ON SIMULATING BRAZIL'S TAX BENEFIT SYSTEM USING A MULTI-COUNTRY MICROSIMULATION FRAMEWORK

Rozane Bezerra de Siqueira *, Herwig Immervoll **, Cathal O'Donoghue ** and José Ricardo Nogueira *.[1]

** Universidade Federal de Pernambuco, Brazil.*
*** University of Cambridge, UK.*

Summer 2000

Preliminary Paper - Please do not quote without the authors' permission.

Abstract

It is widely known that Brazil has one of the most unequal income distributions in the world. On the other hand, government social spending in Brazil is one of the highest in Latin America. The fact that the net impact of previous policy measures on social indicators has been less than satisfactory suggests that a better design and assessment of poverty alleviation policies is needed. One approach that enhances the assessment of tax-benefit systems is microsimulation modelling. This approach takes information about a nationally representative sample of the population and simulates the effects of detailed policy rules on that population, incorporating the interactions of different elements of the tax-benefit system and taking full account of the diversity of characteristics in the population. This paper assesses the feasibility of building a microsimulation model for Brazil. In particular it examines the possibility of using an existing microsimulation framework, taking the software used in the development of the European Union's EUROMOD cross-country model as a basis.

Keywords: Microsimulation, Fiscal Policy, Social Security, Latin America

JEL: C81, H2, H55, O54

---

[1] Contact details.

Brazil Team: Public Economics Research Group and Network Economics Research Group, Department of Economics. Email: *rbs@decon.ufpe.br* *jrbn@decon.ufpe.br* *http://www.decon.ufpe.br/econ-net.htm*, Website: *http://www.decon.ufpe.br/public.htm*

Cambridge team: Microsimulation Unit, Department of Applied Economics. Email: *co206@econ.cam.ac.uk* *hi207@econ.cam.ac.uk*, Website: *http://www.ecom.cam.ac.uk/dae/um/microsim.htm*

1. Introduction

It is widely known that Brazil has one of the most unequal income distributions in the world. Almost one half of all income in the country accrues to the richest 10 percent of the population, and only about 1 percent of total income goes to the poorest 10 percent. Londoño and Székely (L-S), (1997) measure the Gini coefficient in 1995 to be 61.4, while having fallen in the early 1980's, they found that inequality has risen during the period 1982-1995. Absolute poverty has been severe in Brazil, with about one third of the population lacking the resources to satisfy basic needs. On the other hand, government social spending in Brazil represents approximately 22% of gross national product, one of the highest levels in Latin America.

Brazilian society has become increasingly less tolerant towards this situation, urging government to take actions towards improving the living conditions of those at the bottom of the income profile. Several social programs, such as the *Bolsa Escola* program, have been proposed aimed at tackling the problem, but their actual impact will depend on how they are financed, whether by taxes and/or social security contributions or by reallocation of social spending. It is generally agreed that Brazil's tax burden, at about 30 percent of gross national product, is already high. Moreover, more than half of the tax revenue corresponds to indirect taxes, which fall heavily on lower income groups.[2]

The fact that the net impact of previous policy measures on social indicators has been less than satisfactory suggests that a better design and assessment of poverty alleviation policies is needed in the form of improved targeting and more detailed information about the efficacy of their results.

Due to the great diversity observed among the population and the complexity of the Brazilian tax-benefit system, the redistributive analysis of the impact of social and fiscal policies requires that a high level of disaggregation be used in order to capture in fine detail their effects on the various types of individuals, families and households. Ultimately, it is the social and economic diversity typically found in the national populations that determines how economic agents will be affected by the tax and benefit rules. On the other hand, as different social programs interact with each other and with the tax system, it is crucial to take explicitly into account the interdependencies within the whole tax-benefit system. The lack of an analytical tool to properly focus on the poor and the neglect of the issue of how the programs are to be financed are major reasons why social and economic policies fail to significantly reduce poverty.

---

[2] The results presented in Siqueira et al (1998) suggest that, for Brazil, the amount of indirect taxes paid by the poor is greater than the social benefit associated with some guaranteed minimum income programs.

Typically hypothetical families have been used to examine the operation of taxes and benefits and impact of reforms. For example the OECD uses this method to calculation the *Tax Position of Average Workers*. Although a useful method for illustration purposes and for comparison across countries, the approach is not very satisfactory for looking at tax-benefit policy in a country as usually families which are considered "typical" form in fact only a very small proportion of the population. It is desirable therefore to look at the population as a whole using representative micro-datasets.

An approach that follows this method is microsimulation modelling. Recent advances in information technology and the availability of large-scale datasets have allowed and stimulated the development of these models. Microsimulation models are computer programs that calculate tax liabilities and benefit entitlements for individuals, families or households in a nationally representative micro-data sample of the population. The model calculates each element of the tax-benefit system in the legal order so that interactions between different elements of the system are fully taken into account. Calculations for each individual, family or household are weighted to provide results at the population level.

By incorporating the interactions of different elements of the tax-benefit system and by taking full account of the diversity of characteristics in the population, this approach allows a very detailed analysis of the revenue, distributional and incentive effects of the individual policy instruments and the system as a whole. In particular, they give a great deal of flexibility to analysts. For example:

- They simulate policy instruments that may not already exist in the micro-datasets on which they are based. As micro-data is not necessarily collected every year and may take time for the data to be available to researchers, microsimulation models can be used to simulate more up to date policy rules.

- Therefore they have the capability of looking at the incidence of existing policy on an existing population and can examine the efficiency of anti-poverty measures in actually reducing poverty.

- As a simulation mechanism, they are also well placed to look at the incentive impact of existing policy. Although the model framework described here is a static framework, it is possible to measure the pressures on behaviour such as marginal tax rates and replacement rates[3].

- The primary advantage of microsimulation models however is that they can simulate policy reform. They can thus be used to compute the first round revenue effects and containing both social protection programs and taxation

[3] See for example, O'Donoghue and Utili, (2001) who study both the distributional and incentive effects of the impact of reforms targeting low wage workers in Europe.

instruments, models of this kind can look not only at changes to social policy programs but also examine different methods of financing.

- The first round distribution of resulting winners and losers particularly with reference to particular target populations can also be found.

- Capturing the heterogeneity of government law, they can examine the interaction of different instruments.

- Incorporating micro-data, they can also be used to look at the distributional impact of policy reform. Thus it is possible to see how reforms are incident on households of different incomes, examine horizontal redistribution by focusing on families with children, the elderly or the sick. Exploiting the hierarchical nature of households, they can also focus in gender dimensions by looking at within household sharing and the impact of government policy.

- The user-friendly nature of such models makes them suitable for a variety of uses and users, both governmental and non-governmental, informing the debate of social and economic policy, and making policy decisions more transparent in terms of their impacts on the population.

The use of microsimulation models therefore, can greatly contribute to improved design and efficacy of policies (For example, Atkinson et al., 1999). The models provide a powerful aid to policy design and assessment, allowing users to consider how expenditure aimed at certain targeted groups is to be financed, how social spending is distributed among the population, and how fiscal and social policies impact on the different groups of the population. Thus, working with a microsimulation model, policy designers and analysts can simulate changes in the existing tax-benefit system, performing "what if" experiments and examining their distributional and revenue implications (Redmond, Sutherland and Wilson, 1998). For example Piachaud and Sutherland (2000), recently used a microsimulation model to examine the policies necessary for the UK government to meet its poverty reduction targets.

However the development of microsimulation models is quite a difficult and expensive process. It involves the construction of a software environment to handle the data, policy simulation and output routines, the transformation and matching of existing micro-datasets into definitions and structures required to simulate tax-benefit laws is quite time consuming and the translation of the law itself into a computational framework. The latter is another very large task as instruments are often very complicated with particular exemptions for different classes of individual or income source. Also instruments, having often been developed by different governmental organisations within government may

follow different logic and interact in peculiar ways.[4] Another important expense is the actual updating of the model. Government policy tends to change year on year and population structures can change too due to the number of unemployed in recessions or through demographic changes. Hence in order for the model to become out of date, efforts need to be made to update the model, both the data and the rules, in regular intervals. As a result of the expense, although a number of Western countries and institutions have utilised this technique, there is still not widespread use in emerging economies. Yet it could be argued that the benefits of these techniques could be relatively more important in emerging countries because of the greater proportions in poverty and because of their poorer public finance positions, greater need is required in the design of effective government policy.

Recently a software framework was developed to construct an integrated tax-benefit microsimulation model, EUROMOD covering all 15 European Union countries. EUROMOD, is a tax-benefit microsimulation model that estimates the effects of changes in social and fiscal policies on measures of personal income and household welfare, capturing the full range of family circumstances without needing to define *typical* or *representative* agents (Immervoll, O'Donoghue and Sutherland, 1999). EUROMOD can simulate tax-benefit instruments such as family benefits, social assistance benefits and other income-tested benefits, social contributions, income taxes, property taxes and indirect taxes (idem). The model has recently been used to carry out an analysis of child poverty and child benefits in Europe (Immervoll, Sutherland and De Vos, 1999)

In order to cut down on the costs of developing parallel models in each country and also importantly to enhance comparability, a software framework was designed which could simulate generalised tax-benefit systems and be easily altered to accommodate particular national specific instruments. As a result it may be possible to utilise this framework to develop model for countries without access to such technologies. In fact this has already been the case in Austria, Greece, Portugal and Spain. Placing different national instruments side by side can be very illustrative when examining their relative strengths and weaknesses.[5] Therefore a second distinct advantage is the fact that the integration of a Brazilian tax-benefit model into an existing international model will ultimately permit comparisons to be made between the tax-benefit systems in Brazil and those of other countries. In addition to analysing the impact of entirely new tax-benefit instruments in Brazil, users of the model would benefit from the large library of existing tax-benefit instruments, allowing them to "borrow" policy instruments from other countries and assess the effects they would have if introduced in Brazil. The framework is

---

[4] Ironically one side-effect of using tax-benefit models in a country is to help to streamline the actual tax-benefit code itself as government analysts prefer instruments which they can program more easily.

[5] For example O'Donoghue and Sutherland (1999) the impact of income taxes on families in Europe.

described in more detail in section 3 below and readers interested in further information can consult, Immervoll and O'Donoghue, (2000).

One of the issues this paper must consider are the fact that circumstances, systems and data may not necessarily be the same in developed economies where the technique has been utilised and in emerging economies. Atkinson and Bourguignon (1990) carried out a study of the lessons of Tax-Benefit modelling in OECD countries for emerging economies. They found that although often more difficult to implement, simulating tax-benefit systems for these countries should "lead to a comprehensive, powerful and yet simple instrument for the design of an efficient redistribution system adapted to the specificity of developing countries". Focusing on Brazil as a case study, they found that much of the redistribution in the existing Brazilian system in the 1980's relied on instruments that were less important in OECD countries. For example, indirect taxes, subsidies and the provision of targeted non-cash benefits such as public education and subsidised school meals were found to be more important. Instruments more important in OECD systems and often the main instruments in tax-benefit models (personal income taxes, social insurance contributions and pensions), were largely confined to the modern sector in Brazil and thus of less importance to policy makers. Nevertheless they argued that sufficient data existed at the time to simulate many of the Brazilian specific instruments in addition to the "classic" ones. They stressed however that merging of data from different datasets may be necessary for this purpose. As a consequence of recent advances in the analysis of related data-sets (See Deaton, 1998) as well as improvements in the availability of data for less developed countries, the use of tax-benefit modelling techniques needs no longer be limited to countries where such models have been in use for some time.

Atkinson and Bourguignon's paper set the scene for the construction of tax-benefit models for less developed countries. The objective of our study is to go beyond this and actually focus more on the practical issues of constructing a tax-benefit model by reference to the precise rules of the tax-benefit systems and the detail of the available micro-data. This paper attempts to carry out a first assessment of the feasibility of building a comprehensive microsimulation model for Brazil, using this modelling framework as a basis. The following sections present the details of the paper. Section 2 introduces the main features of the modelling framework and discusses how this structure can be used to extend the model to further countries. In section 3, we give an overview of the Brazilian tax-benefit system. Section 4 addresses the question of data access restrictions and other data problems for Brazil. Section 5 describes the modelling strategy to be adopted. Finally, Section 6 concludes the paper.

2. A MULTI-COUNTRY TAX-BENEFIT MODEL

This section briefly describes the structure and main features of modelling framework. This should also provide a first overview of the steps and elements involved in incorporating new instruments or entire tax-benefit systems into the existing model. It also demonstrates how a tax-benefit model could be constructed for a new country using the existing framework.

This microsimulation framework has been developed within a European Commission sponsored program to create a benefit-tax model for the European Union, EUROMOD. The objective of this model is to simulate taxes and benefits for representative household datasets in each of the 15 member states of the European Union. Currently the model is a static model, in that only first round effects of reforms are measured. Most instruments which depend upon current income in each of the countries are simulated such as income taxes, social contributions, indirect taxes, family benefits and means-tested benefits. Due to limitations of the underlying data, instruments that depend upon contributory histories such as public pensions are not currently modelled in the framework[6]. In order to allow for comparability, a single model framework has been developed. The resulting generalised modelling framework for tax-benefit models allows new countries to be added relatively quickly, avoiding the need for programming a new framework whenever a new national model is to be built. As a result use of such a model can significantly reduce costs and the time taken to develop a new tax-benefit model for a country.

The microsimulation framework adopts a hierarchical view of a country's tax-benefit system. In modelling a country's system, it is desirable to match the "real" system's hierarchy as closely as possible so that the logical representation provides a good intuitive equivalent of the original. Since the structure of the framework already has to accommodate many different systems, a suitable "common denominator" had to be found. Figure 1 below shows the hierarchical structure that the framework provides.

Each tax-benefit **system** is made up of individual **policies**. These are elementary collections of tax-benefit instruments. Examples for a policy are Income Tax, Social Insurance Contributions or Social Assistance Benefits. The **policy spine** is a list of policies indicating the sequence by which they are applied in the tax- benefit system. For example, if social insurance contributions are tax deductible, then the entry Social Insurance Contributions would have to appear *before* Income Tax. This is because the model needs the amount of social insurance contributions as a

---

[6] However, the data do provide the amounts of pensions, unemployment payments, etc. In computing the distribution of taxes, benefits and household incomes, these contribution-based instruments are taken into account. Not simulating these instruments only means that one cannot evaluate *changes* to the underlying rules of these instruments.

prerequisite to calculating income tax; similarly. On the otherhand, if social assistance benefits depend on after tax income, then the entry Social Assistance Benefits would have to appear *after* Income Tax since income tax is a necessary input for calculating social assistance benefits.[7] At the lowest level is the tax-benefit **module**, which performs the calculation of a certain part of the tax or benefit (e.g., a deduction, or applying a rate schedule to a tax base) on each fiscal unit. Only the modules contain actual tax-benefit rules. The other levels of the model are necessary to structure these rules and apply them in the correct sequence.

In a multi-country model, this modular structure means that one has available a large library of existing modules. These can be used as "building-blocks" so that when it is necessary to incorporate a new tax or benefit instrument, it will often not be necessary to program any new tax-benefit rules. Instead, existing modules can be used. They can be re-arranged in any order necessary. A high level of parameterisation ensures that the same modules can be used for a multitude of different purposes. Concepts that the user can change without any need for re-programming include

- the definition of the fiscal unit (e.g., individual, household, married couple, families with children - including the definition of a "child") which is relevant for the module,

- income concepts (e.g., the definition of taxable income, "means" for a means-tested benefit, etc.) and

- all relevant amounts (such as thresholds, limits, allowances, rates, number of tax bands, etc.) necessary for applying the relevant tax or benefit rule.

In addition to modules that have been designed for a specific purpose in a specific country, the framework also provides a large number of "general" modules that were designed without any single country or specific purpose in mind. These "general" modules provide a high degree of flexibility and can be used for many different purposes. Examples are schedules where the number of rates, etc. is flexible and where the income base to which the schedule is to be applied can be freely defined. There also exist a number of standard deductions, allowances, etc. One of the most powerful set of "general" modules is available for implementing benefit rules. General modules exist for defining eligibility conditions, means and disregards for means-tested benefits, and equivalence scales for determining the benefit amount as a function of characteristics of the fiscal unit (such as age, number of people in the family, number of children, etc.). These modules currently

[7] In a few cases, it might be desirable to deviate from a purely linear sequence of policies. If there are optional policies, which the tax payer/benefit recipient can choose from, it would be necessary to simulate all the individual options (e.g., individual or joint taxation) and then apply some rule for choosing between them (e.g., by assuming a decision which would maximise disposable income). In EUROMOD, it is possible to specify such decision rules within the policy spine.

provide more than 400 different parameters, which makes them extremely flexible. All these parameters can be specified in spreadsheet-style parameter sheets, which means that in many cases, even very complicated benefits can be implemented without any need for programming. Apart from the considerable amount of time and effort that can be saved by re-using existing building blocks, there is the added advantage that these general modules have already been thoroughly tested. One can therefore be confident that the risk of programming errors is minimal. This means that the user can focus his or her efforts on specifying policy rules and analysing different policy scenarios rather than having to worry about programming technicalities.

For incorporating a new country into the model, the modular structure of the framework offers two distinct advantages. One is that the existence of a framework as well as a large library of existing "building blocks" ensures that modelling resources are used efficiently. One does not have to "re-invent the wheel" when designing a new tax-benefit model for a country. By using the framework, one can rely on a well-tested environment that has already proved to be powerful and flexible enough to accommodate a multitude of different tax-benefit systems. Even though some programming is of course necessary for every newly incorporated tax benefit system, many necessary elements do already exist. Frequently, these would only need to be adapted and, in many cases, changing parameter values of existing modules would be sufficient. The second advantage relates to using the model once the new country has been incorporated. Because of the possibility to use existing tax-benefit building blocks in any other context, it is relatively straightforward to test what effects the introduction of other countries' tax-benefit instruments would have. Since the framework has been used to produce EUROMOD which already covers all 15 EU countries, this opens up very interesting opportunities to test the appropriateness of very diverse tax-benefit instruments and philosophies in that country which is being newly incorporated into the model framework.

Because these "advantages" relate to different phases of the modelling work, it is useful to think of the introduction of a new country into the framework as a two-stage approach:

- Use the model framework to build a one-country tax-benefit model.
- Integrate this model with the countries already integrated within the EUROMOD platform.

The main difference between the two is the requirements in terms of micro-data. The first heading clearly requires less stringent requirements in the data. As the model does not have to be recoded when new data are included, the model framework will work regardless of the specification of the data. Thus a national model could be created using purely national specific rules (i.e. not usable by other

countries in the framework) with an existing national dataset. However in order to be able to use the existing library of tax-benefit routines, additional efforts needs to be made to produce a dataset which is comparable with the existing datasets in the model. In particular this means creating a dataset that conforms to a pre-specified definition of approximately 75 core variables.

These data need to be gross variables, that is before taxes or benefits are subtracted. However as it is the case in many countries that data collected in household surveys are net of taxes or benefits, the original gross income may need to be imputed. As we have come across this problem for a number of European countries, we have developed a routine to do this within the framework. (See Hansen et al, 2000 for a description)

Also, it is rare that all necessary variables will be contained within one dataset. For example detailed income and expenditure variables may be contained in different datasets. In this case it is necessary to use a procedure to impute the missing variables in the base dataset using data from the other. In many of the EU countries, expenditure data, missing in the base income survey, were imputed from household budget surveys using a method described in section 4..

Accomplishing these transformations will allow the simulation of tax-benefit reforms in the new country. For full integration in the framework, allowing the tax-benefit system of one country to be compared with another, extra work however is necessary. Firstly it is necessary that the data should be of the same year as the other countries in the comparative analysis. As this may not be the case it may be necessary to uprate the dataset to the required data-year and thus make the datasets comparable. Potential methods include accounting for inflation/income growth and reweighting to account for changes in the labour market and demographic structure. As national populations can change for very many different reasons, such as differential inflation and differential growth in different sectors, it is difficult to prescribe a common method for handling uprating. It is often better to use national specific methods. Due to the framework's flexibility these methods can be accommodated without much difficulty.

In addition even if the base datasets are comparable, model outputs may not be. In reality, authorities may not have the full information assumed by the model. This can account for problems such as tax-evasion and benefit take-up problems. In a number of EU countries, tax-evasion is a significant issue. As a result of this effort has been made to try to account for this effect, typically using external information from the fiscal authorities. Currently benefit take-up has been ignored as insufficient basic research has been done across the EU.

3. THE BRAZILIAN TAX-BENEFIT SYSTEM

The Brazilian government sector comprises the federal government, 27 states, over 5,000 municipalities, the federal district and several agencies. In 1998, the total revenue raised from taxes and contributions levied at all levels of government amounted to 29,8 percent of gross domestic product, distributed by level of government in Table 1. Key Features of the tax and benefit system are presented in the remainder of this section.

3.1. The Tax System

The current tax system was introduced by the 1988 Constitution. In contrast to the previous one, it involves a major redistribution of revenue among the three levels of government (federal, state and municipalities). The power to tax is distributed as follows. The federal government keeps the taxes on income, manufactured products, imports and exports, financial, insurance and exchange transactions and rural land. State retain taxes on the circulation of goods, transportation and communication services, inheritance and gifts and vehicle ownership. Finally, municipalities levy taxes on general services, urban building and land, *inter vivo* transfer of real state, and retail sales of liquid and gaseous fuels.

A major characteristic of the Brazilian tax system is the fact that indirect taxes constitute the main source of tax revenue, amounting to more than 50 percent of the total, which in 1999 was about 30 percent of gross domestic product. Also, despite the great number of taxes (over 60 different types of taxes), tax revenue is concentrated on a few of them (Giambiagi and Além, 1999). About a quarter of total revenue comes from a single tax, the ICMS (tax on the circulation of goods and transportation and communication services). The five major taxes [ICMS, IPI (tax on manufactured products), Cofins (contribution to the financing of social security, which is a payroll tax), income tax and individual social contribution], correspond to about three-quarters of total tax revenue. Table 4 gives an overview of the distribution of total revenue by type of tax and contribution.

3.1.1. Income tax

Personal income tax has only a minor role in the financing of government expenditures in Brazil, accounting, in 1998, for less than 10 percent of total tax revenue and comprising about 38.4 percent of total income tax receipts.

The income tax base is defined as the difference between gross personal income received in the calendar year and total tax reliefs. Gross income corresponds to earned incomes in general, including:

- Labour income
- Rental income

- Pensions
- Farming income

Income from stock exchange transactions, called variable income, and from the sale of non-financial assets (for example, real state), called capital gains, are treated separately, being taxed at the moment the transaction is made. The return on financial assets and shares in corporate profits and dividends are also taxed separately at the time of their realisation. Wages are also subject to taxation at source. In the annual tax report, the annualised amount is deducted from the total tax liability. Additionally, Brazil has the peculiarity that all employed individuals receive the so-called thirteenth wage (*décimo-terceiro salário*), which is a legal benefit taxable exclusively at source. Some forms of income such returns on savings, disability benefits and charitable contributions are tax-free or exempted.

The main tax reliefs built into the Brazilian income tax system are the following:

- Amount for each dependent person
- Social insurance contributions
- Private insurance contribution
- Educational expenses
- Medical expenses
- Maintenance payments

Dependent persons are defined as those who have a dependency relation to the taxpayer, including: spouse, children aged less than 21years old, parents and grandparents with earnings less than a pre-specified threshold, and underage individuals whom the tax payer is the guardian. A standard deduction is applied for each dependent person.

Social and private insurance contributions, educational expenses and alimony are fully deducted from gross income, while an annual pre-determined upper limit applies to educational expenses. There also are deductions related to contributions made to charitable foundations and to cultural projects.

Individuals may choose to file either a simplified form or a complete form. In the first case, a standard deduction already built into the tax form is applied. The objective is to simplify tax reporting for most taxpayers who have only a limited amount of deductions. In the complete form, individuals have to report all deductible payments.

The family circumstances of the individuals may affect the way they file the tax report. Married couples may jointly file the tax form or do so separately. In the case of separate filing, the common assets are divided equally between the couple. The income earned by underage individuals may be reported individually or together with one of their parents.

Personal monthly income is taxed according to the rate schedule shown in table 2 below, while The distribution of total tax payers by income class for 1998 is given in table 3.

3.1.2. Indirect taxes

Taxes on goods and services in Brazil are levied at the federal, state and municipal level, and constitute the main source of government revenue. They are:

- Tax on services (ISS): levied at the municipal level;
- Tax on the circulation of goods and transportation and communication services (ICMS): levied at the state level;
- Tax on manufactured products (IPI), tax on exports, tax on imports, and tax on financial transactions (IOF): levied at the federal level.

Of the indirect taxes, the ICMS and the IPI are by far the most important financially, accounting for the bulk of indirect tax receipts. The ICMS is a general sales tax which applies the value-added technique and is imposed on the transfer of goods at all stages of production and distribution including retail. The federal government, which establishes the rates to be charged on interstate and on export transactions and sets maximum and minimum rates on internal transactions regulate it. The IPI is also of the value-added type and is levied on sales by manufacturers only.

3.1.3. Other taxes

Individuals also pay several other taxes at all levels of government. The most important are:

- Tax on the ownership of urban real state (IPTU): levied at the municipal level;
- Tax on the ownership of motor vehicles (IPVA): levied at the state level;
- Tax on fuel and tax on the ownership of rural state (ITR): levied at the federal level.

There also are some forms of compulsory payments called contributions, targeted to the financing of the social security system (in addition to the social security contributions), all levied by the federal government. The most significant are:

- Contribution on banking transactions (CPMF): falling on all banking transactions made by individuals and firms;

- Contribution to the financing of the social security system (Cofins), PIS / PASEP, Social contribution on net profits (CSLL): these work like payroll taxes on firms.

3.2. THE SOCIAL SECURITY SYSTEM

The social insurance system in Brazil is a pay-as-you-go scheme that covers civil servants (at the federal, state and municipal levels, representing 4.7 percent of total insured individuals) and workers in the private sector (amounting to 95.3 percent of total insured individuals). Its main goals are: (I) to secure maintenance income to those out of work due to old age, invalidity, retirement or due to the death of the head of the family; (ii) to complement family income.

In addition to the social contributions, the system is financed by payroll and earmarked social taxes. Brazilians compulsorily contribute to the social security system according to their occupational status and their income. There are two main groups of contributors:

- Employed workers (including domestic and temporary workers): Contributions are calculated as a percentage of their wages following a rate schedule. The rates vary with income classes.

- Self-employed workers and employers: Contribution levels are defined by a pre-determined schedule, with the amount of contributions being calculated based on number of months of contribution, not on individual income.

On the other hand, there is a multitude of benefits built into the Brazilian social security system. In 1998, the total number of benefits offered was 95[8]. They amounted to about 10% of gross domestic product and about half of total public social expenditure.

Pensions constitute the most important benefit, accounting in 1998 for 84.6 percent of total benefits offered (corresponding to 8.2 percent of gross domestic product) . In fact, there are several types of pensions, divided in three main general classes, related to length of service, old age and invalidity, respectively. In addition, there exist benefits also called pensions that are paid to the insured person's dependants in the case of their death. Table 5 below gives the distribution of the main social

[8] Actually, by 1998 some of the benefits had already been abolished due to reforms of the system. However, they continued to be paid to those already receiving them prior to the reforms.

benefits as percentage of total social benefit expenditure and as percentage of total quantity of benefits offered.

Two other major benefits are the unemployment benefit and the *thirteenth wage* (annual wage bonus) which are not paid through the social security system. The unemployment benefit, which in 1997 benefited 4.3 million people, is paid through the Ministry for Labour, while the *thirteenth wage*, which in 1997 was received by about 5.8 million individuals, is paid to all formal workers and to those receiving pensions by the employers.

3.3. THE BRAZILIAN TAX-BENEFIT SPINE

Brazil's tax-benefit system can be summarised in the form of a "policy spine", as presented in table 6 below. By following the spine from the top to the bottom and applying the instruments in this order, the "original" or "market" income is transformed to "final" or "disposable" income. The spine shows a list of taxes, benefits and other instruments that constitute the system's policy parameters. Also, the unit of analysis (individual, family and household) and the data requirements for the calculation of each element of the tax-benefit system are specified.[9] The policy spine summarises the Brazilian tax-benefit system and serves as the basis for the assessment of the modelling feasibility that will be carried out in the next section. In addition it also includes a number of operations necessary to impute missing data such as the number of months of contributions for self-employed or consumption expenditures for all households. The spine also details whether tax or benefit amounts relating to a certain instrument are to be simulated or whether they will be taken from the data. As discussed earlier, the most important instruments to be simulated are those which depend on current income, so that the full impact of policy changes, including interdependencies between instruments, can be taken into account. Some instruments although clearly important in terms of policy reform considerations, are beyond the scope of a static model. Examples include the simulation of pensions that depend on previous contribution histories and require dynamic models that simulate longitudinal processes.

4. DATA REQUIREMENT AND ACCESS RESTRICTIONS

The microdata sample of the population constitutes the principal input of a microsimulation model. To perform a comprehensive analysis of the impacts of tax-benefit regimes requires detailed information on the characteristics of households.

[9] Data requirement are presented at the individual level, unless otherwise noted.

4.1. The Input Dataset

In Brazil, the main microdata source of demographic and socio-economic household characteristics is the *Pesquisa Nacional por Amostra de Domicílios* (PNAD), a rural-and-urban survey covering all Brazilian regions with the exception of the North region's rural area. PNAD's sample size is quite large, including more than 100,000 households and more than 300,000 individuals. The latest PNAD survey was carried out in1998. However, PNAD does not contain expenditure data.

Information for family expenditure is available in three separate surveys: the *Estudo Nacional da Despesa Familia* (ENDEF) 1974, the *Pesquisa de Orçamentos Familiares* (POF) 1987/88[10] and the *Pesquisa sobre Padrões de Vida* (PPV) 1996/97. The ENDEF covers a total of about 55,000 families and is the only expenditure survey carried out at the national level so far. The ENDEF's main drawback is that since 1974 the consumption patterns of Brazilian families have changed considerably. The POF is Brazil's main expenditure survey, usually carried out in intervals of ten years. Its sample size is 16,000 households. However, it covers only Brazil's metropolitan areas. The PPV is Brazil's most recent expenditure survey, following the World Bank's *Living Standard Measurement Survey* format. It covers the urban and rural areas of the Northeast and Southeast regions only, having a sample size of 5,000 households.

Other datasets that can serve as complementary sources are the national accounts, the population census and the *Pesquisa Mensal de Emprego* (PME). The monthly PME surveys households in only six metropolitan areas and is basically concerned with information on labour force and employment condition.

The tax-benefit spine presented in the previous section shows the data needed to perform simulations of the Brazilian tax-benefit system. Table 7 in the appendix below assesses the availability of those data for Brazil. Detailed income information is an essential input for microsimulation analysis. For Brazil, the PNAD contains information about individual, family and household monthly earnings. Personal income is given both for each type of earnings and in aggregated form. Total income is divided in labour income and non-labour income. The first includes earnings in cash and in-kind. The latter comprises earnings from: (i) pension, (ii) rent, (iii) gifts, and (iv)interest on savings and other investments, dividends and other incomes. Individuals are asked if they receive a number of specific benefits (namely, housing benefit, food benefit, transport benefit, education benefit and health benefit), but there is no information about their values. As Ferreira, Lanjouw and Neri (1999) observe, the only logical place

[10] There is a more recent POF release, for 1995/96. However, technical problems with the survey resulted in the microdata not being publicly released as yet by the Instituto Brasileiro de Geografia e Estatística (IBGE), the federal government agency for national statistics responsible for the household surveys.

they may be included is in the item "interest from savings accounts or other investments, dividends and other incomes". Also, there is no specific information on other social benefits that individuals may receive. Some are actually paid together with monthly wages, so that it is usual to report as labour income, all income paid jointly with wages. But from the PNAD data it is not possible to be sure if any other benefit received by individuals are included in "other incomes".[11]

Therefore as benefits are aggregated within other incomes, some effort will be necessary to reach the required level of disaggregation. For example, any variable, which is simulated, like say Unemployment Benefits, will have to be separated from non-simulated incomes Otherwise there will be double counting of incomes when summing up all income sources.

Given the available sources of microdata, the most sensible choice for constructing a microsimulation model for Brazil is to use the PNAD 1998 as the main source of demographic and socio-economic data, and the POF 1987/88 for expenditure data. The ENDEF is too old to be relied on, while the PPV and other datasets may be used for specific data imputation exercises.

4.2. Merging Datasets

In order to simulate instruments that depend upon income such as personal income taxes and income related benefits, together with instruments that depend upon expenditures such as indirect taxes and subsidies, it will be necessary to merge data from different data sources. The most appropriate sources of data in Brazil are the POF dataset for expenditure data and the PNAD dataset for incomes and social-economic information. There are a number of potential methods that can be used for this purpose. On one hand, regression methods can be used, where regressions of consumption are estimated in one dataset, on variables common to both datasets and then imputed in the other. An alternative method which employs statistical matching, finds using multivariate methods households which are most similar to each other and then assigns the consumption from the household in the expenditure survey to the socio-economic information in the income survey. The latter technique has been used by Taylor et al., (2000) to link expenditure information with income information using UK household datasets and has the advantage of being able to retain the level of inter household

[11] The absence of such data suggests that incomes are underestimated in the PNAD, specially for those in the urban informal sector and in the rural sector. The reason is that "the urban self-employed or farmers working their own or rented land (i.e. all agricultural non-wage workers) ... do earn a living from a number of different sources, many of them in kind and in benefits, and are likely to benefit from questions which specifically remind them of all their sources of income, helps them value in kind and benefit incomes, and helps distinguish between consumption and investment expenditures"(Ferreira, Lanjouw and Neri, 1999). However, data from the POF and the PPV may be used to impute benefit receipts.

heterogeneity in household expenditure patterns. The method however is quite complicated, requiring a high level of expertise in the area. They also require permission for direct access to the data that in some countries is not always available. Instead it is necessary to carry out imputations remotely. As a result in the construction of EUROMOD, the former method has been used (See Baldini et al., 2000). Initially this method will be used in the creation of the Brazilian input database, although it may be possible to examine the statistical matching techniques later.

In summary the technique requires that a regression of total consumption to be estimated using OLS on the expenditure dataset using the following functional form:

$$\ln C_{HBS} = a + b \ln Y_{HBS} + gX_{HBS} + u \quad (1)$$

where, C is total household consumption, Y is disposable income, and X is a vector of socio-demographic characteristics (detailed in table 8). The estimated coefficients (indicated with a hat… ..need to add the hat in the equations…) are then applied to the income survey in order to obtain an imputed value for total household consumption. The next stage is to estimate budget shares of total consumption for the expenditure categories defined in table 8 using the following functional form:

$$w_i = a + b \ln C_{HBS} + g(\ln C_{HBS})^2 + dX_{HBS} \quad (2)$$

where, w_i refers to the ith budget share.

Turning now to the variables required for the expenditure imputation and the modelling of indirect taxation, the framework, currently uses a set of 20 variables that represent approximately the main indirect tax headings in European countries. This may however be different to what is necessary for Brazil. Table 8 details the variables required by the framework and the extra variables necessary for Brazil.

4.3. Data Access Requirements

Micro-data from the main national household surveys (PNAD, POF, and PPV) are publicly available through digital means. Other important datasets that are also publicly available are the PME, the Census and the national Accounts. The main difficulty is related to access to administrative data, which need special contractual arrangements.

5. MODEL ASSEMBLY STRATEGY

This section details some of the programming issues necessary for implementing the Brazilian Tax-Benefit System in the modelling framework. Table 9 outlines the principle steps involved in the process.

5.1. Addition of New Variables

As outlined in section 3, altering the model framework to incorporate the new variables detailed in table 7 is a relatively easy task, requiring no new programming. The variables simply need to be included in the parameter sheets.

5.2. Updating of Dataset to year of simulation

As the year of simulation may not necessarily be the same as the year of simulation (the year policy rules are taken from), it will be necessary to update the dataset to account for differences in the intervening period. For this purpose external information will be needed. Updating which may be required include:

- Allowance for inflation / income growth by variable
- Allowance for changing population structure by altering the weights

5.3. Specification of Fiscal Units

Existing fiscal unit definitions can also be included using existing code. Based on these definitions, the model then assigns each individual to the appropriate fiscal unit (See Immervoll and O'Donoghue, 2000). The fiscal units required within the system are described in table 10.

5.4. Implementation of Policy Spine

This task has already been completed and the results are shown in table 5.

5.5. Creation of the component Modules for each component of the Policy Spine

This is one of the most important components of the model construction, the actual coding of the policy rules of the tax-benefit system. Rather than describing in detail each element of the spine and how it will be coded, we focus instead on some particular issues.

5.5.1. Social Benefits

Simulation of entitlement to old age pensions is difficult due to lack of data, particularly since they depend on past income and years of contribution,. Instead pensions will be taken from the input data and not simulated. If necessary they can be updated to the year to be simulated.

Of the set of benefits offered, the family credit, the unemployment benefit, the thirteenth wage bonus and the old age benefit can all be fully simulated since the PNAD has the necessary data for their modelling. Only the work-related disablement, sickness and invalidity benefits present difficulties due to lack of information. For these latter, one may think of various alternatives for imputation based on assumptions about the distribution of their aggregate amount and take-up rates.

5.5.2. Income Taxation

Concerning the tax system, simulation of income tax is the least difficult, although imputation is needed for some tax relief elements such as educational, medical and alimony expenses.

Optional joint taxation can be included using existing code in the model. For example France also has a joint system where children are included with adults in the assessment of incomes for tax purposes. An optional joint system has already been implemented for Spain, among others.

5.5.3. Social Contributions

As in the case of benefit incomes, there is no specific value for individual contribution to social and private security in the data. Individuals are simply asked whether or not they contribute to social and private security. Although social contributions for employees are relatively straightforward to simulate, the simulation of self-employed contributions present problems.[12] They depend on information about past income and length of contribution. PNAD has neither information. Here the strategy will be to take the distribution of months of contributions from official statistics, published by the Ministry of Social Security and impute a value for the self-employed and employers in the dataset.

5.5.4. Indirect Taxes

The methodological difficulties concerning the actual simulation of indirect taxes relate to the merging of income and expenditure information. However there are more difficulties in actually assessing the impact of indirect tax changes on household welfare. The effects of changes in indirect taxes (or subsidies) on expenditures at the micro-level depend on

(a) price effects in the relevant market(s);

(b) effects of changed prices on consumption patterns at the micro-level; and

[12] Here we classify both self-employed and employers as self-employed.

(c) changed consumption behaviour due to income effects of changes in other taxes e.g., revenue-neutral tax reform where lower direct taxes are financed by an increase in indirect taxes).

In a static microsimulation framework that does not incorporate behavioural responses, none of these effects can be simulated. If one still wants to make some statement about the distributional effects of indirect taxes, assumptions about the relevant parameters have to be made. In many cases it makes sense to explore the upper and lower bounds of the potential effects that tax changes have on people's expenditures.

Regarding effect (a), since static non-behavioural-response microsimulation is (necessarily) concerned with the immediate ("first round", "day-after") effects of policy changes, it would seem reasonable to assume that indirect tax changes will be fully absorbed by market prices (i.e., the incidence will be entirely on the consumer). Turning to effect (b), an upper bound result for expenditure increases due to price effect (a) of a tax increase (and for expenditure decreases due to the price effect (a) of lower indirect taxes) is obtained if one assumes constant quantities (a vertical demand curve) for the good(s) concerned. An alternative scenario is to assume constant expenditure, i.e., the elasticity of demand is h=-1. Hence, in the absence of actual simulation of effect (b), the two alternative assumptions of constant quantities and constant expenditure provide the best available guidelines for estimating the effects of indirect tax changes on expenditure. The two scenarios are intuitively easy to grasp. In addition the constant quantities assumption gives an upper bound for expenditure increases (decreases) due to higher (lower) indirect taxes (to avoid misinterpretation of the results, however, it will be important to stress that the constant expenditure assumption does *not* give a lower boundary).

Effect (c) will depend on the magnitude of other tax changes and individual preferences (the particular shape of peoples' indifference curves). Being a principal output of the microsimulation model, the effects of "other" tax changes on disposable income at the micro-level are known, while the individual preferences are not. In this situation, one possible assumption with regard to effect (c) is that it is zero. The "day-after" argument could again be used to (partly) justify this assumption since the immediate income effects of direct taxes are probably less obvious to individuals than the immediate price effects of changed indirect taxes. Alternatively, expenditure functions estimated on income and other variables could be used to derive the differential effect of changes in net income on peoples' expenditures.

Price changes affect individuals' (households') capabilities to consume and, thus, their "real" income. Since indirect taxes affect prices, one way of measuring these taxes' impact on income is to deflate before-indirect-tax income by a price index that captures the price changes due to indirect taxes. If one compares different

indirect tax policies, one can then easily isolate the differential effect on income by using one policy's net prices as the reference price vector (price index equals one) and computing the appropriate price index resulting from the alternative indirect tax policy relative to this reference value.

If, as is the case here, the distribution of overall expenditure among the different expenditure categories is known at the household-level, one can construct household-specific price indices by weighting the prices of each expenditure category by this category's share in overall expenditure. A price index which uses the same weights for the base and reform scenarios is subject to substitution bias. If people substitute towards goods that, as a result of the indirect tax reform, become relatively cheaper, then a price index that uses a fixed base (reform) basket of goods overstates (understates) the change in the cost of living. In order to reduce this bias, one could use a Fisher Ideal price index as an income deflator:

$$i = [(p_1 \cdot x_0 \,/\, p_0 \cdot x_0)\,(p_1 \cdot x_1 \,/\, p_0 \cdot x_1)]^{(1/2)} \qquad (3)$$

where p_0 and p_1 are the before- and after-reform price vectors, and x_0 and x are the before- and after-reform vectors of quantity weights (i.e., the vectors of shares in overall expenditure).

In computing this income deflator, one is now free to make any assumption with regards to the response of individual prices and quantities. If for example, one assumes constant quantities for good g then x_{g1} will equal x_{g0}. Assuming constant expenditure, on the other hand, means that $x_{g1} \cdot p_{g1}$ equals $x_{g0} \cdot p_{g0}$ (i.e., $x_{g1} = x_{g0} \cdot p_{g0} \,/\, p_{g1}$). Similarly, this approach would permit to explore the consequences of different assumptions with regards the response of prices.

5.5.5. Other Instruments

In less-developed countries, non-cash social spending can often be relatively more important than in developed countries, especially for households outside the modern sector as they are often excluded from coverage of social security benefits. Atkinson and Bourguignon (1990) raise a number of issues related to the inclusion of such instruments in a tax-benefit model. Firstly the amount one should impute for in-kind services. In other words what value do you assign to recipient households, the average public cost, the opportunity cost in the private sector or who much the household would be prepared to pay. It is also difficult to identify the beneficiaries of these services. However the PNAD from time to time includes modules on the consumption of public services. Particular instruments that may be included under this heading for Brazil include free meals in public schools, the cost of public education, public health care programs and subsidies such as the “wheat price subsidy”. Further work needs however to be done to work out the feasibility of including these instruments. Other potential instruments to be simulated on

which data exist include food benefit, transport benefit, education benefit and health benefits.

5.6. Creation of Income Lists

Any aggregated income definitions (such as taxable income, "means", disposable income, etc.) are defined at this stage. Again as outlined in section3, there is no need for re-programming as parameter sheets exist which allow the user/model-builder to define income concepts using any of the monetary variables as components.

5.7. Behavioural Response and Sensitivity Analysis

As a static modelling framework, the model only measures the day after effect. However it is clear that reforms may have a behavioural response. For example the introduction of the *Bolsa Escola* program in a number of Brazilian cities which gives cash benefits to poor families whose children continue on in school until 14, saw school dropout rates decrease and school attendance increase (Schiefelbein, 1997). Thus the cost of the program would have been higher than a static analysis would have indicated. Incorporating dynamic processes like this would be beyond the scope of an initial stage of construction of a microsimulation model. It would require extra algorithms to be coded in the framework and in addition, *a priori*, the micro-behavioural information required would not have been available for a reform of this kind. However as an alternative sensitivity analyses could be carried out. It would be possible for analysts to vary the proportion of those eligible for the new instrument. Routines of this kind are analogous to the implementation of marginal tax-rate calculators. On this point some effort may also be necessary to specify appropriate definitions of marginal tax calculations in the framework for a Brazilian perspective.

5.8. Validation against Hypothetical Calculations

Once the tax-benefit system has been coded the data are passed through the model. At this stage, one discovers whether all the variables required by the model algorithms have in fact been included in the dataset and whether they are in the correct format. Once this works, one must determine whether all the interactions between the simulated components operate correctly. Typically the first stage in this process is to compare the output of the model for sets of hypothetical households against manually calculated taxes and benefits.

5.9. Validation against Aggregate Statistics for Baseline and Accounting for the Informal Economy

Although the rules may in fact be correctly coded, simulated aggregates may not necessarily match official aggregates. The next stage of the validation process is therefore to compare the aggregate outputs against those in official statistics.

Useful external sources of data for validation include official figures, other studies, other survey data, existing models, etc. What follows can be used as a checklist of potentially useful steps for the validation of aggregates.

5.9.1. *Sources of External Aggregates for Validation:*

Comparison of Monetary Aggregates:

- for different components of instruments simulated (e.g., certain deductions)
- for each individual instrument simulated (e.g., employee health insurance contributions)
- for groups of simulated instruments (e.g., employee contributions)

Comparison of Monetary Sub-aggregates (e.g., by quantile; by region; by type of recipient):

- for different components of instruments simulated (e.g., certain deductions)
- for each individual instrument simulated (e.g., employee health insurance contributions)
- for groups of simulated instruments (e.g., employee contributions)

Numbers of tax payers / benefit recipients:

- for different components of instruments simulated (e.g., certain deductions)
- for each individual instrument simulated (e.g., employee health insurance contributions)
- for groups of simulated instruments (e.g., employee contributions)

There are a number of possible reasons for deviations of simulated results for each of the above. These should be quantified if possible - either as best estimates or quoting related studies if available. In drawing conclusions, it will be important to look at the different instruments together. For example, can assumptions about the reasons for the deviation of one instrument be reconciled with the deviations of another one (e.g., if income taxes are "too low" but contributions, which are subject to upper contribution limits, are ok then this would be consistent with the explanation that the source of underestimating income taxes is the under-representation of high incomes in the underlying micro-data)?

5.9.2. *Conceptual differences:*

Known differences in the definition of simulated and reference aggregates

Data related:

- Coverage of underlying micro-data (incl. attrition for panels)
- Miss-representation of certain types of units (e.g., high income individuals)
- Known bias of survey responses (e.g., self-employment incomes)
- Imputation techniques
- Missing variables in the data (e.g., mortgage interest; imputed rent)
- Uprating techniques employed to carry the data forward to 1998
- Method used for net-to-gross conversion etc.

Simulation related:

- Simplifying assumptions regarding eligibility / liability conditions
- Benefit take-up; tax evasion
- Simplifying assumption regarding the computation of amounts of benefits / taxes

One of the most common problems in microsimulation is simulating the correct number of benefit recipients in non-universal systems. This is especially true if:

- the duration of entitlement for these instruments is limited, so that not all units who appear to be eligible in the data (because they receive the benefit during the period covered by the survey) are in fact eligible at any one point in time or
- if the authorities can exercise some degree of discretion in determining who is eligible / liable for a certain instrument.

The size of the informal sector is likely to be a dominating issue in the validation of Brazil's tax benefit system. By some estimates, about one-quarter of the economic active population work in the informal sector, amounting to 12.9 million individuals (of which only 18.6 percent contribute to social security) and 8 percent of gross domestic product.[13] This problem has to be taken into account to adequately simulate the impacts of social and fiscal policies. One strategy that could be employed is to compare the distribution of taxpayers in official statistics with our distribution and then use some Monte Carlo mechanism for selecting individuals to be in the informal economy.

---

[13] See Almanaque Abril, 2000. Rio de Janeiro: Abril Cultural.

6.CONCLUSION

This paper carried out a preliminary feasibility study of building a comprehensive microsimulation model for Brazil using a multi-country modelling framework. The paper detailed the available data for Brazil and found that the data allow the simulation of many policy instruments built into Brazil's tax and benefit system. However, the need to use data from more than one household survey and the absence of some data required for the simulations imply that matching of data sets and some imputation will be necessary.

This work is an initial stage of an ongoing project to assess the feasibility of constructing a microsimulation tax-benefit model for Brazil. Further work planned includes the assessment of the data. This process will adopt a questionnaire used by the EUROMOD project, based on the Canberra Income Surveys Group to assess the robustness of micro-datasets. One data quality problem often associated with micro-datasets is the under-representation of the very rich and the very poor. Thus models of this kind may both miss out on part of the target population for social policy reform and simultaneously miss out on the part of the population that may bear a significant proportion of the costs of reform. Also as part of this exercise it is planned that more detailed tax-benefit rules and parameters will be collected and written up into algorithms and descriptions to form a brief guide to the current Brazilian Tax-Benefit System. In particular emphasis will be placed on the simulation of non-cash components of Brazilian social spending. Work also needs to be done to identify appropriate external totals both for handling the size of the informal economy and for updating the underlying dataset. This work will be used then to compare and contrast the main features and objectives of tax-benefit policy in Brazil and Western Europe.

REFERENCES

Atkinson A.B. and F. Bourguignon (1990). "Tax-benefit Models for Developing Countries: Lessons from Developed Countries", Ecole Normale Superieure: *DELTA Working Paper* 90-15.

Atkinson, A.B., F. Bourguignon, C. O'Donoghue, H. Sutherland and F. Utili (1999). "Microsimulation and the Formulation of Policy: A Case Study of Targeting in the European Union", *EUROMOD Working Paper* EM2/99, Microsimulation Unit, Department of Applied Economics, University of Cambridge. Available through http://www.econ.cam.ac.uk/dae/um/emwp2.pdf

Baldini M., H. Immervoll, D. Mantovani, C. O'Donoghue and S. Toso, (2000). "Consumption Behaviour and Indirect Taxation in Europe", *EUROMOD Working Paper* forthcoming, Microsimulation Unit, Department of Applied Economics, University of Cambridge.

Deaton, A (1998). The Analysis of Household Surveys: A Microeconometric Approach to Development Policy. Washington D.C.: World Bank.

Ferreira, F., P. Lanjouw and M. Neri (1999) "The urban poor in Brasil in 1996: a new poverty profile using PPV, PNAD and census data", mimeo.

Giambiagi, F. and A. C. Além (1999) *Finanças Públicas: Teoria e Prática no Brasil*. Rio de Janeiro: Campus.

Hansen H., H. Immervoll, C. O'Donoghue, C. Rodrigues and J. Sastre-Descals, (2000). "Iterative Methods to Impute Gross Income from Net Income in Micro-datasets", *EUROMOD Working Paper* forthcoming, Microsimulation Unit, Department of Applied Economics, University of Cambridge.

Immervoll H., C. O'Donoghue and H. Sutherland, (1999). "An Introduction to EUROMOD", *EUROMOD Working Paper* EM0/99, Microsimulation Unit, Department of Applied Economics, University of Cambridge. Available through http://www.econ.cam.ac.uk/dae/um/emwp0.pdf

Immervoll, H. (2000). "The Impact of Inflation on Income Tax and Social Insurance Contributions in Europe". *EUROMOD Working Paper* EM2/00, Microsimulation Unit, Department of Applied Economics, University of Cambridge. Available through http://www.econ.cam.ac.uk/dae/mu/emwp4.pdf

Immervoll, H. and C. O'Donoghue, (2000). "Towards a Multi-Purpose Framework for Tax-Benefit Microsimulation A Discussion by Reference to EUROMOD, a European Tax-Benefit Model", Paper Presented to the *6th Nordic Workshop on Microsimulation*, Copenhagen, June.

Immervoll, H., Sutherland, H., de Vos, K., (2000). "Reducing Child Poverty in the European Union: the Role of Child Benefits", in Vleminckx, K., Smeeding, T.M. (eds.) *Child well-being in Modern Nations*, The Policy Press, Bristol. A longer version is available through http://www.econ.cam.ac.uk/dae/mu/emwp3.pdf

Londoño J. L. and M. Székely, (1997). "Persistent Poverty and Excess Inequality; Latin America, 1970-1995". *Office of the Chief Economist Working Paper 357*. Washington D.C.: Inter-American Development Bank.

O'Donoghue, C. and H. Sutherland (1999). "For Richer, for Poorer?: The Treatment of Marriage and the Family in European Income Tax Systems", Cambridge Journal of Economics.

O'Donoghue, C. and F. Utili (2001). "Micro-Level Impacts of Low Wage Policies in Europe", forthcoming, in Salverda W., B. Nolan and C. Lucifora (eds.), *Policy Measures for Low-Wage Employment in Europe*.

D Piachaud and H Sutherland, (2000) How Effective is the British Government's Attempt to Reduce Child Poverty? CASE paper 38, CASE, London School of Economics.

Redmond, G., H. Sutherland, and M. Wilson (1998). The Arithmetic of Tax and Social Security Reform: A User's Guide to Microsimulation Methods and Analysis. Cambridge: Cambridge University Press.

Schiefelbein, E.. (1997). School-Related Economic Incentives in Latin America: Reducing Drop-Out and Repetition and Combating Child Labour. *Innocenti Occasional Papers, Child Rights Series* (CRS 12). Florence: UNICEF International Child Development Center.

Siqueira, R. B. (1997) "Redistributive Effects of Alternative Indirect Tax Reforms for Brazil", *Economia Aplicada*. Available at http://www.decon.ufpe/br/rozane/rea97.htm

Siqueira, R. B. (1998) "Optimal Indirect Taxes for Brazil: Combining Equity and Efficiency", *Revista de Economia Brasileira*,1998. Available at http://www.decon.ufpe.br/rozane/rbe97.doc

Siqueira, R. B. et al (1998) ""Uma Análise da Incidência Final dos Impostos Indiretos no Brasil", *Anais do Encontro Nacional de Economia-ANPEC*, vol.2. Available at http://www.decon.ufpe.br/anpec98.doc [forthcoming in *Revista Brasileira de Economia* (2000)]

Siqueira, R. B. et al (1999) "Impostos sobre Consumo no Brasil: a Questão da Regressividade Reconsiderada", *Anais do Encontro Nacional de Economia-ANPEC*, vol.3. [forthcoming in *Economia Aplicada* (2000)]

Siqueira, R. B. e C. Satie (1999) "Gasto, Renda e Desigualdade no Brasil", Public Economics Research Group, Department of Economics, Universidade Federal de Pernambuco, mimeo.

Taylor R., J. Gomulka and H. Sutherland (2000). "Creating Order out of Chaos? Identifying Homogeneous Groups of Households across Multiple Datasets", Paper for the *26th General Conference of the International Association for Research on Income and Wealth*. Cracow, Poland, August.

Tables and Figures

Table 1 Taxes as a Share of National Income (GDP) by level of Government

Level of Government	Taxes as a percentage of GDP
Federal	20,7%
State	7,8%
Municipal	4,3%

Source: Almanaque Abril 2000. Rio de Janeiro: Abril Cultural

Table 2 The Brazilian Marginal Tax Rate Schedule (2000)

Income (R$)	Tax rate (%)	Standard deduction (R$)
0 - 900.00	Exempt	-
> 900.00 - 1,800.00	15	135.00
> 1,800.00	27.5	360.00

Note: Tax liability is also net of deductions related to dependent children, old age pension, alimony, social and private security contributions.

Source: Secretaria da Receita Federal, Brasília, DF.

Table 3 Distribution of total tax payers by monthly income class – Brazil - 1998

≤ R$1,000	> R$1,000 ≤ R$2,000	> R$2,000 ≤ R$4,000	> R$4,000 ≤ R$6,000	> R$6,000 ≤ R$10,000	> R$10,000	Total number of tax payers
44.4%	33.6%	15.0%	3.9%	2.2%	0.9%	10,446,083

Source: Secretaria da Receita Federal, Brasília, DF.

Table 4 Brazil Distribution of Total Tax Revenue by Type of Instrument, 1998

Taxes	%
Tax on the circulation of goods and transportation and communication services (ICMS)	22.6
Tax on manufactured products (IPI)	6.0
Tax on financial transactions (IOF)	5.7
Taxes on foreign trade	2.4
Tax on general services (ISS)	1.7
Provisory contribution on banking transactions (CPMF)	3.0
Tax on the ownership of motor vehicles (IPVA)	1.7
Tax on the ownership of urban rural state	1.3
Income tax	17.7
Contribution to the financing of social security (COFINS)	6.6
FGTS	6.2
PIS / PASEP	2.7
Contribution on net profits (CSLL)	2.4
Federal social security contribution	17.3
State social security contribution	1.4
Others	1.3
Total	100.0

Source: Almanaque Abril 2000. Rio de Janeiro: Editora Abril; Secretaria da Receita Federal, Brasília, DF.

Table 5 Benefits as percentage of total social benefit expenditure and total quantity

Benefit	% total expenditure	% total recipients
Pensions	87.6	84.6
Sickness benefit	3.6	2.8
Lifelong monthly income[14]	2.8	5.4
Invalidity benefit	1.7	3.5
Employment injury benefit	1.7	1.7
Old age benefit	0.4	1.1
Maternity benefit	0.2	0.2
Others	2.0	0.7
Total	100	100

Source: Ministry for Social Security, Brasília, DF.

[14] This is a non-contributory benefit conceded to those who are not eligible to pensions payments but have insufficient income to support themselves.

Table 6. The Brazilian Tax-Benefit Spine

Tax-benefit element	Simulated / Data	Fiscal Unit of assessment	Variable requirements
Annual bonus (thirteenth wage)	Simulated	Individual	Monthly wage
			Formal employment status
Minimum Wage	Simulated	Individual	Monthly gross earnings
			Formal sector employee
Employee* social security contribution	Simulated		Monthly gross earnings
Civil Servants social security contribution	Simulated		
Employers own social security contribution	Simulated		Monthly contribution
			Number of contributions
			Contribution wage
Self-employed social security contribution	Simulated		Monthly contribution
			Number of contributions
			Contribution wage
Employer payroll social security contribution	Simulated		Monthly gross earnings
Private pension contribution	Data	Individual	Age
			Monthly contribution
Pension	Data	Individual	Age
			Public / private worker
			Social security contribution
			Number of contribution
Personal Income tax	Simulated	Individual	Income base**
			Marital status
			Number of dependants
			Educational expenses
			Medical expenses

			Maintenance payment
Investment Income Tax	Simulated	Individual	Investment Income
Family credit	Simulated	Family unit	Number of children
			Monthly earnings
			Formal sector employee
Unemployment benefit	Simulated	Individual	Unemployed status
			Average monthly earnings before unemployment
Tax on Thirteenth wage	Simulated	Individual	Thirteenth Wage
Old age benefit	Simulated	Individual	Age
			Per capita family income
Sickness benefit	Data	Individual	Per capita family income
			Sickness status
Invalidity benefit	Data	Individual	Invalidity status
Employment injury benefit	Data	Individual	Injury status
Estimation of Expenditure	Simulated	Household	See Table 10
Municipal Indirect taxes on Services	Simulated	Household	Municipality
			Disaggregated Expenditure
State Indirect Taxation on the circulation of goods and transportation and communication services	Simulated	Household	State
			Disaggregated Expenditure
Federal Indirect Taxation on manufactured products	Simulated	Household	Disaggregated Expenditure
Federal Indirect Taxation on imports	Simulated	Household	Disaggregated Expenditure
Federal Indirect Taxation on financial transactions	Simulated	Household	Disaggregated Expenditure
Non Cash Subsidies	Simulated	Household	Public school enrolment

* This term actually refers to employed workers, domestic workers and temporary workers.

** The income base corresponds to the aggregation of income from several sources

Table 7 Income and Socio-Economic Data Requirements for Model

Framework Variable	Available in Data	Brazilian Specific Variable	Available in Data
Individual Level			
Age	Yes	Length of contribution / Length of service	No
Child care costs	No	Educational expenses	No
Civil servant	Yes	Unemployment status	Yes
Current Education Status	Yes	Formal employment status	Yes
Highest Level of Education Achieved	Yes	Sickness status	No
Student payments	No	Invalidity status	No
Employee contributions	Yes	Injury status	No
Employment status	Yes		
Current Gross Employment Income	Yes		
Employer Social Insurance contributions	Yes		
Financial Capital	No		
Size of firm	No		
Gender	Yes		
Housing benefits	Yes		
Hours worked per week or month	Yes		
National direct tax	Yes		
Industry	Yes		
Gross Investment income	No		
Other irregular lump sum benefits	Yes		
Sub-national (local or regional) taxes	Yes		
Lump sum income	Yes		
Maintenance payments	Yes		

Maintenance payments received	Yes
Marital Status	Yes
Maternity payments	Yes
Occupation	Yes
Other Capital	No
Other regular primary income	Yes
Other personal taxes and contributions	Yes
ID of mother if in household otherwise, father	Yes
ID of partner if married or cohabiting	Yes
Pension contributions	Yes
Unique Person ID = HHID * 100 + unique number within household	Yes
Gross Property income	Yes
Gross Private pension benefit payments	Yes
Other private transfers received	Yes
Other regular cash payments	Yes
Self-Employment Income	Yes
Wealth or national property taxes	Yes
Household Level	
Date of interview	Yes
Household disposable income	Yes*
Household ID	Yes*
Imputed rent (rental value)	Yes
Mortgage interest	Yes
Other housing costs	Yes
Region	Yes
Rent	Yes
Compulsory service charges	No

Housing tenure	Yes
Market value of main residence	No
Grossing-up weight	Yes

Table 8 Variable Required for Indirect Taxation

Framework variable description:	Available in Data	Extra Brazilian Variables:
Alcoholic beverages	Yes	Motor vehicles
Beer	Yes	
Book and education	Yes	
Clothing and footwear	Yes	
Communications	Yes	
Domestic fuel	Yes	
Education, training and courses	Yes	
Electricity	Yes	
All food different from meat	Yes	
Health Care	Yes	
Household goods and services	Yes	
Leisure goods and services	Yes	
Non-alcoholic beverages	Yes	
Other goods and services	Yes	
Petrol and other motor fuels	Yes	
Restaurants, hotels, cafes etc..	Yes	
Spirits	No	
Tobacco	Yes	
Transport	Yes	
Wine	No	
Car Owner	Yes	
Age	Yes	
Gender	Yes	
Marital Status	Yes	
Profession of the head	Yes	
Education level of the head	Yes	
Sector of activity of the head	Yes	
Number of Elderly, Adults, Children	Yes	

Number of Children	Yes
Housing Tenure	Yes

Source: Baldini et al. (2000) and POF dataset

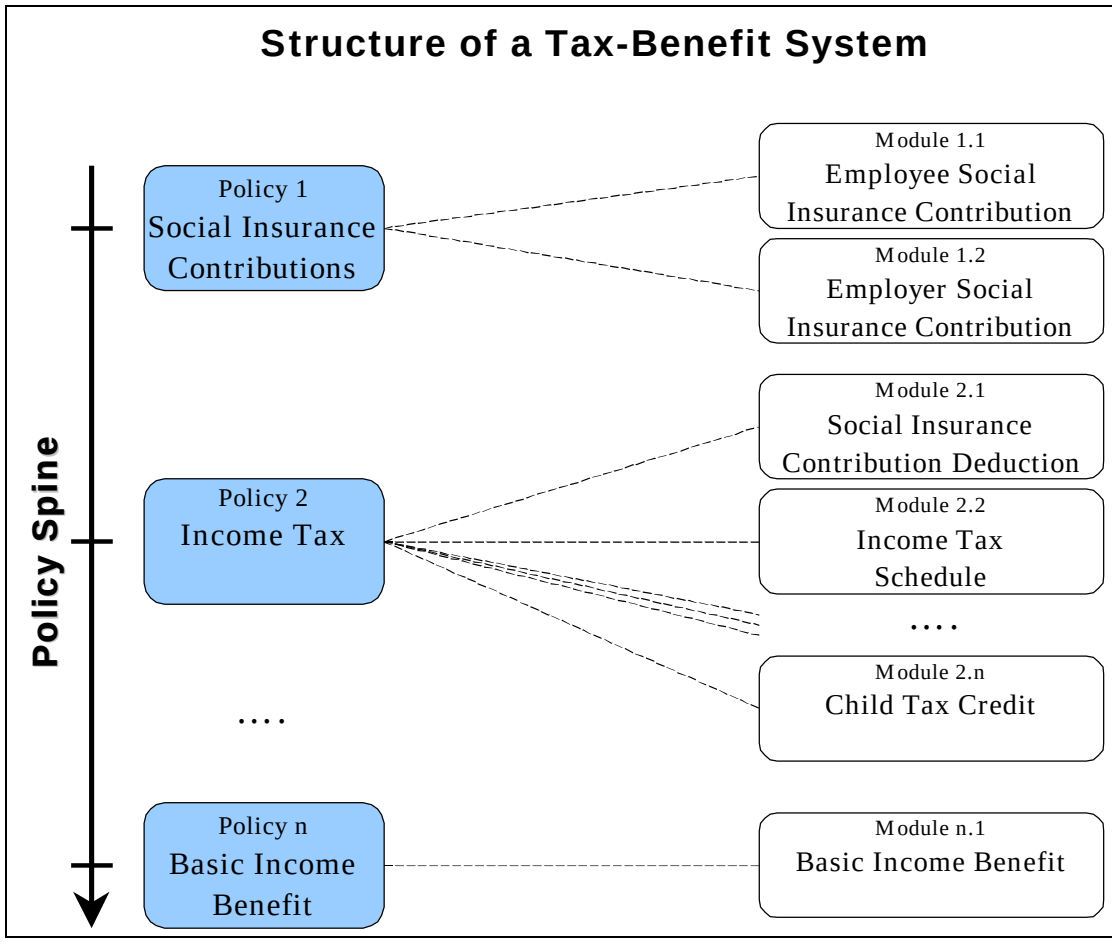
Table 9 Implementation Steps

Step
1. Addition of new variables
2. Updating of Dataset to year of simulation
3. Specification of Fiscal Units
4. Implementation of Policy Spine
5. Creation of the component Modules for each component of the Policy Spine
6. Creation of Income Lists
7. Behavioural Response
8. Validation against hypothetical calculations
9. Validation against aggregate statistics for baseline and accounting for the informal economy

Table 10 Fiscal Units Used in the Brazilian Tax Benefit System

Fiscal Unit	Description
Individual	Individual
Family	Parents and children plus relatives and other persons who are not lodgers
Household	Set of families who cohabit in the same place
Income Tax Fiscal Unit	Tax payer plus, dependent persons who are defined as those who have a dependency relation to the person filing the tax form, including: spouse, children aged less than 21years old, parents and grandparents with earnings less than a pre-specified threshold, and underage individuals whom the tax payer is the legal tutor.
Social Benefit Fiscal Unit	As per Income Tax Fiscal Unit
Family Credit Fiscal Unit	As per Income Tax Fiscal Unit except children are defined as being less than 14 years old or disabled

Figure 1


Structure of a Tax-Benefit System
Policy Spine
Policy 1
Social Insurance Contributions
Policy 2
Income Tax
....
Policy n
Basic Income Benefit
Module 1.1
Employee Social Insurance Contribution
Module 1.2
Employer Social Insurance Contribution
Module 2.1
Social Insurance Contribution Deduction
Module 2.2
Income Tax Schedule
....
Module 2.n
Child Tax Credit
Module n.1
Basic Income Benefit