions, *Abono PIS/PASEP* and *Salário Família*. This research will analyze the first two programs (BF and BPC), which are the main cash transfers programs specifically designed for poverty (and inequality) reduction.

The BPC is a constitutional right that aims to aid the elderly not included in the public social security system and the disabled people that cannot support themselves with their families' financial care, reaching 2.9 millions of Brazilians nowadays and expending the budget of R$11.63 billions (0.5% of GDP) in 2006. The benefit consists of one minimum wage (R$415/month) and the beneficiary's family per head monthly income must be less than a quarter of a minimum wage.

The *Bolsa Família* program, created in October 2003, is the main transfer program of the Federal Government today. It is the unification of four other former programs: *Bolsa Escola* (since 2001), *Bolsa Alimentação* (since September 2001), *Auxílio Gás* (since December 2001), *Cartão Alimentação* (since

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[4] Considering the existing information on inequality in income distribution for 124 countries, almost 95% of them present an income distribution less concentrated than the Brazilian one (Barros *et al*, 2006; Hoffmann, 2006a; and UNDP, 2006).
[5] See Barros *et al* (2001).
[6] Barros *et al*, 2007c.
[7] Henceforth, respectively referred as *BF* and *BPC*.

2003). Since then, the program has been enlarged to incorporate new groups of beneficiaries. *BF* is pointed towards extremely poor and poor families, with household per head income under R$120/month in 2008. The families receive a transfer of R$62 and a variable amount of R$20 per child, until the maximum of R$60 (three occurrences), with the maximum benefit at R$122.

Unlike the *BPC*, *BF* is a conditional cash transfer program and requires the fulfillment of some requirements for the benefit concession, like the school attendance of 85% for the children in scholar age, the actualization of vaccination for children under six years old, and regular visits to the health center for pregnant women and for those in phase of breastfeeding. In 2007, *BF* beneficiated 11,048,348 families and reached the expense of R$9.26 billions (0.4% of GDP).

Despite the historical stability presented by the inequality in income distribution in Brazil, recent studies show empirical evidence that this inequality has declined in an expressive, accelerated and continuous way from 2001 to 2005, as shown in the Figure 1.1 in the Appendix C.

Recent studies also show that the *BF* and the *BPC* income transfer programs have played an important role in this process, once 22.9% of the decline in the inequality of income distribution was due to the implementation and enhancement of these programs. According to Barros *et al* (2007c), from 2001 to 2005, the Gini index declined from 0.592, close to its average value for the last 30 years, to 0.566, its lowest level until that date, corresponding to a reduction of 4.6% in the inequality degree. Once the income inequality is the main determinant of poverty in Brazil, we should also expect that its decline has caused an important reduction of the poverty level. Barros *et al* (2007b) reports that the reduction of the income inequality from 2001 to 2005 induced declines of the poverty and the extreme poverty levels of around 3.3 and 2.7 percentage points. Once these levels have decreased 4.6 and 3.4 percentage points, the fall of the income inequality has caused almost 73% and 80% of these reductions.

In order to assess the effects of income transfer programs, some researchers compare the program participants (treatment group) with a control group of people with similar characteristics that are relevant to program participation, by running counterfactual simulations that determines the evaluation design, which can be classified as experimental or as quasi-experimental. Also, they vary in feasibility, cost, and the degree of clarity and validity of results (Rawlings and Rubio, 2003).

Experimental and non-experimental designs have been used to impact evaluation of conditional cash transfers in some Latin American countries. To evaluate the *Programa de Educación, Salud y Alimentación* (PROGRESA) in Mexico, evaluators applied an experimental design with panel data that randomly assigned localities into the treatment and control group. A similar design was used to impact evaluation of the *Programa de Asignación Famíliar* (PRAF) in Honduras, and of the *Red de Protección Social* in Nicaragua, at the municipal and census area level respectively.[8]

In Brazil, the *Programa de Erradicação do Trabalho Infantil* (PETI) was evaluated by a quasi-experimental design with single-cross section. This program was firstly implemented in some cities in the state of Pernambuco, and later expanded to other states including Bahia and Sergipe. Once the evaluation was planned after the program beginning, and it was not possible to randomly allocate the cities into treatment and control groups, then the treatment group was composed of three participating cities in separate states, and the comparison group of three similar municipalities not in the program.[9]

Other methodologies as partial equilibrium and decomposition analysis were used to evaluate similar impacts. Some studies that used these methodologies shed some light on the issue about the impacts of transfer programs on income inequality and poverty in Brazil, and deserve to be commented in order to show how this research can contribute to address some knowledge gaps on this subject.

By simulating the impacts that some income transfer programs would have whether they were applied to their entire target population, considering the rules for each program, Rocha (2005) points that the more recent programs would be more efficient in reducing poverty once their value of transfers were much higher and the target population much larger.

Hoffmann (2006b) evaluates the impacts of the income transfer programs on poverty and income inequality at national and regional levels. The study points that 31% of the decline in Brazil's inequality 2002 to 2004 was due to the mentioned programs. In Northeast region, these programs induced 87% of the estimated decline in income distribution for the same period.

Barros *et al* (2007d) estimated that *BF* induced around 11.8% of the income inequality fall from 2001 to 2005, while *BPC* would have caused around 11.1% of this reduction.

These empirical evidences were found by partial equilibrium or decomposition approaches and, in this sense, they did not take in account some systemic (general equilibrium) effects induced by these programs, as well as, the feedback impacts from the economic system on the household income. When the poor families receive the income transfer, they increase their consumption expenditures, which tends to induce firms to produce more and to employ more workers. When these people receive their wages, a new round of additional effects induced by their expenditures goes on, inducing the generation of a higher amount of income in the economy due to a multiplier effect.

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[8] Further details can be found in Rawlings and Rubio (2003).
[9] *Idem*.

These demand effects can be enhanced when we take into account the differences in the expenditure pattern of Brazilian families differentiated by income level. Among the poor urban Brazilian households, the food expenditure was 40% of the total consumption. On the other side, the Brazilian richest households' consumption standards are totally different, once their food expenditure was just 12 %, while health and education private services accounts for near 20% (Cury *et al*, 2006).

Also, the relevance of the general equilibrium effects is justified by the size and evolution of the transfer programs between 2001 and 2005. In the same period, the total expenditure in the main targeted transfer program, *BF*, increased 300%. According to the last Brazilian Central Government report,[10] in 2007, 11 millions of families (around one in each five in the country) are program beneficiaries, reaching 45.8 millions of individuals (around one fourth of population).

On the other hand, we also expect that the program effects are sensitive to the budget sources that are financing this specific public expenditure. As mentioned before, the increased amount in the transfers were financed in specific ways. Also, during this period, some important changes were introduced in the fiscal system. For example, in the social security budget, the sharpest increase revenue came from PIS-COFINS taxes (increased 30% as ratio of GDP), which in 2003-2004 started to levy imports. Facts like this one changed the size and composition of the fiscal sources that are financing the programs and reinforce the general equilibrium impacts derived from the programs recent evolution.[11]

By other side, when the income of poor families increases, it is possible that this additional income can induce some people to reduce their labor offer and reducing their working hours. If this happens, the abovementioned effects induced by expending the transfers would be less than expected.

However, this negative effect of transfer on willingness to supply labor does not have empirical support until now. According to Medeiros *et al* (2007), the rate of participation in the labor market among programs beneficiaries is 73% for the first poorest decile of distribution, 74% for the second and 76% for the third, while the same rate is of 67%, 68% and 71%, respectively, for people that live in households with no beneficiaries. These authors also evaluated the effects of *BF* on labor supply of four demographic groups: women head of family, women non-head of family, men head of family, and men

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[10] "Perfil das Famílias Beneficiárias do Bolsa Família".

[11] In this research we identified in the Federal Brazilian Budget ("Orçamento Geral da União") the specific expenditure items related to the transfer programs. The first classification level for expenditure items is identified by a system of 4 digit codes, named "programas". For example, Bolsa Família has the code "1335" and can also be divided into a second classification level with more 4 digits, called "subprogramas". On the other hand, each "programa"/"subprograma" is earmarked with your own revenue source. In this case, it is a system of 3 digit identification code, called "fonte". See section 4 and Appendix D for more details about this subject.

non-head of family. They found that only the benefited women head of family has likelihood of participation in the labor market lower than similar non-benefited women.

CEDEPLAR (2006, *apud* Medeiros, 2007), also found positive effects of *BF* on labor supply. According to it: (i) adults in households with beneficiaries presented a participation rate 3% higher than adults in households with no beneficiaries; (ii) the positive impact is higher among women, 4%, than among men, 3%; (iii) the program reduced the chances of women quiting their jobs in 6%. However, Tavares (2008) found evidence of an adverse effect of *BF* on willingness to labor market participation of benefited mothers. As we can see, there is some evidence that *BF* can reduce the participation in the labor market only for benefited mothers, and, even in this case, this effect is not consensual.

From the discussion above, it is clear that changes in transfer programs imply modification in both, relative prices and quantities that can be far from being negligible. In this sense, it is not unequivocal which would be the final prevailing effects. This work does not intend to prove that a specific methodology is unequivocally superior to others. Despite this, given the systemic consequences induced by the changes in these programs on markets and on financing sources, we believe that the usage of a CGE model integrated to a Microsimulation model (CGE-MS model), as presented in section 3, for evaluating the impacts of *BF* and *BPC* programs will generate information that will enhance the debate on the effects of these programs on poverty and inequality, once it will capture some systemic effects that are not considered by the methodologies used by other studies.

This paper is organized in more four sections, besides this introduction. The section 2 presents a brief literature review of the CGE-MS integration methodology. Section 3 describes the adopted methodology, including all the steps of CGE-MS integration and solution. The research questions, the implemented simulations and results are presented in the section 4. The last section presents the conclusion and the final remarks. Appendix A, B, and C supplement this paper with more details on the CGE model, intermediate results and Figures and Tables.

2. Review of literature on CGE and microsimulation integration.

The first assessments on the issue about the distributional and poverty effects of economic policies using CGE models was formally presented by Adelman and Robinson (1978), that combined one of the first CGE model with the treatment of Income Distribution through a very disaggregated model. Dervis *et al* (1982) and Gunning (1983) followed the same path, with the introduction of new modeling techniques to this issue. After them, different approaches were developed and this section briefly presents some of their characteristics, and main advantages and drawbacks.[12]

In the CGE model with representative households (CGE-RH) approach, distributional analysis is performed by comparing the changes in income of these representative households (RHs) generated by the CGE model between the different groups of RHs or applying these changes to households' income in survey data to perform comparison between distributive indicators after and before the policy implementation. Poverty analysis is made by applying the change(s) of income of the RH(s) generated by the CGE model on household survey data to compare ex ante and ex post poverty indicators.[13]

Its disadvantages are either the assumption of no changes of intra-group income distribution, or that the changes of intra-group distribution change follows an exogenously fixed rule between the mean and the variance of the income distribution. This drawback is more serious when the analysis is performed with just one RH, when the impacts on poverty are evaluated by applying the change of the RH income on all households in the survey data. Thus, the intra-group nor the between groups effects are not captured, once it just changes the mean but not the variance of the distribution. Despite that, this approach can be easily implemented by simulating the economic policy with a CGE model and using the simulation outputs to make distributional and poverty analysis.

In the CGE model integrated multi-households CGE (CGE-IMH), as many households as are present in income and expenditure household surveys, or a large sample of them, are incorporated to the CGE model.[14] Compared to the CGE-RH, this method has the advantages of allowing changes in intra-group income distribution and not requiring pre-definition of household groups, giving more flexibility to po-verty and distributional analysis since the households grouping can be defined in many different ways. Nonetheless, the large size of the model can difficult its numerical solution and the conciliation of data from household income or expenditure surveys and national accounts, due to under or over reported variables in the household surveys.

According to Bonnet and Mahieu (2000, *apud* Savard, 2003), the above limitations could be overcome by the usage of microsimulation which is required to analyze distributional effects. Thus, in order to better assess the distributional and/or poverty effects of economic policies, Bourguignon, Robilliard and Robinson (2003) presented a CGE model integrated to a micro-simulation (MS) model by

[12] We are considering the same categories proposed by Savard (2003), where more details can be found.
[13] Dervis *et al* (1982), de Janvry *et al* (1991), Chia *et al* (1994), Decaluwé *et al* (1999a), Colatei and Round (2001) and Agenor *et al* (2001) present evaluations based on this approach.

top-down method that permits to decompose the CGE results in their micro components. The CGE model is solved first and the changes of a vector of prices, wages, and aggregate employment variables are transmitted to the MS model, which calculates the variations in individual wages, self-employment incomes, and employment status that would consistent with the set of macro variables generated by the CGE model. In this sense, this top-down model permits to assess the distributive and the poverty impacts from the shock or the policy change simulated in the CGE model.

Despite providing richness in household behavior and presenting extreme flexibility in modeling specific behaviors, as households decisions and labor market switching rules, the reactions of households are not feed backed and, thus, are not taken into account by the CGE model. Thus, in order to achieve better assess of distributional and/or poverty effects of economic policies Savard (2003) and Muller (2004) proposed the methodology of using a CGE model linked to a micro-simulation model, with a bi-directional linkage between them that would guarantee a convergent solution for both models.

3. Methodology

This section describes the methodology used in this research. In the following three subsections are described the CGE model, the microsimulation model, and the integration between them.

3.1. The CGE Model

This section briefly describes some characteristics of the CGE model, as they are standard features, and emphasizes the presentation on the labor market, the household income formation process and the Government expenditure. Further details on it can be found in the Appendix A.2.[15]

The CGE model is single country and recognizes 42 domestic sectors,[16] 8 families,[17] the Government and the external sector. The model takes the hypothesis that Brazilian economy is an international price taker but the movement of their export prices can affect the external demand for Brazilian goods through an export demand equation. Foreign product supply does not face any constraint to attend Brazilian demands. The supply of the 42 domestic sectors is represented by a function that

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[14] Decaluwé *et al* (1999b), Cockburn (2001), and Boccanfuso *et al* (2003) applied this approach to perform poverty and income distribution analysis.

[15] The CGE model used in this research is an extension from the one presented by Cury *et al* (2005) where further details can be found. This model results from a series of developments made in the model proposed by Devarajan *et al* (1991), as can be seen in Cury (1998), Barros *et al* (2000) and Coelho *et al* (2003).

[16] These 42 sectors are listed in Appendix A.1.

[17] Poor urban families headed by active individual (F1), poor urban families headed by non-active individual (F2), poor rural families (F3), urban families with low average income (F4), urban families with medium income (F5), rural families with medium income (F6), families with high average income (F7), and families with high income (F8)

convert 7 types of labor,[18] capital and intermediate inputs into products that are sold as imperfect substitutes in the domestic and international markets.[19]

Concerning demand for products, the utility maximizing families choose their consumption levels according to a Cobb-Douglas function. Families and firms demand domestic and imported goods according to the Armington (1969) hypothesis. Firms demand commodities to fulfill their production requirements of intermediate inputs according to the technical coefficients from the input-output matrix. The Government expenditure faces the fixed budget amount registered for the base year and according to a Cobb-Douglas utility function.

3.1.1. The Labor Market

Firms demand the seven types of labor, classified by contract status and schooling.[20] It is assumed that firms aim at maximizing profits under technological constraints conditions imposed by production function, in an environment where prices of inputs, production factors (labor and capital) and output are beyond their control. Therefore, as a result of this maximization, for each type of workers, a specific demand curve is defined by the condition that their marginal productivities equalize their wages:[21]

$$P_i * \partial X_{il} / \partial F_{il} = W_{il} \qquad (3.1.1)$$

This research uses a CGE model integrated to a MS model. In the last, each individual chooses between offering or not his workforce in the labor market after comparing the observed wage in his sector to his reservation wage. Thus, the labor supply by type of worker is generated by the MS model and communicated to the CGE model, where it is exogenous.[22]

The labor market equilibrium in the integrated CGE-MS model (employment and wage), for each type of worker, represented in the Figure 3.1 in the Appendix C, is determined by E^{l}, the intersection point between the labor demand (L^d) and the labor supply (L^s), which is calculated by the MS model and transmitted to the CGE model. The difference between the economically active population and the

[18] Unskilled informal (L1), skilled informal (L2), formal with low skill (L3), formal with average skill (L4), formal with high skill (L5), public servant with low skill (L6) and public servant with high skill (L7).
[19] The SAM used in this research is fully described and documented by Cury *et al* (2006), which can be requested by e-mail with the authors.
[20] The labor treatment that follows is applied for the five types of private workers. The two types of public servants follow the traditional labor market closure of CGE models with either wage or employment being fixed. Therefore, there is no substitution between public servants and the private kinds of workers, in the sectors where there is no public companies. In the sectors where public and private firms coexist, the changes in the public-private composition of labor are related to the changes in the public-private composition of the sectoral representative firm.
[21] The derivative of the profit function with relation to the factor demand must be equal to the factors' price (first order condition).

employment level, ($L^o - L$), is the excess of labor supply that corresponds to the involuntary unemployment level (U) in the economy.[23]

It deserves to be mentioned that the CGE model takes the assumption that this market equilibrium mechanism does not describe the adjustments for the two types of public servants considered in the model. In Brazil, in general, public servants are hired by mean of official examination for a governmental post and their working contract includes a job stability clause in Brazil. Therefore, it is assumed that the employment levels of these workers are fixed and that the disequilibria in their labor markets are adjusted by means of changes in wages.

The labor market closure is not formulated by sector, but rather by type of labor. Then, the adjustment mechanism is from the aggregate to the sectoral level. After an economic shock, first are defined the aggregate levels of labor supply, wages and unemployment for each type of labor by the interaction of their aggregate demand and supply curves, as explained earlier. To obtain the employ-ment and wage levels in each sector, it is assumed that the sectoral differentiation of wages remain the same as in the base year, which implies in sectoral imperfect segmentation in the labor market.

The hypothesis implicit in the adopted mechanism is that workers with similar observed productive characteristics (schooling and contract status) are paid in a different way according to their sector of employment. The idea is to capture the fact that, although the abovementioned similarities, the workers have another characteristics such as profession type and sector specific training or qualifications that do not permit their free mobility between all sectors but also do not completely constrain their mobility to some other sectors. Therefore, the wage differentials among sectors remain constant due to the imperfect mobility of workers between the economic sectors. Pinheiro and Ramos (1995) have not only proven this fact but have also demonstrated that the wage differentials among sectors are stable along the time. In this sense, there is imperfect mobility of workers among sectors and, thus, the sectoral wage differentials will not be changed, that is, the wage equalization among sectors cannot be achieved by the migration of workers from sector(s) paying lower wages to sector(s) paying higher wages.

The wage of each kind of worker in each sector (W_{li}) is obtained by the interaction between the average wage for each type of labor (W_l) and an exogenous variable for the relative wage differentials among the sectors. With this information, by means of a sector and labor type specific demand curve

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[22] Further details on the determination of labor supply by type of worker will be presented in the section 3.2.
[23] In previous versions of this CGE model it were adopted an alternative specification of the labor market, in which the involuntary unemployment is captured by means a wage curve as proposed by Blanchflower and Oswald (1990, 1994).

(equation 3.1.1), we can also determine the sectoral employment level of each type of labor (F_{il}), which are aggregated by a Cobb-Douglas function[24] to define the sector *i*'s composite labor.

3.1.2. The Income Transfer Mechanisms

This section presents the formation process of income flows received by families and firms. The remuneration of capital is paid to firms and the labor earnings to workers. In each sector, the payments to capital are distributed to the firms according to their initial share in the total earnings of capital.

The eight types (*h*) of families receive earnings from the seven types (*l*) of labor according to the initial shares (ε_{hl}) of these workers in these families, which also receive the income transferred by firms (*YK*) according to the family *h*'s share in these income flows (ε_{hk}).[25] Finally, the families also receive net remittances from abroad (RE_h), adjusted by the exchange rate (*R*), and transfers from the Government (*TG*), in the form of payment of benefits (direct income transfers) and as other transfers (essentially domestic debt interest) that are allocated to the families according to the initial shares (θ_{ht}).[26] Therefore, the family *h's* income is:

$$\boldsymbol{Y_h = \varepsilon_{hl} * W_l + \varepsilon_{hk} * YK + (pindex) * \theta_{hk} * TG + R * RE_h} \qquad (3.1.2)$$

3.1.3. The Government

The Government spends by consuming ($\sum_i CG_i$) and transferring resources to the economic agents. It plays a very important role in the process of determination of secondary income, once it directs a share of its transfers to firms as interests on the domestic debt and also demands products. Similar to families, the sharing of government transfers to the types of firms follows the proportions in the base year (θ_k). Finally, it also transfers resources to abroad (*GE*) and its total expenditure is:

$$GG = \sum_i CG_i + pindex * (\theta_{ht} + \theta_k) * TG + R * GE \qquad (3.1.3)$$

To face all expenditures, the Government relies on three types of collections: (1) direct taxes levied on firms' and families' income (ϕ_h and ϕ_k, respectively), and (2) indirect taxes on domestic and imported goods (proportional to production (*X*), domestic sales (*D*), imports (*M*) and value added (*VA*)

[24] Equation 2.1 in the Appendix A.
[25] The firms are classified in small (self-employed people) and large (other firms). The large firms transfer interest, dividends and others, and house rental to families.
[26] These transfers include the social security benefits as well as other programs such as unemployment benefits, income transfer social programs and other cash benefits.

amounts). Besides these sources, it also receives transfers from abroad (*gfbor*) and, finally, there is the balance of the social security system (*SOCBAL*).[27] Thus, the Government total revenue is:

$$RG = \sum_h \phi_h * Y_h + \sum \phi_k * YK + \sum_i (\eta_i * X_i) + \sum_i (\xi_i * D_i) + \sum_i (\pi_i + \sigma_i) * VA_i + \sum_i (\mu_i + \kappa_i + \gamma_i) * M_i + R * gfbor + SOCBAL \quad (3.1.4)$$

where η_i are the tax rates on production, ξ_i and π_i are, respectively, the sector *i*'s PIS-COFINS rates on domestic sales value (cumulative regime) and on value-added (non-cumulative regime), σ_i and κ_i are, respectively, the ICMS-IPI tax rates on value-added and imports, μ_i is the tariff on imports, while γ_i are the PIS-COFINS rates on imports of commodity type *i*.

An eventual lack of government resources is defined as a government deficit that, together with domestic private (firms and families) and foreign savings, defines the amount of resources spent as investments.

The indirect tax revenue (INDTAX) from domestically produced goods is given by:

$$INDTAX = \sum_i (\eta_i * (PX_i * X_i)) + \sum_i (\xi_i * (PD_i * D_i)) + \sum_i ((\pi_i + \sigma_i) * (VA_i)) \quad (3.1.5)$$

where $PX_i * X_i$ is the production value, $PD_i * D_i$ is the gross revenue value from domestic sales and VA_i, η_j, ξ_i, σ_i and π_i were presented in equation (3.1.4).

The other equation that contributes to the Government revenue and deserves to be mentioned is the one describing the indirect taxes on imports revenue, which is given by:

$$TARIFF = \sum_i (pwm_i * R).(\mu_i + \kappa_i + \gamma_i) * M_i \quad (3.1.6)$$

where pwm_i is the external price of imports (in US$), μ_i is the tariff on imports, κ_i is ICMS-IPI rates on Imports and γ_i are the PIS-COFINS rates on imports.

3.2. The Microsimulation Model

This section describes the specification of the household income model used for the microsimulation. The initial hypothesis for using a microsimulation model is the fact that the public income transfers can induce changes of individuals' behavior, concerning their willingness to participate in the job market and their level of expenditure. The application of a microsimulation model will permit to evaluate the effects of the programs *Bolsa Família* and BPC on the individual's willingness to supply

[27] In fact, social security is treated as an agent apart from the Government in the model, not only because of the considerable amount of resources that it handles in Brazil, but also because of the contributions that it applies on either the company's income (here again in a different form), or on the installments of the added value of labor.

labor, and also on poverty and income distribution indicators, considering a nationally representative sample of the population.[28]

The microsimulation model adopted in this research is based on the procedure proposed by Savard (2003). The main adaptation for this model will be the use of another segmented labor market.[29] As described before, we will assume five segments with flexible wage that adjusts with labor supply and demand. For the unemployed, the reservation wage of each individual determines its potential choice between offering (or not) his workforce in the labor market. Furthermore, a worker decides to quit the job market if the observed wage is lower than his reservation wage.

The procedure used to estimate the microsimulation model is applied to individuals in active age (over 10 years old) belonging to the five type of factors (L1 to L5) that have the wages paid in the private sector as the main source of income. Once in Brazil the public servants' (factors L6 and L7) working contract includes a job stability clause, it is assumed that their employment levels are fixed.[30]

A prior concern to the individuals' reservation wage estimation is the issue related to labor supply identification problem. In principle, the enlargement of income transfers exogenously affects the willingness to supply labor of various demographic groups in different ways. Thus, it is necessary to estimate an equation for individual labor supply, identified by the number of individuals' worked hours, as a function of the individual wage-hour after changes in income transfers, for each demographic group to be considered. Besides, it is also necessary to correct the potential auto-selection bias to labor supply participation. After applying this procedure, it is possible to properly identify the different reaction of the labor supply to exogenous changes of transfers' level, for individuals in each demographic group. Therefore, the estimation procedure can be described in two steps as follow.

- *Step 1*

The predicted working hours are obtained from the observed and non-observed individuals' characteristics, as well as the family *H*'s characteristics, to which this individual belongs to, and his own

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[28] As the database used in this work, the National Research of Sample by Domicile (PNAD) doesn't have information about the domicile's expenditures, the micro simulation model will be reduced to the analyzes of the individual's labor offer. See appendix B for further details.

[29] In Savard (2003), the labor market is segmented in two types: one with a fixed wage and another one with a flexible wage. Therefore, an individual could alter between three states (observing the implicit costs of choosing each one of them): offering her workforce in each one of the two markets or getting unemployed by choice.

[30] The Brazilian labor market also has a segment of non-flexible wages. However, this segment is formed primarily by public sector workers with job stability clauses. These workers who belong to the factors L6 and L7 are not included in the MS model, but they are agents in the CGE model.

wage. Therefore, the worker *i*'s predicted hours of work, h_i^j, is estimated by the semi-log specification, according to Blundell and McCurdy (1999):[31]

$$h_i^j = \alpha_i + \theta_i \log w_i + \beta_i \log Q_i + \delta \log B_i + \gamma_i(Z_i) + u_i, \qquad i = 1,...,n \;\; e \;\; j = 1,2,3 \qquad (3.2.1)$$

where α_i, θ_i, β_i, δ_i and γ_i are the parameters to be estimated; w_i is the hourly wage rate for individual *i*; Q_i is the vector of the total household income net of all earnings (including income transfers) received by individual *i*; B_i is the vector of benefits received by individual *i*;[32] Z_i represents the individuals' observable characteristics; u_i is the random error term, which captures the non-observable characteristics that affect the individual labor supply; and *j* is the individual's demographic group, being 1 for men, 2 for woman head of household with children, and 3 for other women.[33] The value of θ determines the substitution effect related to sensitivity of individual labor supply to changes in wages. The values of β and δ represent the income effect, that is, the impact of non-labor income on labor supply.

The Z_i vector of individual characteristics was composed by the following variables:

$$Z_i = educ, \text{age}, \text{age}^2, famsize, \; D_a$$

where *educ* denotes the number of years of schooling, *age* is a *proxy* to the level of experience; *famsize* is the family size in number of individuals (excluding pensioners, domestic servants and their parents), D_a is a dummy for the area where the family's domicile is located (0 for urban and 1 for rural).

The individual working hour is observed just for occupied people. Thus, the sample of individuals that present a strictly positive hour of work is not random. However, it is possible that the choice to work be related to the income dependent variables, either from labor or non-labor (other income sources). Therefore, the situation is typically one of endogenous selection, in which there is a decision to participate or not in the job market and, given that the individual had decided to work, it is necessary to determine how many working hours he will offer. In order to control the potential selection bias, it will be applied the procedure proposed by Heckman (1979), which consists of:

$$\Pr(S_i = 1 \mid \mathbf{z}) = \Phi\{\gamma_i(Y_i Z_i)\} \qquad (3.2.2)$$

[31] This functional form was proposed because it is consistent, first, with the existence of individuals' preferences by labor and leisure, and, second, with the presence of households budgets constraints (Blundell and MaCurdy, 1999).
[32] This is the amount of benefits that the individual received from Bolsa Família and BPC in 2003.
[33] In this last case, the women are not heads of families.

where: Φ is a function of accumulated distribution, where S_i is a qualitative variable representing the occupational choice for a individual *i*: this variable will take the value 0 if the individual doesn't supply work or 1 otherwise. The variable γ_i is a vector of estimated parameters that determine the probability of the individual to take part in the labor market. Y_i is the vector representing the variables related to the labor and non-labor income that affect the decision of supplying labor by individual *i*. As before, Z_i is the individual characteristics that determine the probability of participating in the labor market.

The equations (3.2.1) and (3.2.2) are estimated by the two stages method proposed by Heckman (1979). In this model, equation (3.2.2) is also known as the equation of correction of sample selection's bias by non-observables. These equations are run separately for three demographic groups: men, women with children and that are head of family, and other women which permits to estimate their elasticity of labor supply. From equation (3.2.2) is extracted the inverse of Mills' ratio, $\lambda(\mathbf{z}\gamma)$, which will be applied in equation (3.2.1), in a way that the parameters of this equations are going to be consistently estimated.

After the estimation of the coefficients in (3.2.1) and the inverse of Mills' ratio, it will be possible to estimate the adjusted working hour of each individual, $\overline{h}_i^{\,j}$, based on the observed and non-observed characteristics. The adjusted working hour is then applied to the individual *i*'s observed wage, $\hat{w}_i$, which results in the adjusted individual *i*'s wage (w_i).

- *Step 2*

In accordance with the formulated hours of work model, the individual labor supply is a function of individual market wage rates and the non-labor income among other variables. These wage rates can be observed for paid employed individuals. For non-paid persons there is a unobservable wage rate which an individual could receive in potential. According to Heckman (1974) it is possible to express this reservation (potential) wage as a function of their individual characteristics as well as the non-labor income and other constraints.

Following Savard (2003), the non-observed reservation wage is obtained from the observable and non-observable individuals' characteristics, as well as the family *H*'s characteristics, of which this individual belongs to. Due to the importance of evaluating the reservation wage before and after a income transfer shock, we include de non-labor income in the structural reservation wage equation and identifying separately the income transfer variable. Therefore, the worker *i*'s reservation log wage, $\overline{w}_i$, is estimated by the equation:

$$\log \overline{w}_i = \alpha_i + \beta_i \log Q_i + \delta \log B_i + \gamma(Z_i) + u_i, \qquad i = 1,\ldots,n \tag{3.2.3}$$

where α_i, β_i, δ_i and γ_i are the parameters to be estimated. The observed wage, $\hat{w}_i$, is the hourly wage adjusted by the procedure descript in step 1; Q_i, B_i and Z_i are the same variables presented early.

Due to the impossibility of observing the wage offer to the sample's individuals that are unemployed, we need to estimate a *probit* model that determines the probability of the individual to take part in the labor market. This probability, $S_i = 1$, is estimated by the function:

$$\Pr(S_i = 1 \mid \mathbf{z}) = \Phi\{\gamma_i (Y_i Z_i D_g)\} \tag{3.2.4}$$

where: Φ is a function of accumulated distribution; γ_i is a vector of estimated parameters that determine the probability of the individual to take part in the labor market; as before, Z_i and Y_i are respectively the individual characteristics and the work and non-work income that determine the probability of participating in the labor market; and D_g is a demographic *dummy* (0 for man, 1 for woman that is mother and head of family, 2 for the other women).

Finally, the equations (3.2.3) and (3.2.4) are estimated by the two stages method proposed by Heckman (1979). In this model, equation (3.2.4) is also known as the equation of correction of sample selection's bias by non-observable. From this equation is extracted the inverse of Mills' ratio, $\lambda(\mathbf{z}\gamma)$, which will be applied in (3.2.3), in a way that the parameters of this equations are going to be consistently estimated.

After the estimation of coefficients in (3.2.3) and (3.2.4) and the inverse of Mills' ratio, it will be possible to calculate the reservation wage of each individual, $\overline{w}_i^k$ (k = 0,1), based on his observed and non-observed characteristics. If the individual belongs to state $k = 1$, the reservation wage of worker i will be used in comparison with the observed wage, w_i, to select the potential employed or unemployed persons . If he pertains to the state $k = 0$, the reservation wage of this individual is obtained to construct a rank of potential new employed persons.

For each employed person, this procedure applies the following criterion: if the estimated reservation wage $(\overline{w}_i^j)$ is higher than the earned wage (w_j) observed in the database, then this person is indicated as potentially unemployed; otherwise, he remains employed, i.e.:

$$\begin{cases} \text{if } \ w_i < \overline{w}_i^k , & \text{individual } i \text{ is a potentially unemployed} \\ \text{otherwise} , & \text{he is a potentially employed} \end{cases}$$

After making this comparison for each employed person, the model determines the Heckman pre-simulation occupational level by private labor type $(HLsl)$ by summing up the number of people originally unemployed with the number of people that would unemployed according to the Heckman criterion.

It deserves mentioning that this occupational level by private labor type $(HLsl)$ is different from the original level in the database (Lsl), once there are people in the database that work and earn wages lower than their estimated reservation wages. Actually, this happens because these last wages are estimates of the ones that these people could earn in the market according to characteristics of themselves and of their families. Therefore, just the application of the Heckman procedure to the database changes the occupational level for each labor type.

As proposed by Savard (2003), the selection of individuals who should be unemployed starts with the classification of workers according to their reservation wages. Those with the highest reservation wage will be the first to become unemployed if the real wage decreases. If there is positive change in the real wages, the first to be employed will be those with lower reservation wage.

3.3. Integration Between The CGE and The MS model

The impacts of the *Bolsa Família* and BPC programs on welfare indicators will be assessed with an integrated CGE-MS modeling framework with bi-directional linkage between them to guarantee convergence of solutions for both models. The communication between the CGE and MS models will occur by means of wages and occupational level of labor. This sub-section describes the way these models are integrated to generate a convergent solution for them.

Running the integrated model involves the following procedure: we first compute the income transfers changes in the MS model and sequentially run the CGE model. By computing the changes of income transfer programs, the MS model simulates the variations in labor supply by type of worker that are communicated to the CGE model.

The basic issue is implementing the variations of labor supply by type of private worker, calculated by the MS model, and of Government expenses that are due to changes in transfer programs in the CGE model, in order to calculate the induced alterations of the average real wage for each type of private worker and the general price index.34 These last changes are fed back into the MS model, in which they are exogenous variables, to define a new labor occupational level for each kind of private worker, that are feed backed to the CGE model, in which they are exogenous variables, producing new values for the average real wage for each type of private worker, and the general price index that are retransmitted to the MS model, in order to define labor occupational levels compatible with the new value of the average real wage specific by private worker type.

This iterative process continues until the difference between the values of occupational levels for the private labor types in the CGE model between two consecutive iterative steps are very close to zero. The following description illustrates the bidirectional procedure works in the case of simulating the implementation of changes in the Bolsa Família and BPC programs according to each simulation, which will be described in the next section:

- *Step 1*

The MS model contains data about thousands of individuals and estimates the reservation wage ($\overline{w}_i^j$) for each person i in the database and defines occupational levels for each category of private labor by means of the equations (3.2.3) and (3.2.4), as exposed in the previous section.

The first step of the integrated solution consists in replacing the values that represents the benefits received from the income transfer programs in 2003 (B_i) in the equations (3.2.3) and (3.2.4) by the specific new values of these benefits (B_i^*) in each simulation and, then, re-estimating to calculate what the Heckman post-simulation occupational level for each private labor type ($HLsl_{MS}^*$), the occupational level under the simulated conditions.

In order to capture the changes in the occupational level by private labor type due only to the variation in the benefits, isolated from the effects of applying the Heckman procedure to the database, it is calculated the difference between the Heckman post-simulation occupational level by private labor type ($HLsl_{MS}^*$) and the Heckman pre-simulation one ($HLsl$), and sum it to the original occupational level in the database (Lsl) to have an occupational level that is compatible with the new values of benefits, that is, a post-simulation occupational level by private labor type calculated by the MS model (Lsl_{MS}^*).

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[34] The model's numeraire is the nominal exchange rate.

- *Step 2*

The occupational level after implementing the changes of income transfer programs $\left(Lsl_{MS}^{*}\right)$, as well as the new amount of given benefits $\left(B^{*}\right)$ are applied to the CGE model, where

$$B^{*}=\sum_{i}\sum_{t}B_{i}^{t},\quad i=1,...,n;\quad t=BF,BPC \qquad (3.2.5)$$

and B_{i}^{t} is the amount of benefits that individual *i* received from *Bolsa Família* and BPC.

Besides, the new values of taxes that are used to finance the changes in transfer programs $\left(B^{*}\right)$ are also applied to the CGE model in order to simulate the changes in the economic environment induced by the variation in the income transfer programs.

All these changes will induce the economic system to achieve a new general equilibrium and, as part of this process, the labor market will reach equilibrium with new values for the real wage $\left(W_{CGE}^{*}\right)$ for each kind of worker.

- *Step 3*

The percentage change in the average real wage $\left(\Delta W_{CGE}^{*}\right)$ for each kind of private worker obtained from the simulation with the CGE model is applied on the wages earned by each person *i* in the MS model's database $\left(w_{i}\right)$, who belongs to the respective category of worker, defining after-shock values for earned wages $\left(w_{i}^{*}\right)$ by each kind of private worker. For example, if the post-simulation average real wage of worker type l5 (formal with high skill) in the CGE model is 5% higher than its initial value, then all wages earned by each one in this category in the MS model's database are raised by 5%.

After that, we compare the values of these new individual wages $\left(w_{i}^{*}\right)$ with their respective reservation wage amounts $\left(\overline{w}_{i}^{j}\right)$ by means of Heckman procedure. Using the same previously mentioned criterion for this procedure, we have that:

$$\begin{cases}\text{if } w_{i}^{*}<\overline{w}_{i}^{j}, & \text{individual } i \text{ is unemployed,}\\ \text{otherwise}, & \text{he is employed.}\end{cases}$$

Therefore, after classifying the workers by the reservation wages, those with the highest reservation wage will be the first to become unemployed if the real wage decreases, and in the case of a positive change in real wages, the first to be employed will be those with lower reservation wage.

Summing up the number of people to be employed or unemployed according to this criterion to the initial occupational level, one obtains a new level of occupation for each private labor type $\left(Lsl_{MS}^{*}\right)$.

- *Step 4*

These new levels of occupational levels are then transmitted to the CGE model, as shown in the Figure 3.2 that illustrates the iterative procedure.

If the occupational levels calculated by the MS model are different from those in the CGE model, they change the equilibrium of the labor markets, which will present new values for wages and induce changes in the economic environment as a whole until the CGE model reaches a new equilibrium situation. In this sense, the step 2 restarts, but without changes in benefits and their financing sources, and this integrated solution procedure loops until the difference between the post-simulation occupational level calculated by the MS model $\left(Lsl\,*\right)$ in one round is reasonably close to the one obtained in the previous round.

This association is done in a consistent way with the equilibrium of aggregate markets in the CGE model, which requires that: (1) relative changes in average earnings in the MS model must be equal to changes in wage rates obtained in the CGE model for each private wage group in the labor market; (2) relative changes in the number of privatly waged workers by labor market segment in the MS model must match those same changes in the CGE model, and (3) changes in the consumption price vector, *p*, must be consistent with the CGE equivalent price indicator.[35]

According to the above procedure, the private labor supply is being modified along simulation iterations and for example, some individuals will be losing their former jobs. If this happens, the share of each household in the total income of each labor category can also change (parameter εhl in equation 3.1.2). In order to capture those variations, we incorporate the differences among the parameter εhl, along the simulation rounds, as also a shock in the CGE, which performs together with the procedures described in this section.

3.4. Non-Labor Income Procedures

After the models solutions' convergence it is still necessary to treat the non-labor incomes before calculating poverty and inequality indicators. Basically, the variables related to these sources of income in the MS model or follow the CGE variations or held the same value of the household survey, as

[35] The change in consumption prices is transmitted from the CGE model to the MS model through the variation of the real wages by worker type, which are used as linking aggregate variables between the models.

described in the table bellow. In the former case, the changes from the CGE model are transmitted to the correspondent variables in the MS model in a unidirectional way. (See Table 3.1 in the Appendix C).

4. Simulations and Results

This section presents the simulations features in order to provide some basis for a better understanding the reported results which are also presented bellow.

4.1. Simulations description

The aiming of this section is the description of the simulations carried out in this project which are related to the project research questions: what are the impacts of the current income transfer programs on income distribution and poverty in Brazil? Each of them is accomplishing its objective of poverty reduction? Which would be the impacts of these programs if they have alternative policy designs?

At the CGE level, our simulation objective is the evaluation of the effects of changing the values and the beneficiaries of the programs *Bolsa Família* and BPC from the ones they presented in 2003 to the ones presented in 2005. Also, we can understand this simulation as the following question: How the 2003 Brazilian economy (base year) would behave if it had the same characteristics of the transfer program in the year 2005. To do so, we proceed in the following way.

Transfer Programs. We addressed the changes between 2003 and 2005 with similar procedures adopted by Barros *et al* (2007e).[36] At the CGE level, with that information, we just took the benefits share among the 8 CGE model families with amounts, for each program, given by the administrative Federal Budget data respecting the consistency with our SAM data. The values are shown in the Table 4.1 in the Appendix C.

The Table 4.1 shows the differences among the benefits amounts in 2005 and 2003. The amount imputed in the 2003 model base year increased the transfers by R$6,392 million which represents 0.57% of the total family income in the model. Separately, the program's increase was approximately 116% for "BF" and 53% for "BPC". Also, there was an improvement in the targeting group. The poorest families in the CGE model (F1, F2 and F3) increase their "BF" share from 44.9 % (2003) to 46.1% (2005). Despite these improvement, the data shows that the BPC targeting were much worse than those from BF program (from 19.4 % in 2003 to 26.6 % in 2005).

[36] For 2003, at micro data level, we used the same adapted household survey, which was provided by those authors.

The effects of abovementioned changes will be evaluated by the simulations henceforth referred as SIMU A and SIMU B. The only difference between them is if the programs are financed or not, before the shock. In the SIMU A, the government expenditure in transfers is not financed and government just increases its expenditure in transfers.

Program Budget Finance at SIMU B. The expenditure increase of BF and BPC was fully financed by the increase in federal government taxes. This choice was made in order to hold almost constant the nominal Government deficit and its contribution to the total amount of savings, at the CGE level. The justification for this policy arrangement can be explained by the "fiscal responsibility law", which requires that every new expenditures must be explicitly financed at the budget law, which means at the moment the law is approved but before the expenditure occurrence.

For the choice of which tax we should increase, we made an extensive research in the 2005 federal budget data to identify the specific tax sources that were financing the BF-BPC programs in that year. The Table 4.2 in the Appendix C shows the amounts of the federal tax sources, their participation and the equivalent CGE tax, presented in the CGE model.[37]

From the Table 4.2, we collected the financial share of each tax in the total increase of programs expenditure. Thus, the taxes below were increased to finance the programs in the following way:

- 2.2% increase of direct income taxes of all types of families (IR);
- 2.2 % increase of direct income taxes of the model firms (IR);
- It was made an appropriation of 27.5% from the tax increase due to the PIS-COFINS tax reform, which was implemented in the same period and is fully described by Cury and Coelho (2006).

4.2. Macroeconomic Impacts

Table 4.3 in the Appendix C presents the macro results that formed the background for SIMU A and SIMU B. The analysis will focus on results from SIMU A once it captures the effects of changes in transfers and in the taxes that were used to finance the variation in transfers, while the results from SIMU A are reported to provide information on the impacts only from the changes in transfer programs.

In general, the impacts were adverse since they induced a real GDP fall of 0.46%, an aggregate employment decrease of 0.48% and generated a price index increase of 0.65%. These effects can be

[37] A more comprehensive data about tax sources is presented in the appendix D of this report.

mainly attributed to the partial PIS-COFINS tax reform that was one of the financing sources of these programs. The analysis of this tax reform done by Cury and Coelho (2006) provided similar results.[38]

The taxation of the firms' value-added (VA) imposed to firms the need of earning higher marginal revenues or reducing marginal costs, which can be done by reductions of the VA components usage. This implies in a lower labor demand that induces decrease in wages, and so, reduces the available income. Particularly, the consumption fall is due to the decrease in the overall family income despite the rise in the poorest ones due to the transfer's increase.

The taxation of imports imposed by the fiscal reform increased their prices in the domestic market and induced another adverse effect on aggregate consumption, once this have risen the composite commodities prices in the internal market. This relative increase of prices in the internal market induces reductions of the households and firms demands.

Exports fell due to the price-responsiveness behavior of external agents and the model external closure characteristics. First, the simulation induced an increase in domestically produced commodities prices, which, by its turn, caused a decrease in external demand for Brazilian commodities. Second, the rise in import prices and the reduction of internal absorption (activity) induced a fall in demand for imported commodities, and in exports, in order to cause no disequilibrium in the trade balance.

The government deficit worsened 7.88% showing that the simulated taxation changes were not enough to completely finance the total transfer costs. However, comparing with SIMU A, this deficit decreased from 17.87 % to 7.88%. Despite the intention of fully finance in SIMU B design, this deficit was not held constant due to the tax deadweight losses incurred during the simulation.

Finally, the comparison between both simulations can demonstrated the isolated effect of transfers without the tax increases (SIMU A). At this simulation, the GDP is practically stable. The same occurred with internal absorption, but the shock caused a trade off between consumption and the investment, with the former increasing 0.5 % and the later decreasing 1.42 %. This fact can be explained by the increase in income transfer and by the higher public deficit (+17.89 %) and consequently, reducing total savings.. If there is no increase in another source of savings, the consequently fall of Investment can reduce the rate of economic growth in the near future.

Besides the former adverse effect, overall the SIMU A almost doesn't change the macro indicators in the short run, therefore we can conclude that the adverse impacts of SIMU B are due to the implemented financing structure.

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[38] This paper provides an intensive analysis of the PIS COFINS tax reform explaining the negative effects reasons.

4.3. Impacts on Labor Market

The changes of transfer programs from 2003 to 2005 induced a slight adverse effects on aggregate employment (–0.48%, see Table 4.3) and on employment by labor type, as shown in Table 4.4 in the Appendix C. The results show that employment would fall for all categories of workers in the private sector only. The public servants employment does not change because public sector does not follow the behavior of private sector concerning hiring/firing people and so, by assumption, their employment levels are fixed and their labor market adjust only by means of wages.

Among workers in the private sector, one can see two patterns. First, the effects would be more pronounced among those allocated in the informal market (L1 and L2) and, second, among the less skilled ones in each (informal or formal) market.

In our interpretation, with lower imports and an external closure implying fixed balance of goods and services there will be a pressure to overvalue the exchange rate that will tend to make exports more expensive, which will be reinforced by an increase in input prices used to produce exported goods. The sectors in which exports are more sensible to price changes are the most traditional ones. Thus, by exporting less, there would be a tendency for these sectors to produce less and, therefore, to employ less workers, especially the less skilled ones.

The decrease in employment of more skilled workers is due to the fall in the output of sectors that produce goods with higher technological content and demand this kind of worker in a more intensive way (automobiles, auto parts, electronic, electrical, and pharmaceutical). Behind this fact , probably there is the consumption fall of families with higher income.

Table 4.5 in the Appendix C presents the impacts on real wages by labor type. Recall that the CGE model takes the assumption of rigid sectoral wage differentials, and, thus, the wage structure can only react to the type of labor. As a consequence, the changes reported in Table 4.5, are for each type of worker without any sectoral desegregation.

Note that the general effect is a real wage fall. The wage of informal workers (L1 and L2) would fall relatively more comparing to the wage of formal workers with similar level of skills. The higher reduction of public servants' earnings is due to the assumption that the equilibrium in their labor market is almost exclusively achieved by means of wages adjustments.

Table 4.6 in the Appendix C shows that the effects on payroll by type of worker (total labor income) representing the former quantity and price effects together. They are stronger among the less skilled workers, especially for those allocated in informal market.

These effects on payroll are due mainly to the falls in real wages, once the impacts of changes in transfer programs on employment are lower than the ones on real wages for each kind of worker. Again, the comparison between the simulations shows that the transfer programs themselves practically don't cause any significant adverse effect. Even the informal unskilled worker (L1) shows a labor income improvement, derived from the fact that there is a production reallocation in favor of more intensive labor sectors. On the other hand, the increase in taxes to finance the programs brought the adverse effects through the changes in the relative prices and a less efficient resource allocation with higher unemployment.

Finally, it is important to mention that the convergence procedures affect the final labor market equilibrium. Thus, concerning these effects on payroll, the convergence solution of the CGE and the MS models show that the changes in the transfer programs induce general equilibrium effects that are firstly concentrating on wage (price effects) and along the iterative process are partially reallocated to employment impacts (quantity effects).

The Table 4.7 in the Appendix C illustrates the process described in the previous paragraph through the evolution of model variables during the simulation B. In the first line, we represent the real wage, price index and GDP in the first simulation round. In the second line, the same variables are presented for the last round of SIMU B, which is the source of the results reported in this section. For the wage, we realized that the iteration change considerably the results, lowering the impact on wages. The price index received an increase and GDP just a small variation, helped by the employment increase, confirming that the model integration leads a new set of results.

4.4. Impacts on Income Distribution

Table 4.8 in the Appendix C shows the impacts of changes in transfer programs on inequality indicators. In general, the results confirm the important role of these programs in the Brazilian recent inequality fall.[39] Focusing on Gini index changes, the fall of –0.48% is slightly lower than ones reported by other studies that have evaluated the importance of transfer programs to the decrease in inequality using partial equilibrium/decomposing analysis. Barros *et al* (2007) found that 22.9 % of the total Gini decrease between 2001 and 2005 was due to BF and BPC.

The simulations implemented in this research had isolated the effects of changes in transfer programs from 2003 to 2005. In the same period, the before mentioned authors reported a total decrease

[39] The book printed in Brazil, edited by IPEA (Barros *et al*, 2007) has several chapters aligned with this view.

of Gini index of –2.6%. Therefore, the decrease displayed in the Table 4.8 accounts for approximately 14% (SIMU A) and 19% (SIMU B) of total inequality fall in that period.

Although the period is different, we found evidences that just the transfer programs (SIMU A) had lower effects on inequality than those reported by other studies that had evaluated the distributive effects of these programs. But, in the case of SIMU B, the effect is very similar. It is important to observe that the taxation changes related to the programs contributed in a significant way to reduce inequality.

Despite the previous comments, we must be careful when comparing with former analysis. As stressed before, they have methodological differences and design of the simulations is not the same, although we tried to replicate their experiments.

Table 4.9 in the Appendix C shows the impacts of changes in transfer programs on per head family income. Before presenting these results, it deserves mention that the changes in programs had slight adverse effect on the national average household income of – 0.18% (SIMU A), which was magnified to – 0.81%, when the changes in taxation related to the programs expansion were considered (SIMU B). At both simulations, the positive strong effects in the three poorest families are primarily due to the increase of the transfer amounts for them. But at SIMU B, the effects are a little lower for each of these same families type. This happens because one of the main sources of resources for the enlargement of the programs was the increase in income taxes that does not charge them.

For the same reason previously mentioned, the effects of programs expansion on income of richer families (F7 and F8) already were negative in the first simulation (SIMU A) and were magnified when the changes in taxation were considered.

SIMU A captures the effects just of the transfer programs expansion that positively impacts the income of the poorest family types. This simulation also captures the systemic effects induced from these programs that were generally adverse, as shown in sections 4.2 and 4.4. Besides capturing these effects, SIMU B also captures the additional negative impacts from taxation on all families, mainly on the richest ones (F7 and F8).

This helps to understand the improvement of the Gini index at SIMU B, in relation to SIMU A, because besides capturing the increase of income of the poorest families, it also captures the fall of income of the richest families due to the taxation.

4.5. Impacts on Poverty

The effects of the transfer programs on poverty are presented in the Table 4.10 in the Appendix C. Based on observed and simulated per head household income, we calculate three poverty indicators:

Proportion of Poor (P0), Income Gap (P1) and Severity of Poverty (P2). To calculate these indicators, it was used values for September 2005 estimated by Barros *et al* (2007b), and we deflated to September 2003 according to IPCA (Índice de Preços ao Consumidor Amplo) index.

The general reduction in poverty indicators (P0, P1 and P2) show that the changes just in transfer programs (SIMU A) had positive effects on poverty and on extreme poverty. Although the impacts are positive, they are lower than the income of the poorest families showed at Table 4.9 because the transfers are concentrated on the families that receive them and on the other hand, some poor families loose their labor income due to the unemployment generated in the economy

From the results on the table above, we also see that the impacts of programs on poverty were reduced by the changes in taxation conducted to finance their expansion (SIMU B), that is, the changes in taxation generated some adverse impacts in the markets that affected the poor population and in a more intensive way, the extremely poor individuals. As we have seen previously in section 4.4, the impacts on employment were stronger among the less skilled workers (L1 and L3) and for the informal workers (L1 and L2). Despite these workers have not presented the highest reduction in wages, their wages also have decreased in a significant way. These workers are the prevailing types in the poorest families, which also present a high dependence on the labor income. Therefore, despite the increase of the received benefits, some families experienced adverse effects from job losses and from wage reduction that were induced by the changes in taxation.

Specifically in the case of SIMU B, the extreme poverty level was not affected by the programs expansion. However, the income gap and severity of extreme poverty have worsened. One fact that helps to understand, besides what was pointed before, is the deterioration of non-labor income due to the prices increase, which especially hammered the family F2, whose income is basically from Social Security benefits.

5. Conclusions and Recommendations

In the last two sections of this paper, we presented the methodological approach and the main results of the simulations. In these previous analysis it became very clear the interdependence of both to achieve the main objectives stated in this research project: "*The Impacts of Income Transfer Programs on Income Distribution and Poverty in Brazil: An Integrated Microsimulation and Computable General Equilibrium Analysis*".

From the methodology, the general equilibrium effects can not be neglected, not only to evaluate the effects brought by the transfer increases, but mainly to address the economic impacts originated in the tax structure that finances this social expenditure. Without the CGE part of the integrated approach, many economic facts, reported at the simulation results, could not be identified.

On the other hand, the MS model allows the individualization and the treatment of individuals and families. In view of this, we implemented the individual imputation of the transfer benefits and the respective labor supply reaction, whose system inside the MS model improved a lot the treatment of the labor market. Also, without the MS model, we could not generate more realistic results about poverty and inequality than those obtained with models with representative agents.

Then, we have the integration between these models (CGE and MS). Throughout the interaction in the labor market, the employee's reactions to wage movements were better captured allowing a set of price and quantity adjustments with economic consequences for the entire system. Without them, the simulations effects would be more concentrated on quantity adjustments that rarely fit the empirical data of this type of shock.

The aiming of the simulations presented before was the investigation of the role of the two most important Brazilian cash transfer programs in reducing inequality. Through them our main objective was to provide information that could help on the answers of the main project research questions: What are the impacts of the current income transfer programs on poverty/inequality? In which extent each of them is accomplishing its objective of poverty/inequality reduction? Which would be the impacts of these programs if they have alternative policy designs?

Adopting the same strategy of our results presentation, we will emphasize the impacts of SIMU B, which in our opinion can represent better the cost-benefits of the analyzed policies, since it captures the effects of changes in transfers and in taxes that were used to finance them.

The macro results that formed the background for both simulations showed that, in general, the impacts were adverse for several macro indicators, among them, GDP, employment and price index. However, it is important to emphasize that the adverse results came mainly from the tax increases instead of the transfer policies. Also, the identification of this fact is a direct contribution of the integrated approach.

Starting with the first question, the results confirm the importance of "Bolsa Família" and "BPC" programs for the recent reduction of Brazilian income inequality. The results of SIMU B showed that practically 1/5 of inequality fall, between 2003 and 2005, can be attributed to the adopted policies. Also, the results are very similar of those reported by other studies that used partial equilibrium/decomposing analysis. However, the taxation alone, showed in SIMU B, had a major role in this process. Again, this finding is another contribution derived from our methodology.

For the poverty indicators, the results are also positive but the transfer policy contribution, especially at SIMU B, had a smaller impact than its inequality effect. The transfers itself (SIMU A) generated the positive impacts, but the changes in taxation to finance their expansion practically offset the former effect, particularly, in the case of extreme poverty indicators. The family income components that contributed to this process are both, the labor income through a higher unemployment and the non labor income through the fall of social security benefits, in real values.

The answer of the second question, if the programs are accomplishing their objective of poverty/inequality reduction, can not ignore the analysis pointed out before. Generally, the results demonstrate that the two analyzed programs have achieved their objectives. But, the simulation data at section 4.1 showed that "Bolsa Família" has a better focalization for their beneficiaries, concentrating its benefits in the poor families. On the other hand, BPC doesn't show the same concentration pattern. However, in this case, as shown in the appendix C and D, the main problem lies in the program administration that has not enforced correctly the criteria established by its legal instruments.

Finally, for the third question, we didn't formally made simulations with the alternative designs because the research results indicated there are other issues more important than the benefits alternative models. This fact was also reinforced by the small impacts of the current programs design on labor supply. On the other hand, it became evident that the taxation structure of the transfer programs has an important role in the final welfare impacts. In our opinion, this issue should deserve more attention in the research policy agenda which could explore different strategies to finance the programs and/or cutting some government expenditure that neither improves income distribution nor reducing poverty.

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Appendix A: CGE Model

A.1. The 42 sectors in the CGE model

IBGE-NA Code	Sectors descriptions
01	Agriculture
02	Mining (except fuels)
03	Extraction of oil and natural gas, coal and other fuels
04	Manufacture of non-metallic mineral
05	Steel
06	Non-ferrous metallurgy
07	Manufacture of other metallurgic products
08	Manufacture and maintenance of machines and tractors
10	Manufacture of electrical material and equipment
11	Manufacture of electronic material and equipment
12	Manufacture of cars, trucks and buses
13	Manufacture of other vehicles, parts and accessories
14	Sawmills and manufacture of wood and furniture
15	Manufacture of paper and printing
16	Rubber industry
17	Manufacture of non-petrochemical chemical elements
18	Refining of petroleum and petrochemical industry
19	Manufacture of various chemicals
20	Manufacture of pharmaceuticals and perfumery
21	Processing industry of plastic
22	Textile industry
23	Manufacture of articles clothing and accessories
24	Manufacture of footwear and leather goods and furs
25	Coffee industry
26	Processing of products of vegetable origin, including tobacco
27	Slaughter and meat preparation
28	Cooling and preparation of milk and dairy
29	Sugar industry
30	Manufacture and refining of vegetable oils and fats for food
31	Other food and drink industries
32	Miscellaneous industry
33	Industrial services of public utility
34	Construction
35	Retail trade
36	Transports
37	Communications
38	Financial institutions
39	Services provided to families
40	Business services
41	Rental properties
42	Government
43	Private non-market services

Source: Cury *et al* (2006).

A.2. The CGE Model

A.2.1. The Product Supply

Foreign product supply is modeled as being totally elastic,[40] while sectoral domestic supply is represented by a three steps nested production function with three types of inputs: labor, capital and intermediate inputs.[41]

First, amounts of types of labor (F_l), given by the first order firm's profit maximization conditions, are combined in a composite labor (Ld_i) for each sector *i*, by a Cobb-Douglas function with constant returns to scale:[42]

$$Ld_i = \prod_l F_{il}^{\beta_{il}} \tag{A.2.1}$$

where β_{il} is the share of each type of labor: unskilled informal (L1), skilled informal (L2), formal with low skill (L3), formal with average skill (L4), formal with high skill (L5), public servant with low skill (L6) and public servant with high skill (L7).[43].

Second, in each sector *i*, aggregated labor (Ld_i) and capital (K_i) [44] are associated by a constant elasticity of substitution (CES) function to obtain the production level (X_i):

$$X_i = a_i^D \left[\alpha_i Ld_i^{\rho_{it}} + (1-\alpha_i) K_i^{\rho_{it}}\right]^{1/\rho_{it}} \tag{A.2.2}$$

where a_i^D is the CES shift parameter, α_i is the *i* sector's labor share in the production value and ρ_{ip} is the elasticity of substitution between capital and labor.

Finally, in the third step the various intermediate inputs levels (INT_i) are obtained by a Leontief production function (e.g., fixed proportion to sector *j* total product, X_j):[45]

$$INT_i = \sum_j a_{ij} * X_j \qquad \text{(A,2.3)}$$

where a_{ij} is the technical coefficient of input *j* in sector *i*.

Domestic producers react to the relative prices in domestic and international markets and the domestic output is divided by a constant elasticity of transformation (CET) function with imperfect substitution between products sold in these markets:

$$X_i = a_i^T * \left[\gamma_i * E_i^{(\rho_{it}+1)/\rho_{it}} + (1-\gamma_i) * D_i^{(\rho_{it}+1)/\rho_{it}}\right]^{(\rho_{it}+1)/\rho_{it}} \tag{A.2.4}$$

[40] Thus, Brazilian demands for imported goods are fully satisfied without facing external supply constraints.
[41] The model represents the 42 sectors of activities listed in the Appendix A.1.
[42] This means that an identical increase of every type of worker results in an identical increase of the aggregate worker.
[43] Also, there are more two types of employers that are treated as labor and enter in the Cobb-Douglas aggregation.
[44] The model closure adopted in the simulations determines that the sectoral levels of capital are fixed.
[45] It is worth mentioning that Devarajan *et al* (1991) makes use only the first and third steps, by combining capital with labor and value added with intermediate inputs, in this order.

where X_i, E_i and D_i are, respectively, the domestic sector *i*'s total output, exported volume and sales to internal market. a_i^T and γ_i are model's parameters and ρ_{it} is the elasticity of transformation.[46]

A.2.2. Demand for products

A.2.2.1. Families

Families are classified according to per head household income, level of urbanization and household head characteristics: poor urban families headed by active individual (F1), poor urban families headed by non-active individual (F2), poor rural families (F3), urban families with low average income (F4), urban families with medium income (F5), rural families with medium income (F6), families with high average income (F7), and families with high income (F8).

They choose commodities' consumption levels to maximize utility subject to a budget constraint,[47] according to a Cobb-Douglas functional form (similar to the production function presented earlier).

Families and firms demand domestic and imported goods as imperfect substitutes that differ according to their source (domestic or external), as proposed by Armington (1969), and their utility levels are measured (in product quantity) by a CES function:

$$Q_i = a_i * c\left[\delta_i * M_i^{(\rho_{ic}-1)/\rho_{ic}} + (1-\delta_i) * D_i^{(\rho_{ic}-1)/\rho_{ic}}\right]^{1/\rho_{ic}} \qquad \text{(A.2.5)}$$

where M_i is the imported volume of good *i* and D_i is the consumption of the domestic good *i*. a_ic and δ_i are parameters, while ρ_{ic} is the Armington elasticity of substitution between D_i and M_i.[48] Finally, Q_i indicates the utility derived from the consumption of good *i*.[49]

The external agents demand domestic goods, reacting to changes in relative prices as well. Similarly to the import demand function, the exports demand arises from a CES utility function that represents the imperfect substitution between products from the external regions and Brazil.

A.2.2.2. Firms

Firms demand commodities to satisfy their production requirements of intermediate inputs according to the technical coefficients from the input-output matrix.

Due to the static nature of accumulation in the capital market, investments are only important for product demand. Similarly to consumption, the investment is characterized as the purchases of certain goods and can be considered as a final consumption undertaken by firms. The savings represent this amount of resources and it is assumed that a share of it corresponds to investment in stocks of finished goods, while the remaining parcel represents the net investment required to expand production. The first share is

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[46] There are no empirical estimates of Brazilian export elasticities using a CET structure for a highly disaggregated sectoral specification. Therefore, it was adopted the same procedure used in Cury (1998, pp. 112-113), which departed from the elasticities estimated by Roland-Holst *et al* (1994) to the American economy.

[47] Actually, this utility maximization can happen along the consumers' lifetime. From the point of view of most practical applications, the maximization is on the goods and services available in a given period.

[48] These elasticities values were estimated for the same sectors considered in the model by Tourinho *et al* (2002).

defined based on a fixed proportion to the sectoral output, while the second is distributed exogenously among the sectors, reflecting information from the input-output tables (goods by sector of origin).

It is considered that investment goods are being produced but not used as increments of capital stocks. Thus, the model closure is closer to a medium-run type: constant capital stock, price flexibility and existence of involuntary unemployment in equilibrium.

A.2.2.3. Government

The Government consumption (GC) is derived from maximization of a Cobb-Douglas utility function subject to the budgetary constraint corresponding to the total expenditure that is fixed according to the total amount registered for the base year.

[49] It can be interpreted as the quantity of a hypothetical composite good that would be demanded by consumers.

Appendix B: The Models' Data Bases and Econometrics Estimates

B.1. CGE Data Base.

Almost all data used in the CGE model and simulations were derived from a Social Account Matrix (MSC–2003), which contains all the quantities and prices information in 2003 (the model's base year). Besides, all the model's coefficients and parameters obtained by the model calibration process are calculated from this data matrix, whose description can be found in Cury et al (2006). It deserves mention that it was not made based on new Brazilian National Accounts 2000 series released just in March 2007 by the Instituto Brasileiro de Geografia e Estatística (IBGE). Another set of data used to calculate the economic shocks that will be simulated and evaluated will be presented in the next section.

B.2. Micro Simulation Data Base

The database for the micro simulation consists of the sample of almost 384,834 individuals distributed in 117,010 households in the PNAD 2003. Each of the individuals in active age (over 10 years old) was classified according to the 11 types of factors derived from the CGE model. However, only individuals in active age belonging to the factors L1 to L5 were considered in the CGE-MS integration, that is, those individuals who have as the main income source the wages paid in the private sector. Thus, the sample had 106,590 observations that represent 48,742,853 individuals that were classified as occupied and unoccupied as shown in the table below.

One of the main difficulties in order to make the CGE-MS integration is the convergence. For this convergence be successful it was appropriate to make the two databases had the same values. Thus, the weights of individuals were multiplied by a factor (reweighting), so as the PNAD data base reflected the CGE model data. Table B.1 presents the results of this reweighting for employed and unemployed people.

B.3. Econometric Estimates

The first part of the micro simulation process is the computation of the labor supply equation. For this phase, it was considered the entire PNAD sample. From the reweighed data base, it was estimated the equations (3.2.1) and (3.2.2) by the two stages method proposed by Heckman (1979), for three demographics groups: men, women head of household with children, and other women. Table B.2 contains the econometric estimates by the system equation, including the coefficients and their standard errors to 5% of significance, as well as the inverse of the Mills's ratio, $\hat{\lambda}(\mathbf{z})$. From these estimates were computed the potential hours of work necessary for the completion of the step 2 of the microsimulation process.

The second part of the micro simulation process is the computation of the reservation wages and the new occupation ratio. For this phase, it was considered only the factors L1 to L5. From the reweighed data base, it was estimated the equations (3.2.3) and (3.2.4) by the two stages method proposed by Heckman

(1979). Table B.3 contains the econometric estimates by this system equation and the benefits shocks, changing the $\log B_i$ that corresponding the Bolsa Família and BPC amounts of 2003, to $\log B_i^*$ corresponding the benefits amounts of 2005.[50]

B.4. Labor Supply Elasticities

In this section, we evaluate the relations between the conditional cash transfer programs and the individual work decision through the substitution and income effects. In Table 4.10 we present the marginal effects in respect to hours of work, implied by the estimates in Table B.2 presented in Appendix B.

The wage compensated elasticity of labor supply reflects the strength of the substitution effect from the labor income. The wage elasticities are the coefficients reported by the variable $\log w$ in equation (3.2.1). For women without children (j = 3) this elasticity is positive and higher than women head of families (j = 2), as we would expect and according to the results of many empirical studies. For men, the negative elasticity is not usual, but its result is non-significant.

The magnitude of the income effect is reflected in the income elasticity of labor supply. These income elasticities – described by the variables $\log B$ (public transfer benefits) and $\log Q$ (all other non labor income) in equation (3.2.1) – are all negative, as expected. The highest sensibility is related to the group formed by women, head of households, with children which is in line with the great majority of the empirical works on this subject. Also, the results are consistent with the standard theory and show that the cash benefits may have participation effects on the specific population groups.

Table B.1 – Employed and unemployed reweighing for L1 to L5 work factors

Factor	Description of the worker	PNAD occupational condition (in 1.000 persons)			Unem-ployed ratio	CGE model data (in 1.000 persons)			Unem-ployed ratio	Reweighing	
		Emplo-yed	Unem-ployed	Total		Emplo-yed	Unem-ployed	Total		Emplo-yed	Unem-ployed
L1	Unskilled informal	12.890	1.567	14.457	10,8%	11.714	1.418	13.132	10,8%	0,9088	0,9052
L2	Skilled informal	5.694	952	6.646	14,3%	5.264	878	6.143	14,3%	0,9245	0,9226
L3	Formal with low skill	13.923	1.349	15.272	8,8%	12.274	1.184	13.458	8,8%	0,8815	0,8782
L4	Formal with average skill	9.208	854	10.062	8,5%	8.331	774	9.105	8,5%	0,9048	0,9062
L5	Formal with high skill	2.211	95	2.306	4,1%	2.063	88	2.152	4,1%	0,9334	0,9238
Totals		**43.926**	**4.817**	**48.743**	**9,9%**	**39.647**	**8.537**	**87.788**	**9,7%**		

Source: PNAD 2003, CGE model data base

[50] The procedure to impute this values in 2003 data base is described in Appendix C.

Table B.2 – Results of labor supply estimates

	Coefficients Group: j = 1 (Men)	Coefficients Group: j = 2 (Women with children)	Coefficients Group: j = 3 (Women)
Labor supply regression equation: h_i			
log w	-2,3275 **	-4,4850 **	-2,5876 **
	(0,0567)	(0,1793)	(0,0873)
log B	-0,0893	-1,5730 **	-1,3203 **
	(0,1011)	(0,1373)	(0,0778)
log Q	-0,2655 **	-0,2435 **	-0,1505 **
	(0,0161)	(0,0518)	(0,0371)
Educ	0,1386 **	0,6143 **	0,5238 **
	(0,0129)	(0,0375)	(0,0199)
Age	0,9658 **	1,0852 **	0,6261 **
	(0,0241)	(0,0858)	(0,0367)
age^2	-0,0112 **	-0,0138 **	-0,0089 **
	(0,0003)	(0,0011)	(0,0005)
Famsize	-0,1423 **	-0,1175	-0,3811 **
	(0,0285)	(0,1154)	(0,0463)
D_a	-0,6749 **	-5,6864 **	-9,2074 **
	(0,1275)	(0,5287)	(0,2064)
constant	34,4863 **	32,8253 **	41,7028 **
	(0,4924)	(1,7713)	(0,7587)
Selection equation: $\Pr(S_i = 1 \mid \mathbf{z})$			
log w	2,6519 **	2,6359 **	2,7232 **
	(0,0271)	(0,0454)	(0,0281)
log B	-0,0938 **	0,0870 **	0,0833 **
	(0,0159)	(0,0140)	(0,0065)
log Q	-0,0728 **	-0,0582 **	-0,0259 **
	(0,0044)	(0,0076)	(0,0048)
educ	-0,0494 **	-0,0424 **	-0,0221 **
	(0,0026)	(0,0048)	(0,0020)
age	-0,0122 **	0,0429 **	0,0464 **
	(0,0043)	(0,0089)	(0,0033)
age^2	0,0001 *	-0,0005 **	-0,0005 **
	(0,0001)	(0,0001)	(0,0000)
famsize	0,0660 **	0,0571 **	0,0181 **
	(0,0055)	(0,0130)	(0,0043)
D_a	1,4757 **	0,9410 **	1,2707 **
	(0,0248)	(0,0488)	(0,0160)
constant	-1,8483 **	-2,8367 **	-3,2942 **
	(0,0941)	(0,1818)	(0,0721)
$\hat{\lambda}(\mathbf{z})$	-4,9936 **	-5,2360 **	-5,1552 **
	(0,1117)	(0,2599)	(0,1205)
Number of obs.	108.897	21.526	95.707
Censored obs.	20.292	8.454	44.616
Log likelihood	-363.403,5	-57.265,63	-230.780,8

Note: Standar erros in brackets; ** significant at 1%; * significant at 5%.
Source: Authors' estimates.

Table B.3 – Results of reservation wages – L1 to L5 factors

	Benefits of 2003		Benefits shocks of 2005	
	Coefficients	S.E.	Coefficients	S.E.
Wage regression equation: $\log \overline{w}_i$				
log B	-0,1176 **	(0,0040)	-0,1133 **	(0,0034)
log Q	-0,0029 *	(0,0009)	-0,0034 **	(0,0009)
Educ	0,1039 **	(0,0006)	0,1035 **	(0,0006)
Age	0,0876 **	(0,0011)	0,0871 **	(0,0010)
age^2	-0,0009 **	(0,0000)	-0,0009 **	(0,0000)
Constant	3,4343 **	(0,0198)	3,4477 **	(0,0197)
Selection equation: $\Pr(S_i = 1 \mid \mathbf{z})$				
log B	0,0241 *	(0,0079)	0,0150 *	(0,0068)
log Q	0,0021	(0,0020)	0,0017	(0,0021)
Educ	0,0204 **	(0,0013)	0,0203 **	(0,0013)
Age	0,0346 **	(0,0022)	0,0349 **	(0,0022)
age^2	-0,0003 **	(0,0000)	-0,0003 **	(0,0000)
Famsize	-0,0365 **	(0,0033)	-0,0348 **	(0,0033)
D_g = 2 (Women w/ children)	-0,5199 **	(0,0102)	-0,5116 **	(0,0103)
D_g = 3 (Others women)	-0,3597 **	(0,0089)	-0,2981 **	(0,0029)
D_a	0,2561 **	(0,0220)	0,2556 **	(0,0220)
Constant	0,8714 **	(0,0522)	0,8531 **	(0,0521)
$\hat{\lambda}(\mathbf{z})$	-0,5581 **	(0,0053)	-0,5549 **	(0,0053)
Number of obs.	103.289		103.289	
Censored obs.	10.867		10.867	
Log likelihood	-128.537,9		-126.387,7	

Note: ** significant at 1%; * significant at 5%.
Source: Authors' estimates.

Table B.3 – Elasticities: Marginal Effects for Grouping Demographics

Variable	j = 1 (Men)		j = 2 (Women with children)		j = 3 (Women)	
	Elasticity	**S.E.**	**Elasticity**	**S.E.**	**Elasticity**	**S.E.**
Wage elasticity (log w)	-0,0230	(0,0506)	0,0328 **	(0,0070)	0,1168 **	(0,0047)
Income elasticicity (log B)	-0,0009	(0,0010)	-0,0128 **	(0,0014)	-0,0082 **	(0,0008)
Income elasticity (log Q)	-0,0026 **	(0,0002)	-0,0041 **	(0,0006)	-0,0028 **	(0,0004)

Note: ** significant at 1%; * significant at 5%.
Source: Authors' estimates.

Appendix C: Figures and Tables

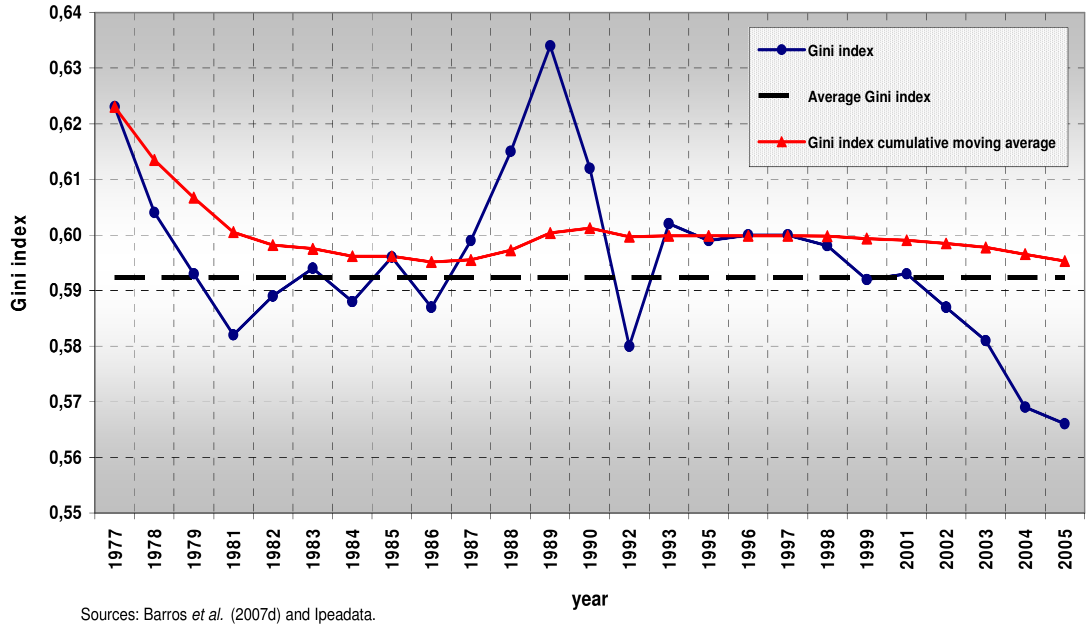

Figure 1.1 - Temporal evolution of inequality in per head income distribution in Brazil

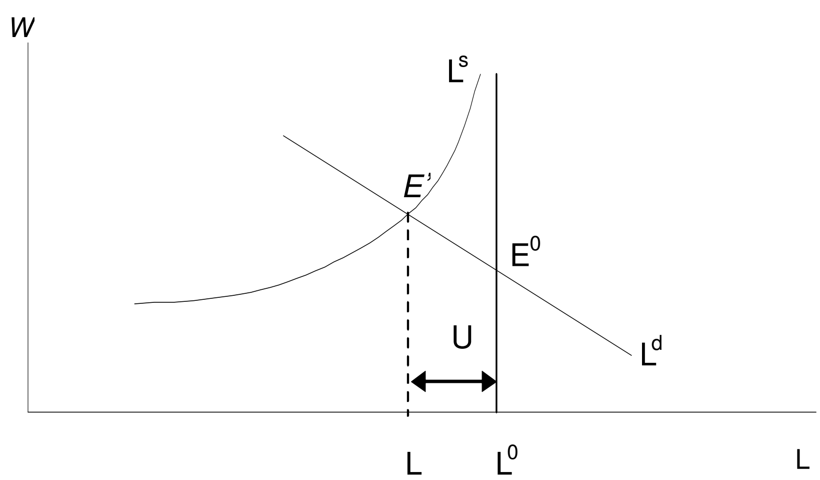

Figure 3.1 - Equilibrium in the labor market by type of worker

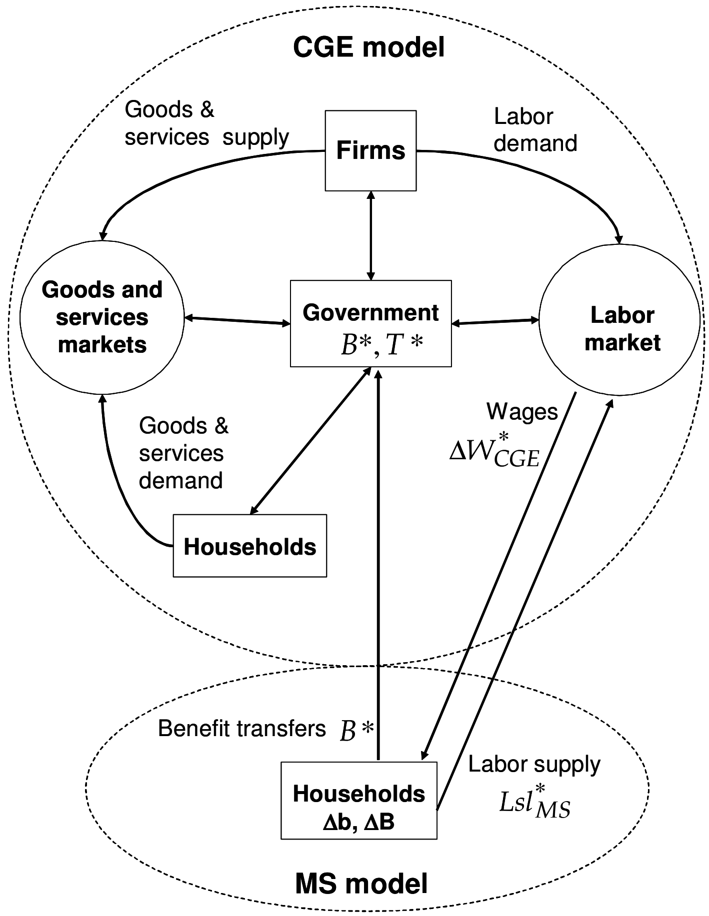

Figure 3.2. – MS-CGE Integration

Table 3.1 – Integration CGE-MS Model for non labor Income (base 2003)

Household Income Source	Procedure in the Microsimulation (PNAD 2003)
Governmental Transfers	The 2005 imputed "Bolsa Família" and "BPC" values described at Appendix C.
Self Employed Income	CGE results variations of these income sources are applied to the microsimulation model vectors.[51]
Interest, Dividends and Others and House Rental	CGE results variation of these income flows individualized to the 8 family types in the model are applied to the microsimulation model vectors.[52]
Retiree and Pension Public Benefits	The same vector value of the microsimulation base year model.
Retiree and Pension Private Benefits	The same vector value of the microsimulation base year model.
Donation received	The same vector value of the microsimulation base year model.
The above sources are deflated by the CGE model price index (after simulation) for each family type (weighted by the consumption model vector)	

[51] Vector included in the matrix ($\varepsilon_{hk} * YK$) in equation (3.1.2).

[52] Another vector of matrix (ε_{hk} * YK) plus Government transfers at equation 3.1.2.

Table 4.1 – Total Amount of Benefits for CGE Model Family type, changes between 2003 and 2005 (R$ mil)

Families	2003		2005		2005-2003	
	Bolsa Família	BPC	Bolsa Família	BPC	Total Increase	Share of Benefits in Total Family Income
F1	777.344	675.171	1.829.805	1.418.757	1.796.048	4,31%
F2	35.269	19.741	88.412	255.354	288.755	3,01%
F3	616.145	302.187	1.250.466	410.307	742.439	5,05%
F4	810.877	2.203.557	1.861.258	4.346.372	3.193.196	2,32%
F5	131.450	653.335	276.218	336.645	-171.922	-0,11%
F6	319.388	653.445	647.264	757.034	431.464	1,09%
F7	336.965	575.066	635.454	288.837	12.259	0,00%
F8	157.558	50.428	282.481	25.328	99.823	0,04%
Total	**3.185.000**	**5.132.934**	**6.871.361**	**7.838.638**	**6.392.065**	0,57%

Source: Author's elaboration based on data from Federal Budget and SAM (2003) based model.

Table 4.2 – Programs Tax Sources in 2005 (R$ mil)

Brazil Tax Source	Value	Composition	TAX in the CGE model
Contribuição para Financiamento da Seguridade Social (Code 153)	7.570.121	51.46%	Pis-Cofins tax reform – value added reform
Contribuição Provisória sobre Movimentação Financeira (Code 155)	5.265.907	35.80%	Direct taxes on firms and households
Outros Impostos Diretos (Income Tax And Others)	993.630	6.75%	Direct taxes on firms and households
Impostos sobre Produtos (Mix Of Indirect Taxes)	445.959	3.03%	Indirect taxes on Revenue
Contribuição Social sobre o Lucro das Pessoas Jurídicas (Code 151)	418.667	2.85%	Direct taxes on firms and households
Operações de Credito Externas - Em Moeda (code 148)	15.713	0.11%	
Total	**14.710.000**	**100.00%**	

Table 4.3 – Macroeconomic Indicators (percentage change)*

Macroeconomics indicators	SIMU A	SIMU B
GDP	–0.02	–0.46
Consumption	0.50	–0.35
Investment	–1.42	–1.04
Public Sector Deficit	+17.87	+7.38
Exports	(**)	–0.84
Imports	(**)	–1.07
Employment	–0.11	–0.48
Price Index	0.13	0.65

Note: (*) Real percentage change from the CGE base year. (**) Lower than 0.01%.
Source: Authors' elaboration.

Table 4.4 – Change in employment from the base-year (%)

	L1	L2	L3	L4	L5	L6	L7
SIMU A	– 0.13	– 0.14	– 0.17	– 0.06	– 0.06	0,00	0,00
SIMU B	– 0.85	– 0.47	– 0.47	– 0.28	– 0.23	0,00	0,00

Note: L1-unskilled informal; **L2**-skilled informal; **L3**-formal with low skill; **L4**-formal with average skill; **L5**- formal with high skill; **L6**-low skilled public servant; **L7**- highly skilled public servant.

Table 4.5 – change in the average real wage from the base-year (%)

	L1	L2	L3	L4	L5	L6	L7
SIMU A	+ 0,32	– 0,12	– 0,04	– 0,07	– 0,09	– 0,04	– 0,01
SIMU B	– 1,77	– 0.96	– 1,52	– 0,90	– 1,61	– 1,66	– 1,62

Note: **L1**-unskilled informal; **L2**-skilled informal; **L3**-formal with low skill; **L4**-formal with average skill; **L5**- formal with high skill; **L6**-low skilled public servant; **L7**- highly skilled public servant.

Table 4.6 – Change in the real payroll from the base-year (%)

	L1	L2	L3	L4	L5	L6	L7
SIMU A	+ 0,19	– 0,25	– 0,21	– 0,13	– 0,14	– 0,04	– 0,01
SIMU B	–2.62	–1.43	–1.99	–1.18	–1.84	–1.66	–1.62

Note: L1-unskilled informal; L2-skilled informal; L3-formal with low skill; L4-formal with average skill; L5- formal with high skill; L6-low skilled public servant; L7- highly skilled public servant.

Table 4.7 – Differences between first and last SIMU B rounds – selected variables (%)

	wage L1	wage L2	wage L3	wage L4	wage L5	pindex	GDP
First round simu B	– 2,16	– 1,39	– 1,76	– 1,29	– 1,93	0.56	– 0.41
Last round simu B	– 1,77	– 0.96	– 1,52	– 0,90	– 1,61	0,65	– 0,46

Table 4.8 – Inequality Indicators from household per head Income (base year 2003)

Inequality Indicators	Base Year	SIMU A		SIMU B	
	Original	Results**	Change	Results**	Change
Gini Index	0.5930	0.5908	– 0.37%	0.5902	– 0.48%
Theil-T Index	0.7213	0.7163	– 0.69%	0.7161	– 0.72%

Source: from the CGE-MS integration model. (base year: 2003 PNAD survey)

Table 4.9 – Change in household income from the base-year (%)

Average household income	Original	SIMU A		SIMU B	
	Values (R$)	Values (R$)	Change	Values (R$)	Change
National average	432.36	431.59	-0.18%	428.84	-0.81%
Family 1 (F1)	43.88	45.89	4.58%	45.76	4.28%
Family 2 (F2)	70.20	74.90	6.70%	74.89	6.69%
Family 3 (F3)	46.87	47.89	2.17%	47.78	1.94%
Family 4 (F4)	166.42	168.19	1.06%	167.67	0.75%
Family 5 (F5)	303.65	302.57	–0.36%	301.23	–0.80%
Family 6 (F6)	191.94	192.31	0.19%	191.76	–0.09%
Family 7 (F7)	696.64	693.84	–0.40%	689.33	–1.05%
Family 8 (F8)	3,015.14	2,998.08	–0.57%	2,972.50	–1.41%

Note: F1 – poor urban families headed by active individuals; F2 – poor urban families headed by non-active individuals; F3 – poor rural families; F4 – urban families with low average income; F5 – urban families with medium income; F6 – rural families with medium income; F7 – families with high average income; F8 – families with high income.

Source: Authors' elaboration.

Table 4.10 – Poverty Indicators - PNAD 2003

Poverty Indicators	Base year	SIMU A		SIMU B	
	Results*	Results	Change	Results	Change
Poverty Line (Line = R$143,70)					
P0	0.3299	0.3256	–1.29%	0.3271	–0.84%
P1	0.1599	0.1579	–1.26%	0.1593	–0.38%
P2	0.1061	0.1047	–1.28%	0.1060	–0.08%
Extreme Poverty Lines (Line = R$71,84)					
P0	0.1485	0.1473	–0.83%	0.1485	0.01%
P1	0.0777	0.0766	–1.38%	0.0778	0.18%
P2	0.0578	0.0569	–1.52%	0.0580	0.40%

Source: Authors' elaboration.