EUROMOD

WORKING PAPER SERIES

EUROMOD Working Paper No. EM5/09

ADAPTING EUROMOD FOR USE IN A DEVELOPING COUNTRY – THE CASE OF SOUTH AFRICA AND SAMOD

Kate Wilkinson

May 2009

Adapting EUROMOD for use in a developing country – the case of South Africa and SAMOD[1]

Kate Wilkinson [2]

Abstract

This paper describes the construction of a microsimulation model for South Africa (SAMOD), which is based upon the EUROMOD platform. The paper discusses the need for a new microsimulation model in South Africa, the reasons why EUROMOD was a particularly suitable candidate as a basis for the new model and the challenges encountered in building the model. The intention of this paper is to provide necessary background material on the construction of the model to anyone wishing to work with SAMOD and to record the lessons learned in the model-building process which may be helpful to those considering developing their own microsimulation models in other countries. Particular attention is given to the way that South Africa, as a developing country, raises challenges that have not previously been encountered in the development of EUROMOD.

JEL Classification: I32; I38; H24

Keywords: tax-benefit policy; microsimulation; developing country; South Africa

Corresponding author:
Kate Wilkinson
Centre for the Analysis of South African Social Policy
Department of Social Policy and Social Work, University of Oxford
32 Wellington Square, Oxford
United Kingdom
E-mail: kate.wilkinson@socres.ox.ac.uk

[1] SAMOD is based on EUROMOD version D17. EUROMOD is continually being improved and updated and the results presented here represent the best available at the time of writing. Any remaining errors, results produced, interpretations or views presented are the authors' responsibility. This paper uses data from the Income and Expenditure Survey, the Labour Force Survey and the Community Survey provided by Statistics South Africa.

[2] This paper was written as part of the Strengthening Analytical Capacity for Evidence-based Decision-making programme, financed by UK Department for International Development Southern Africa. We are indebted to all past and current members of the EUROMOD consortium for the construction and development of EUROMOD. The author is grateful to other members of the SAMOD project team (Gemma Wright and Michael Noble) for their contributions to the construction of the model and comments provided on this paper and to the project consultants (Holly Sutherland, Ingrid Woolard, Martin Evans and Charles Meth) for their advice throughout the project. In addition, a good deal of invaluable technical help during the model building process was provided by Francesco Figari and Alari Paulus at the Institute for Social and Economic Research. However, any errors and the views expressed in this paper are the authors' responsibility. In particular, the paper does not represent the views of the institutions to which the authors are affiliated.

1. Introduction

In 2007 the Centre for the Analysis of the South African Social Policy (CASASP) at the Department of Social Policy and Social Work at the University of Oxford was commissioned to build a microsimulation model for South Africa, which could be used by analysts in the National Government Department of Social Development in the Republic of South Africa. This two-year project was funded by the UK Department for International Development Southern Africa as part of its Strengthening Analytical Capacity for Evidence-based Decision-making programme (SACED).[3] The project outputs included a functioning microsimulation model (SAMOD – South African microsimulation model), a user handbook (Wilkinson *et al.*, 2009), some examples of simulations carried out using SAMOD and training sessions for SAMOD users.[4]

This paper documents the process of building SAMOD with particular reference to the approach taken (i.e. the choice of building a new model or using an existing model), the selection and use of micro-data and the particular challenges encountered in adapting the model for use in a developing country. The intention is to provide necessary background material on the construction of the model to anyone wishing to work with SAMOD and to record the lessons learned in the model-building process which may be helpful to those considering developing their own microsimulation models in other countries.

2. Microsimulation in South Africa

2.1 Existing models

At the start of the SAMOD project there were already a number of models in use both in government and in the academic community. For example, Haarman (2000) modelled the impact of existing social grants on poverty and tested the impact of potential reforms using a microsimulation model. Woolard has examined the redistributive impacts of the tax system and looked at the relationship between social assistance grants and economic growth (Woolard, 2003; Woolard *et al.*, 2005). Adelzadeh has developed a microsimulation model that is accessible on the internet where the user can modify certain elements of the existing system and add in a basic social assistance benefit (Adelzadeh, 2005). Adelzadeh has also developed more complex models to investigate options for halving poverty and unemployment in

---

[3] The SAMOD project team comprised Professor Michael Noble (Principal Investigator for the project and Director of CASASP), Kate Wilkinson (Research Fellow at CASASP and main researcher on the project) and Dr Gemma Wright (Senior Research Fellow and Deputy Director of CASASP). Consultants on the project were Professor Holly Sutherland (University of Essex), Dr Ingrid Woolard (University of Cape Town), Dr Martin Evans (University of Oxford) and Dr Charles Meth (acting in a personal capacity).

[4] SAMOD is jointly owned by The University of Oxford, The Department of Social Development of the Government of the Republic of South Africa and The University of Essex 2008. SAMOD was developed using the EUROMOD framework (based on Version D17 of EUROMOD). The author and all other members of the SAMOD team are grateful to Professor Sutherland and her team at The University of Essex for granting access to EUROMOD and allowing it to be modified to build SAMOD, and for their help and support during the project.

South Africa over the next ten years (Adelzadeh, 2007). Finally, researchers at the Economic and Policy Research Institute have investigated the potential impact of existing social benefits and proposed policy reforms using microsimulation modelling (Samson *et al.*, 2002; Samson *et al.*, 2004).

In addition, research has also been undertaken on linking microsimulation models with computable general equilibrium models (Herault, 2005). The model developed by Herault examines how macro-shocks and policy changes lead to macroeconomic changes. A microsimulation model is then used to investigate the impact of the macro-level changes on individual behaviour.

2.2 The requirement for a new model

Although there are a number of microsimulation models already in existence in South Africa the existing models have been developed by the academic community and are (in most cases) used exclusively by academics for research purposes and to provide simulation results to government departments. Training has been provided within government departments on using the microsimulation models developed by Woolard and Adelzadeh. However, analysts in government generally do not have the capacity to modify and develop these models, only to use them to run simulations.

All existing South African microsimulation models are limited in the types of policy reform that they allow both in terms of altering the parameters of existing policies and adding completely new policies. Of course, the model developers themselves are able to change these parameters but this cannot be done by external users. A further problem is that the calculations carried out by existing microsimulation models are only 'accessible' to the model builder, thus, there is a lack of transparency in the arithmetic procedures underlying the policy simulations. In South Africa there was, therefore, a need for a microsimulation model, which could be used by analysts within government, which had the flexibility to allow users to alter policy parameters and build in entirely new policies. In addition, in order to ensure the long-term use and sustainability of the new microsimulation model, users should have the capacity to update the model and add new data as they become available.

In developing a new microsimulation model for South Africa in response to the needs identified above it is important to note that the intention was not to replace the models already in use, rather to encourage and expand the use of microsimulation modelling as an analytical technique. The existence of several different microsimulation models in one country is beneficial as each will have different strengths and weaknesses and comparison of the outputs produced from each one strengthens the quality of knowledge and research.

2.3 Selecting a model design for South Africa

In developing the new model the first step was to decide what sort of model needed to be built. Microsimulation models are classified in various different ways (for a useful taxonomy of microsimulation models for redistribution analysis see Bourguignon and Spadaro (2005: 3)). Bourguinon and Spadaro describe the three key components of microsimulation models as: 1) a micro-data set of information on individuals and households; 2) a set of policy rules; and 3) a theoretical model of the behavioural responses of agents. It is in the last component that models tend to differ in terms of whether they ignore or take account of behavioural responses. Behavioural responses can include any individual or household behaviour that may change in response to a policy change. Typical examples of behavioural responses include labour supply, family composition and saving or investment decisions. The majority of the South African models described above do not take account of behavioural responses, although Adelzadeh has produced a behavioural response model.

Often microsimulation models are classified according to the process which is used to age the micro-units in the data as time moves forwards. Models described as 'static' models do this by re-weighting the household data whilst keeping the ages of individuals within the household the same. Dynamic models attempt to age forward the population year by year. Dynamic ageing inevitably incorporates some form of behavioural response as individuals may change employment status, have children and form new families as they get older. In this case, however, the changes occur because of ageing and not because of policy changes so the distinction between static, dynamic and behavioural response models is an important one.

Static models are the simplest and most transparent which makes them appealing to users and they are widely used in academia and government. They are sometimes criticised as being overly simple and restrictive because they ignore behavioural responses. However, Mitton *et al.* (2000) argue that the choice of model really depends upon the policy question to be addressed and both static and dynamic models have uses in differing applications. Bourguignon and Spadaro (2005) also suggest that static models are perfectly adequate in evaluating changes in individual and social welfare, as, in most cases, behavioural changes can be assumed to be insignificant. However, they do warn that static models may not be entirely reliable in predicting government budget constraints when strong behavioural responses are predicted.

The simulation results produced by dynamic models are very sensitive to the robustness of the model of behavioural response that is used. It is difficult to develop good behavioural response models from cross-sectional data and there are no national longitudinal studies available in South Africa from which it might be possible to develop reliable models of behavioural responses to policy changes. In addition, as many households in South Africa have incomes which are at or below a basic subsistence level and unemployment rates are extremely high due to a severe shortage of jobs, it could be argued that the impacts on labour supply due to a change in household income is likely to be small. Most individuals do not have the choice to opt in to or out of work if their income changes: many people are desperately looking for work and those who do have jobs are keen to keep them (Noble *et al.*, 2008; Surender *et al.*, 2007).

Of course this is not to say that other factors, such as household formation decisions, are not affected by tax and benefit policy. However, the main aim of the Department of Social Development in using microsimulation as an analytical tool is to evaluate the immediate impact of tax and benefit policy on poverty and redistribution and a static model is able to adequately satisfy this aim.

Aside from considerations of the type of model that was required (in terms of dynamic or static and the incorporation of behavioural responses) the functionality of the model was also a key issue. As already discussed above, one of the reasons for building a new microsimulation model in South Africa was to allow analysts in government to test policy reforms. Existing models only allow a very limited number of reforms to be tested. The capacity to test different policy scenarios is especially important in South Africa. Following the transition to democracy in 1994, there has been much discussion of how tax and benefit policy can help to address the pressing problems of high levels of poverty and income inequality (Department of Social Development, 2003, 2006, 2007, 2008; Department of Welfare, 1997; The Taylor Committee, 2002). Although some policy reforms have been implemented since 1994, most notably the introduction of a means-tested grant for children, there are still significant gaps in the system of social protection currently in operation (Whitworth and Noble, 2008). Determining how to address these gaps in the most effective and efficient manner is one of the key questions that the new microsimulation model (SAMOD) will help to address.

Given the requirements set out above, the EUROMOD microsimulation model fulfilled all of the needs identified for the new South African model (SAMOD). In addition, the significant amounts of research time and expertise that have already been undertaken to develop EUROMOD meant that far more could be achieved by drawing on these experiences rather than developing a new model from scratch.

EUROMOD is a multi-country tax benefit model covering all 15 pre-2004 European Union member states and four new accession states. EUROMOD was initially developed using funding from the European Commission in 1998 and has since been improved and extended by the collaborative efforts of researchers from many different countries. A number of working papers document the construction and development of EUROMOD (Lietz and Mantovani, 2006; Sutherland, 2001, 2005; Sutherland *et al.*, 2008). The original project aim was to build a model that was capable of making reliable cross-national comparisons. Whilst many countries have, and continue to operate, national microsimulation models, these are generally 'black boxes' operable only by a small number of people and specifically designed for the policy system in a particular country. Cross-national comparisons are generally not possible with such models. The EUROMOD approach was to try and make a model that was flexible enough to cope with the variety of policy designs that exist within Europe. In addition the model had to be designed so that it could be used by anyone with a small amount of training, and, especially, that users could design and test their own policy reforms. It is this flexibility and ease of use that makes EUROMOD an excellent basis upon which to build a South African model.

3. Data

3.1 Selection of a micro-data set

Underlying every microsimulation model are micro-data on individuals and / or households which supply the model with the information necessary to carry out the calculations. An important step in building a microsimulation model is choosing an appropriate data-set and cleaning and preparing the data for use in the model. It is common practice to use household survey data for microsimulation modelling, although census data may also be used in certain cases. EUROMOD uses a series of national household surveys (see Lietz and Mantovani for example (2006: 24)). In multi-country models such as EUROMOD obtaining comparable data from different countries can be a considerable challenge. At the European level the launch of the European Union Statistics on Income and Living Conditions survey (EU-SILC) will provide a valuable source of cross-national comparable data which will be of substantial use to the EUROMOD model (Sutherland *et al.*, 2008). For a single country model such as SAMOD, comparability across countries is not such an issue; however, to accurately model tax and benefit policies the data requirements are still substantial.

A number of national household surveys are currently run by Statistics South Africa. There is also a national population census. South Africa's Census pattern is not yet established: the first post democracy Census was in 1996 and was followed five years later by the 2001 Census. The next full Census is not until 2011; however, there is also a new Community Survey (2007) (which replicates the 2001 Census questionnaire), an annual General Household Survey (available from 1993 to 2007), a bi-annual (and more recently quarterly) Labour Force Survey (available from 2002 to 2007) and a five-yearly Income and Expenditure Survey (available from 1995 to 2006). The Labour Force Survey was an unsuitable source of micro-data for this project as most of the information relates to the working age population (those aged over 15) and it contains only banded income data. A 10% sample of the 2001 Census is available at individual level; however, the data is now becoming increasingly out of date and, again, does not contain sufficiently detailed information on income (income data is banded) and no information on expenditure. The General Household Survey does contain detailed information on receipt of social grants and some income and expenditure items, but the coverage of income and expenditure items is not comprehensive enough to provide the detail required to calculate tax liability and entitlement to grants needed for the microsimulation model. The Community Survey was ruled out because it suffers similar problems to the 2001 Census in that there is little information on income and no information on expenditure.

The Income and Expenditure Survey (IES) was selected as the primary micro-data set for SAMOD as it satisfies more of the base data requirements that any of the other data-sets considered. The IES has been conducted at approximately five yearly intervals, most recently in 2006. The survey is primarily used to update the consumer price index for economic decision making; however, the detailed information it contains and relatively large sample size (24,000 dwellings) makes it a suitable source of base data for microsimulation. Although the IES 2000 is not the most recent source of income and expenditure data in South Africa, a number of methodological changes between the 2000 and 2006 surveys meant that the IES 2006 was an unsuitable source of micro-data for SAMOD. The reasons for selecting the 2000 IES instead of the 2006 update are set out below:

First, the IES 2000 and the IES 2006 have near identical questionnaires; however, the IES 2000 is a richer data source as the same respondents were sampled as for the September 2000 Labour Force Survey (LFS). This meant that the IES and the LFS could be joined together to increase the number of variables available. For example, the LFS provided key information on the relationships between household members, employment status and receipt of / contributions to unemployment insurance.

Second, the IES 2006 only included banded age data for individuals. However, the eligibility rules for all of the benefits available in South Africa include conditions based on age, hence the simulations could not be done accurately with banded age data.

Given, the limitations of the 2006 IES, the 2000 IES was therefore chosen as the base micro-data set.

3.2 Updating the base data to 2007

Although the IES contains much of the information required to simulate the vast majority of the tax and benefit policies in South Africa, a number of steps were necessary to ensure that the micro-data was as accurate and up to date as possible. This included taking steps to improve the data where key information was missing or badly recorded. Each improvement made to the 2000 IES data to create a suitable base micro-data set for SAMOD is described below. To summarise, these included:

- imputing relationship information to identify the main carer of each child;
- re-weighting the data to take account of population change since the year 2000;
- up-rating income and expenditure figures to take account of changes in these values since the year 2000 and imputing missing income data;
- estimating the number of individuals with a work-limiting disability and the number of children with a disability;
- estimating the number of children who have lost both their biological parents;
- estimating the number of people making contributions to the Unemployment Insurance Fund and the number of people eligible to claim benefits from the fund.

Imputing relationship information

The main drawback of using the IES is that there is no information on the relationships between family members (although detail is given about each person in the household). The 2000 LFS does allow individuals to be linked with a spouse or partner who is living in the same household but more detailed relationship information, to enable children to be linked with their parents or carers is required to determine eligibility for child grants. These relationships between children and their carers had to be imputed in the data.

The creation of relationship structures was carried out in two steps. First, following the methodology of Woolard[5] (Noble *et al.*, 2005) a likely carer was identified for each child under the age of 18. This method assigns children to carers according to a series of rules. First, children are assigned to the first woman in the household who is aged between 13 and 40 at the child's birth[6]. If no carer is assigned then the child is assigned to the first woman aged over 40 at the child's birth. If the child still has no

[5] The same method was used in the microsimulation model developed by Woolard for the Department of Social Development.

[6] The household data is structured so that the head of the household is likely to be the first person listed followed by their spouse or partner, followed by other adult members, followed by children.

assigned carer then the process is repeated for men aged 13 to 40, then, men aged over 40. If this still does not assign a carer to all children then the oldest person in the household who is 18 or over is assigned as the carer to any remaining children. Thus, it is only in child-headed households, where there is no-one present who is aged 18 or over, that children are not assigned a carer. In these cases (representing about 0.5% of all cases) the oldest child is nominated as the carer for the younger children and the oldest child has no carer or parent.

Re-weighting the data to take account of population change

Ideally the micro-data set used within a microsimulation model should relate to a time point as close as possible to the time point of the tax and benefit rules that will be fed into the model. In the case of SAMOD the main aim is to model policy reform so the data therefore had to be as up-to-date as possible. At the time when SAMOD was being developed the latest population estimates available related to 2007. Other key data, for example the national accounts and the consumer price index were also published up to 2007 so it was decided to take the mid-point of this year as the time point for the micro-data. The IES 2000 data therefore had to be re-weighted to take account of population change between 2000 and 2007. The method employed made use of the CALMAR re-weighting programme (Sautory, 1993), which re-calculates household weights based on a series of constraints. Household weights were re-calculated so that the population totals by sex, race and five-year age-band for each province[7] matched the 2007 population estimates produced by the Actuarial Society of South Africa (Dorrington *et al.*, 2005) as closely as possible[8].

Up-rating household incomes and expenditures and imputing missing income data

In addition to updating the population totals, income and expenditure figures also had to be updated. Of course, other characteristics of the population will have changed between 2000 and 2007, for example, household composition and employment status. However, these factors were very hard to predict and so only population totals and income and expenditure figures were updated.

The publication of the 2006 IES provided detailed information about individual incomes from various sources in 2005/06. However, the challenge lay in using this information to update the incomes of the IES 2000 households. South Africa is characterised by a highly unequal income distribution in which income inequality appears to be increasing over time (Leibbrandt *et al.*, 2005). There are also large numbers of individuals employed in the informal sector and growth in formal and informal sector wages are likely to exhibit very different trends. To take account of the fact that earnings for households with different income levels are likely to change at different rates, a series of income up-rating factors were calculated for each income

[7] South Africa is divided into nine administrative areas known as ‘provinces’.
[8] Statistics South Africa also produce population estimates and these should have ideally been used in the re-weighting procedure as they are the preferred source of population statistics for analysts in government. However, the Statistics South Africa population estimates could not be obtained at the level of detail required to re-weight the survey data. It is straightforward to update the household weights using a different set of population estimates if required.

quintile within each race[9] group. The process by which these income up-rating factors were calculated is as follows:

- The first step was to calculate the average household income for each income quintile within each race group for households in the 2006 IES[10]. There were a number of households reporting zero total income from any source (including social grants and remittances). There are various reasons why households may report zero incomes, for example, Deaton (1997) argues that poor households living at a subsistence level may struggle to understand the concept of income when income and outgoings are approximately equal. In addition, income often tends to be under-reported or not disclosed at all as it is a sensitive topic and people may be afraid of their data being passed on to the tax authorities (Statistics South Africa, 2008a). As zero income was considered to be an implausible result (and it was difficult to identify any systematic biases in the failure to report income), households reporting zero income were excluded from the calculations of average household income.

- The second step was to calculate equivalent figures for the households in the 2000 IES. In this case households with zero incomes could not be dropped because these households were included in the re-calculation of the household weights so to exclude them from the data would affect the 2007 population totals. Rather than dropping these households their income was randomly imputed based on the income distributions observed in households of the same race group reporting non-zero incomes. More complex imputation procedures could have been used (for example, as in Ardington *et al*. (2005) and Barnes and Noble (2006)); however, this was not considered worthwhile given that less than 2% of households reported zero incomes. Thus, after incomes had been imputed and average incomes calculated for each income quintile within each race group, the 2000 and 2006 average household income figures could be compared.

- The average household income for each income quintile within each race group in 2006 was divided by the equivalent figure in 2000 to generate a ratio. This ratio was then used to calculate the year-on-year growth (or decline) in income between 2000 and 2006. Assuming that these income trends continued into 2007, the expected average household income for July 2007 was calculated and hence the equivalent ratio for 2007:2000 average household incomes.

[9] Even though all elements of racial discrimination were removed from legislation in 1994, the legacy of the apartheid regime prior to 1994 has resulted in significant income polarisation between white and black South Africans. Even though there are a growing number of middle and high income black South Africans, those living in poverty are almost exclusively black African. It is therefore still appropriate to examine income trends along racial lines. In South Africa race groups are typically referred to as 'population groups'. The population is classified into five groups according to common characteristics of descent and history, these are: black African, Indian, Asian, white and other. The term 'black' is used to refer to all groups who are non-white. (see: Statistics South Africa (2004), *Census 2001 Concepts and Definitions*, Pretoria, Statistics South Africa)

[10] The calculations were based on income from all sources except social grants.

- Household income in 2000 was multiplied by the 20007:2000 ratios to generate an estimated household income in 2007. The ratios were not applied to income from social grants as the amount of the grants is determined by government policy.

- Finally, to check the robustness of the calculations the estimated total wage income was compared to the total compensation to employees as reported in the national accounts (South African Reserve Bank, 2008). The estimated figure was about 20% smaller than the figure recorded in the national accounts so 2007 household incomes were scaled up by a further amount so that the total wage income matched the total recorded in the national accounts. It is debatable whether it is always appropriate to scale up income to match national account totals as this can falsely alter measures of poverty and inequality. In South Africa the process of scaling up incomes has often been used to produce estimates of poverty (Meth, 2006, 2007; Simkins, 2004; van der Berg *et al.*, 2005, 2007; van der Berg and Louw, 2004), although the method used to do this has been the subject of considerable debate. It is known that the Income and Expenditure Surveys undercount income. Wage income in the 200/2001 survey was 21% lower than national accounts and 30% lower in the 2005/2006 survey. As the method used to update income here creates a separate scaling factor for each race group and each income quintile (25 separate scaling factors in total), and is only applied to earned income (and not income from cash transfers) the final scaling up of earned income to national accounts has only a small effect on poverty and inequality measures. The poverty rate changes from 64% prior to scaling up to 60% post scaling up[11]. The Gini coefficient (on pre tax and transfer income) remains at 0.83. Thus, here it is considered appropriate to scale-up incomes as this does improve the estimates of income tax considerably and has little impact on poverty and inequality metrics.

Household expenditure data was updated assuming that each household purchases the same types of items in 2000 and 2007; however, the total quantity purchased may vary. The method used was as follows: first, price inflation factors from the July 2007 consumer price index (Statistics South Africa, 2007a) were applied to each expenditure item. New total expenditure values were then calculated for each household in the IES 2000. These new expenditure totals were then multiplied by a scaling factor. Equation 1 below shows the calculation of household expenditure for household $\boldsymbol{y}$ on a single expenditure item $\boldsymbol{i}$ in 2007 where $\boldsymbol{e_{yi2007}}$ is the estimated expenditure on a particular item in 2007, $\boldsymbol{e_{yi2000}}$ is the expenditure on the same item recorded in the IES 2000, $\boldsymbol{p_i}$ is the price inflation factor for the item and $\boldsymbol{S_q}$ is the scaling factor.

Equation 1 $$e_{yi2007} = S_q \times e_{yi2000} \times p_i$$

[11] As there are no reference data against which to check poverty rates it is not know whether 60% or 64% is the more accurate estimate.

The scaling factor $\boldsymbol{S_q}$ was calculated as follows: Households in the IES 2006 were grouped into deciles according to total expenditure and an average household expenditure figure was calculated for each expenditure decile. The ratio of the 2006 average household expenditure to the 2000 average household expenditure for each expenditure decile was then used to determine the year-on-year growth in household expenditures for each decile. Assuming that expenditure continued to grow at the same rate between 2006 and 2007, the growth rates were used to calculate the expected average total expenditure for households in each decile in 2007. Equation 2 shows the calculation of the average total household expenditure for a household in decile $\boldsymbol{q}$ in 2007 ($\boldsymbol{E_{q2007}}$) where $\boldsymbol{E_{q2006}}$ is the average total household expenditure for a household in decile $\boldsymbol{q}$ recorded in the IES 2006 and $\boldsymbol{E_{q2000}}$ is the average total household expenditure for a household in decile $\boldsymbol{q}$ recorded in the IES 2000.

Equation 2

$$E_{q2007} = E_{q2000} \times \left(\frac{E_{q2006}}{E_{q2000}} \right)^{7/6}$$

Finally, the scaling factor required to calculate the estimated expenditure on each item in 2007 for every household $\boldsymbol{y}$ in expenditure decile $\boldsymbol{q}$ is calculated as in Equation 3. In this case an individual household consumes a total of $\boldsymbol{j}$ different items and there are $\boldsymbol{n_q}$ households in each decile.

Equation 3

$$S_q = \frac{E_{q2007} \times n_q}{\sum_{nj} \left(e_{yi2000} \times p_i \right)}$$

Thus, the total expenditure in 2007 matches that estimated by rolling forward the IES data. However, the ratio of expenditure on different items may change due to differences in the price inflation factors for individual expenditure items.

Imputing disability status and identifying potential foster children

Social assistance is available in South Africa for adults with a disability that prevents them from working (Disability Grant) and children who have a disability that necessitates full-time care (Care Dependency Grant). There is also a grant available for an individual who cares for a foster child (Foster Child Grant). Thus, to calculate eligibility for these grants individuals with a disability and foster children must be identified in the data. The IES does not record such characteristics so the 2007 Community Survey was used to identify adults reporting that they were not able to work due to ill health or disability and children who are recorded as having a disability that prevents them from taking part in normal activities. Potential foster children were identified as children who had neither mother nor father still alive.

Having identified those who may be eligible to receive a disability grant, a logistic regression model was used to calculate the probability that an individual is disabled. The explanatory variables used were: age; gender; race; age of head of household; gender of head of household; province of residence; household income; highest education level achieved of head of household; number of adults in household; and, number of children in household. Only individuals who were not working were included in the model. The model coefficients were then applied to individuals in the IES data-set to identify those individuals most likely to be disabled. As the Community Survey provided an estimate of the total number of individuals likely to be eligible to claim a disability grant, the aim was to assign a disability status to the same number of individuals in the IES data. Thus, individuals in the IES data were ranked according to their probability of being disabled (again only unemployed people were considered) and the highest probability individuals were 'assigned' to the disabled group until the total number of disabled persons matched the totals estimated from the Community Survey. A similar process was followed to identify potential foster children in the IES data, as well as for children in receipt of the Care Dependency Grant.

Identifying unemployment insurance fund contributors and claimants

The only form of protection against unemployment for working age individuals currently available in South Africa is the Unemployment Insurance Fund (UIF). Employees and employers in certain parts of the formal sector are obliged to make contributions. However, there is no coverage at all for those in the informal sector. Contributions have to have been made for a certain period of time in order for a claim to be made in the case of unemployment, and the benefit can only be claimed for a maximum of six months. Although the 2000 LFS (which is matched to the 2000 IES) does record information on UIF contributions and claimants, this information needed to be updated to 2007. The latest LFS available at the time related to 2006 so this was used to estimate the total numbers of UIF contributors and claimants in 2007. The process used to identify claimants in the 2007 data was the same as that used to identify foster children and individuals with a disability i.e. a logistic regression was used to calculate the probability of each individual being a UIF claimant. Certain other constraints were placed on the models, for example, that claimants had to be currently unemployed but having previously worked. The explanatory variables used in the claimants' model included: gender; age; race; province of residence; size of household; means of support; education and time since last employment.

UIF contributors were imputed in the IES data according to their occupational sector. The proportion of workers contributing to the UIF in each occupational sector was estimated using the 2006 LFS. Individuals in the IES data were then randomly assigned to the UIF contributors group until the proportion of contributors in each occupational sector matched the proportions estimated in the 2006 LFS.

4. Tax and benefit policy in South Africa

4.1 Selecting policies to simulate in SAMOD

In the construction of any microsimulation model decisions often need to be made about which policies to simulate and which to leave out. The aim in building SAMOD was to simulate as many existing policies as possible. However, given that data constraints meant that certain policies could not be simulated with a great deal of accuracy, the focus was on those policies most relevant in terms of their direct impact on household incomes.

Given the policy focus on improving the situation of those living in poverty, it was important to include social assistance (referred to in South Africa as 'social grants') available to poor households and people with disabilities. In addition, the inclusion of personal income tax and value-added tax was also crucial given that these taxes provide revenue to fund the payment of social grants. As well as cash benefits, there are also a number of benefits 'in-kind' in South Africa such as free basic water, electricity and free schooling (where these services are normally subject to user charges). Ideally, these would also have been included in the simulations as they can have a considerable impact on the income of poor households. However, there are no reliable data with which to identify households who receive benefits 'in-kind' so these were not simulated within SAMOD (see Meth (2008b) for further details about these items).

The policies included within SAMOD for August 2008 are:

- Child Support Grant – a means-tested grant available to the carer of a child under the age of 15[12] (R210[13] per month)
- Care Dependency Grant – a means-tested grant available to the carer of a child[14] with a severe disability (R940 per month)
- Foster Child Grant – a grant available to the carer of a foster child[11] (not means-tested) (R650 per month)
- Disability Grant – a means-tested grant available to working-age adults who are unable to work due to disability or illness (up to R940 per month depending on income)
- Old Age Grant – a means-tested grant available to men aged 65 and over and women aged 60 and over[15] (up to R940 per month depending on income)
- Grant-in-aid – a top up to the Disability Grant or Old Age Grant for recipients of these grants who require full-time care (R210 per month)
- Personal income tax
- Value-added tax and excise duties
- Fuel levy – a tax levied on petrol and diesel

Other policies which may impact on household incomes but are currently not simulated within SAMOD include:

- War Veteran's Grant – very small numbers of individuals are now eligible for this
- Free electricity – provided as 50Kwh free per month
- Free water – provided as 6,000 litres per household per month to all households with a mains connection or access to a standpipe

[12] The Child Support Grant was extended to include 15 year-olds in January 2009. There is also likely to be a further extension to cover children up to 18 years of age but the timetable for this has not yet been agreed.
[13] Note that one-hundred rand equates to €7.75 as at March 2009.
[14] The grant is available until the end of the year in which the child reaches their 18th birthday.
[15] In October 2008 the Old Age Grant was extended to include men aged 63 and 64. The extension of the age range for men will continue over the next few years until both men and women aged 60 and over are eligible.

- School fees - school fees are charged as standard in South African schools; however, there are an increasing number of no-fee schools operating in the poorest areas
- Free school meals – one free meal is provided per day in certain schools
- Municipal indigent grants – amounts vary according to the area
- Early Childhood Development subsidies – amounts vary according to the area
- Free primary health care – primary health care is free for people who are not members of a private medical scheme. Free health care is also provided to children under the age of 6 and pregnant and lactating women
- Social relief of distress – provided as a short-term cash payment or food parcel to households undergoing temporary financial distress
- Compensation for occupational injuries and diseases
- Compensation for road traffic accidents
- Motor vehicle tax
- Road toll fees
- Private medical and retirement schemes
- Corporate taxation
- Capital gains tax
- Transfer duties – paid on the acquisition of fixed property
- Tax on retirement funds

4.2 Replicating policy rules

Social grants

It is never possible to exactly replicate the actual policy rules for any of the policies simulated in SAMOD. However, the simulated policy rules are generally a very close approximation to reality. For all of the social grants modelled in SAMOD eligibility conditions associated with characteristics that can be obtained from the micro-data are included. For example, conditions related to age, gender, marital status, family composition and income can easily be simulated. Other eligibility rules cannot be simulated, for example, to claim a Child Support Grant the carer must have a valid birth certificate for the child, but this information is not recorded in the micro-data.

As is the case in many microsimulation models, conditions such as these cannot be simulated; however, they are unlikely to have a significant impact on the number of claimants.

One way in which SAMOD differs significantly from reality is that it does not account for take up (i.e. in cases where an individual does not take up the benefits to which they are entitled, or, when someone fraudulently claims a benefit, which they are not entitled to). Take-up rates for the majority of the social grants available are now fairly high so this is not such a significant problem. The only grant which still has very low take-up rates is the Foster Child Grant. This is due to the fact that foster carers have to go through the courts to formally take a foster child into their care before they are eligible to receive a Foster Child Grant and many carers do not have the knowledge or means to do this. The simulations in SAMOD therefore vastly *overestimate* the actual number of individuals receiving a Foster Child Grant. This is not seen as an issue as it is arguably more important to know how many children may be eligible for this grant (given that they have lost both their parents) rather than knowing how many are actually claiming, especially as actual numbers of recipients can be obtained from administrative data.

The other incidence where an approximation is made which is worth noting is in the application of the income means-tests to determine eligibility for the majority of social grants. Here the major difference lies in the fact that the income test for some social grants also includes the value of assets owned by the household or earnings arising from the disposal of assets. Asset values are not recorded in the IES and the asset test can not be applied in the simulations.

Taxation

Compared to the calculations for the simulation of social grants, calculating personal income tax liability is significantly more complicated. However, as the payment of income tax is only recorded at the household level in the IES and the data are not accurate, it is preferable to simulate personal income tax. Building a personal income tax policy into the model also means that it is possible to simulate policy changes, which is a key requirement of the model.

Again, data constraints meant that the simulated income tax policy in SAMOD is a simplification of the actual policy rules. The main challenge in calculating tax liability is that certain income and expenditure items which are necessary for calculating individual liability for personal income tax are only provided at the household level. These include: lump sum payments from insurance and pension schemes; contributions to private medical schemes; employer contributions to health care insurance; and individual expenditure on health care. In these cases the amounts recorded at the household level are assigned to the main earner in the household (or apportioned between the main earners in each family according to income if more than one family lives in the same household). Individual and employer contributions to pension schemes are also reported at the household level but the data appear to significantly underestimate the value of these contributions. There are a large number of pension schemes in South Africa and each varies in terms of the contributions made by the employer and employee. As it was not possible to simulate the rules for each individuals scheme (it is not even known which particular scheme an employee belongs to) average contribution rates were applied to all employees. A recent survey by a South African pension fund estimated that, on average, individuals contribute 5.5% of gross salary to pension schemes and employers contribute 9.7% (Sanlam Employee Benefits, 2008). These average estimates were therefore applied to all wage earners to estimate individual and employer pension contributions.

Tax evasion was not taken into account in the simulations. In countries with a large informal economy rates of tax evasion are likely to be high. However, even though the informal sector is sizeable in South Africa (almost 40% of the labour force) tax collection is considered to be reasonably efficient (Lieberman, 2001) and the threshold at which earners begin paying tax is so high up the income distribution that very few informal sector workers are likely to be liable for income tax. Assuming no tax evasion occurs it is estimated that there were around 4 million tax payers in

2008[16]. By comparison there are around 8 million formal sector workers (Statistics South Africa, 2008b), and these formal sector workers are likely to have higher earnings than informal sector workers. Thus, given that around half of *formal* sector workers earn too little to be liable for income tax, it is fairly unlikely that many *informal* sector workers will earn enough to be liable for income tax. For this reason tax evasion due to a large informal sector is not considered to be a significant problem.

4.3 Model validation and simulation results

The extent to which the output from a microsimulation model needs to replicate reality is debatable. There is a balance to be struck between generating realistic results and adjusting the micro-data to produce such results. Most surveys do contain deficiencies in the data; however, unless there are particular known problems that can be easily (and robustly) addressed it is generally preferable to adjust the micro-data as little as possible. There are various methods of validating model output, for example, by comparing indicators of poverty and inequality or aggregate data on tax revenue and social expenditure. In some cases discrepancies between simulated and recorded figures may not be an issues, this depends very much on how the simulation results are to be used. However, validating model output is a useful test of the robustness of a microsimulation model and can highlight the strengths and weaknesses of the model.

First, looking at indicators of poverty and inequality, SAMOD simulations produce an overall poverty rate of 47.1%, based on a poverty line of R462 per capita per month. This poverty line is based on the lower bound of the poverty line used by Hoogeveen and Özler (2004) and also recommended by Statistics South Africa and the National Treasury (Statistics South Africa, 2007b). The poverty line was calculated using a 'cost-of-basic-needs' approach. The value used by Hoogeveen and Özler (R322 per capita in 2000 Rands) was updated from 2000 to 2007 prices using the average consumer price index for 2007. The Gini coefficient for South Africa based on the simulations of 2008 policies is 0.66. Comparable poverty and inequality figures are extremely hard to obtain due to the absence of regularly updated national surveys providing detail about household incomes. However, Armstrong *et al.* (2008) report poverty rates of 47.1% in 2006 and a Gini coefficient of 0.72 and Streak *et al.* (2008) report a poverty rate (for adults only) of 45.2% based on a poverty line of R556 in 2007 Rands.

Second, considering tax revenue and expenditure on social grants, Table 1 and Table 2 below compare the simulation results from the August 2008 policy system in SAMOD with actual results obtained from the South African Social Security Agency and the National Treasury. Table 1 shows the results for the social grants and the UIF and Table 2 shows the results for direct and indirect taxation. It should be noted that although 2008 policies are modelled for the purposes of the calculations in this table, the data-set still relates to the mid-point of 2007. Thus, some differences will be due to change in income, expenditure and population demographics occurring between

[16] From SAMOD simulations.

these two time periods. The figures in Table 1 have been adjusted to assume take-up rates of 90% for all social grants[17].

Table 1: Comparing SAMOD simulations with actual figures (social grants)

Policy	**Number of claimants – July 2008 (actual)[18]**	**Number of claimants – July 2008 (predicted by SAMOD)**	**Total expenditure million R per annum – July 2008 (actual)[8]**	**Total expenditure million R per annum – July 2008 (predicted by SAMOD)**
Child Support Grant	8,273,859	9,337,745	19,857	23,531
Foster Child Grant	461,573	753,500	3,434	5,877
Care Dependency Grant	103,794	115,921	1,084	1,308
Disability Grant	1,416,841	1,355,917	*	14,182
Old Age Grant	2,255,471	2,327,290	*	23,598
Grant-in-Aid	39,996	32,406	96	82
Unemployment Insurance Fund	464,335	44,496	*	249

* figure could not be obtained

In Table 1, the majority of the simulated and actual figures match quite well with the exception of the Foster Child Grant and the UIF. In the case of the Foster Child Grant, as discussed previously, the simulations seek to estimate the number of potential foster children rather than the number who have actually undertaken the necessary procedures to claim a grant. For the UIF, the figure shown for the actual number of claimants relates to the number of claims made in 2006 (Meth, 2008a). As many claimants are only able to claim the grant for a short period (a month or less) it is likely that the caseload at any single point in time (as presented in the SAMOD simulations) is likely to be much smaller. Given that the Unemployment Insurance Fund currently has relatively few claimants this is not considered to be a significant problem. However, if the UIF were to be expanded in the future, there would be a need to improve how this benefit is simulated in SAMOD.

[17] Those taking up grants are randomly selected from the data.
[18] Figures for social grants obtained from South Africa Social Security Agency, July 2008

Table 2: Comparing SAMOD simulations with actual figures (direct and indirect taxation), based on policies in place in July 2008

Policy	**Revenue million R per annum (actual)[19]**	**Revenue million R per annum (estimated from SAMOD)**
Personal income tax	155,335	134,779
VAT	155,068	61,722
Excise	16,527	8,885
Fuel excise	23,938	5,202

Considering the results of the taxation simulations in Table 2, the simulated value for personal income tax is close to the actual recorded value which suggests that the income up-rating process was reasonably accurate. For the indirect taxes, there is clearly a considerable shortfall between the actual and simulated amounts. Expenditure by households does not represent the total expenditure on goods and services in South Africa. For example, the treasury VAT figure will include expenditure by overseas visitors and the fuel excise figure includes expenditure on fuel in the commercial sector. To some extent the shortfall in all the taxation figures is due to the difference in household incomes between 2007 and 2008 as 2008 policies are simulated assuming 2007 household incomes. As it is difficult to judge the extent to which the differences between the simulated and reported values are due to under-reporting of expenditure in the IES or non-household expenditure, the household expenditure data has not been adjusted upwards to improve the match between simulated and recorded indirect tax revenues.

5. Adapting EUROMOD for South Africa – technical issues and other challenges

The previous sections have discussed issues which are common when building any type of microsimulation model, namely, what sort of model is needed and how can it be best designed to simulate reality given the constraints imposed by the data available. This section considers some of the more technical challenges associated with adapting the EUROMOD platform to a different country and the issues arising due to differences between European Union countries and a developing country such as South Africa.

5.1 Adapting the EUROMOD platform for another country

In brief, the process of adapting EUROMOD for South Africa involved changing certain elements of the Excel-based front end of EUROMOD. The ways in which the EUROMOD design could be changed were limited as certain parameters could not be moved or changed. However, necessary changes such as removing all existing European countries from the model were possible. In addition, a new set of parameter files and a micro-data set were created for South Africa. These simply replaced the existing parameter files and micro-data contained within EUROMOD. It was not

[19] Figures obtained from the National Treasury Estimates of Revenue (2007-08), published in February 2008.

necessary (or possible) to make changes to the EUROMOD ‘calculation engine’ and this remains identical in EUROMOD and SAMOD.

The fact that the EUROMOD interface is built in Excel means that it is straightforward to change the overall design and look of the model. Figure 1 shows the main operating screen of SAMOD. The underlying structure of the model is identical but the design has been changed to one that is better suited to a single-country model.

It is also reasonably straightforward to amend the dialog boxes so that the captions and contents are appropriate for SAMOD (see Figure 2).

Although the design of the model can be easily adapted to a single country there are some EUROMOD features which are unnecessary in the case of a single country but which cannot be removed, for example, parameters relating to exchange rates. In addition, it is not currently possible to remove all country-specific variables from EUROMOD which results in a number of ‘unnecessary variables’ remaining in the model.

Figure 1: SAMOD main operating screen

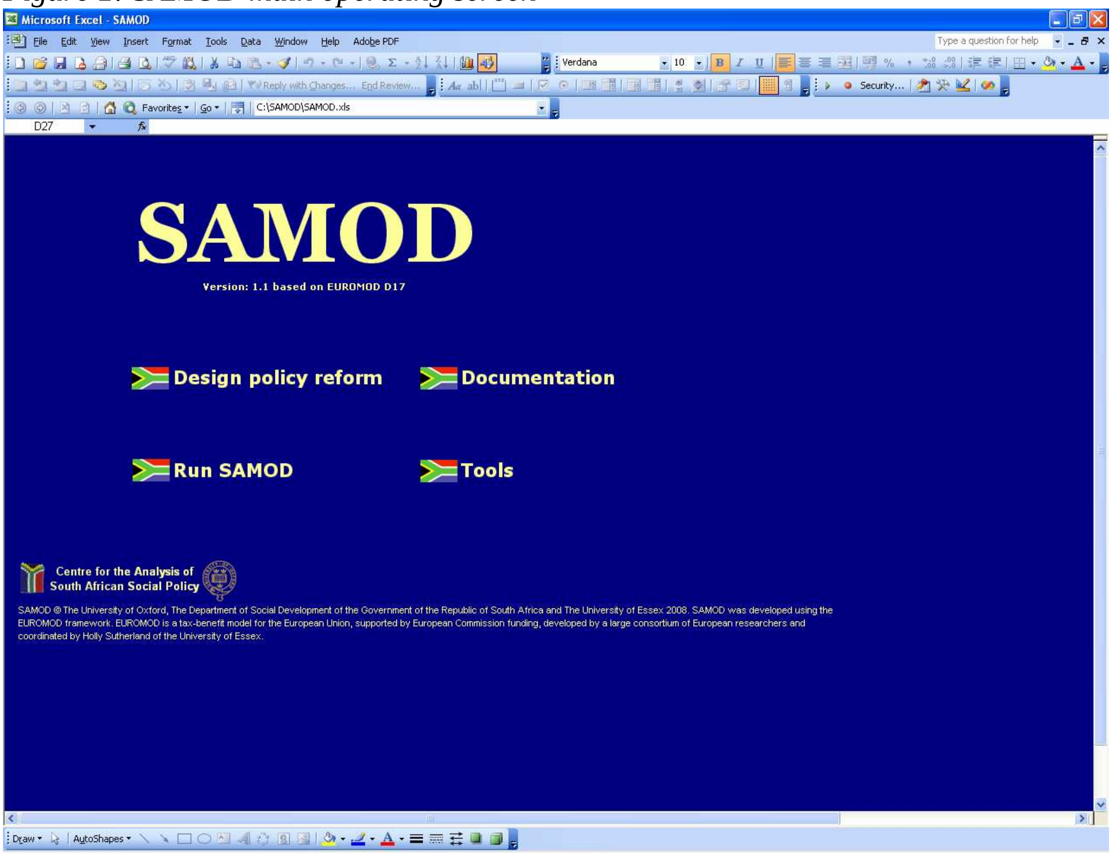
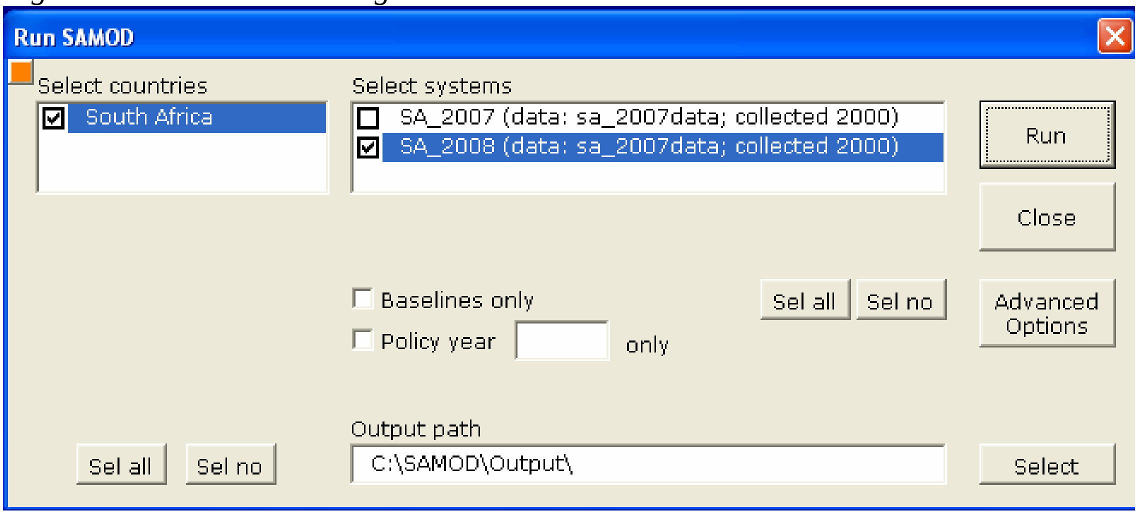


Figure 2: Run SAMOD dialog box



The fact that it is possible to add and delete variables and construct new variables following a standard naming convention is a very valuable feature of EUROMOD. Many of the variables required to model the tax and benefit system in South Africa could not be constructed from the existing acronyms[20] so new ones had to be added. However, the fact that all variables must be named following a standard convention makes the process of adding new variables straightforward and transparent to the model users.

The only part of the EUROMOD design that is not particularly suitable for a single-country model is the summary statistics tool. EUROMOD is designed to produce comparable statistics across a range of countries; however, the statistics included were not the ones of most interest for South Africa. In addition, there was a further problem in that the size of the South African data set (103,695 cases) is too large to be processed in Excel so, in fact, this tool could not be used with the South African data.

Feedback from future SAMOD users indicated that a number of tools, which could be used to quickly calculate various basic statistics (for example, the number of people entitled to receive a particular grant or the poverty headcount) would be very helpful. A number of tools were developed to present this summary information in the Stata software package. As well as being more flexible to the particular needs of the SAMOD users, these tools have the advantage that they carry out calculations much more rapidly than Excel, where it can take considerable time to process a large data-set. Of course, the drawback of developing tools in other software programmes is that users are required to have access to the software package (and some competence in using it), whereas this is not generally an issue with Excel-based tools.

[20] Acronyms are a series of one and two letter codes which are used to construct variable names in EUROMOD.

5.2 Challenges of a developing country

Family structures

Adapting EUROMOD for South Africa presented a number of challenges due to the differing nature of household structures and relationships in South Africa. In fact the household itself as a unit of analysis has been argued to be somewhat inappropriate for many individuals living in countries like South Africa (Haarman, 1999). Westernised analyses tend to treat the household as a self-contained unit and ignore its relationship with, and economic dependence on, the wider community. Certainly, it is true that many households in South Africa have different compositions from households typically seen in Europe. For example, nearly 20 per cent of households contain children, working age and old age adults[21] and many households contain multiple families. Many working age individuals are forced to migrate in search of work and this fact coupled with the incidence of HIV/AIDS means that many children are cared for by people other than their biological parents and there is an increasingly large number of child-headed households. These differences in household structures have implications for the analysis of simulated data in terms of the assumptions made about income pooling between household members. However, there are also implications for the method used to specify relationships in SAMOD.

As discussed above, relationship information is not available in the IES data with the exception of information on partners and so children were linked with carers following the application of a series of rules. In EUROMOD a child's parent would be their biological parent or legal guardian; however, given that many South African children do not live in the same household as their parents because their parents may have migrated in search of work or died, the person identified as the 'parent' in the South African data is actually the child's main carer. Fortunately policy design in South Africa has also adapted to better reflect family structures and child grants are provided to the child's main carer regardless of whether or not this person is a direct relation to the child. Thus, the variable linking parents and children can easily be used in SAMOD to link children to their carers. As there is no need, in policy terms, to identify the biological parent or the legal guardian of the child in addition to the child's 'carer', this poses no problems. However, if both the child's carer and their parent or legal guardian had to be identified in the data then this would be more difficult in the current model set up.

Child-headed households

Although child-headed households are not generally found in European countries these households actually did not present a problem for SAMOD. EUROMOD identifies the person in the household who has the largest income (or the oldest person otherwise) as the head of the household and does not impose the condition that the head of the household has to be over 18. Thus, a household head could be identified for child-headed households and the model was able to accept the presence of these households in the data-set without generating an error.

Polygamy

---

[21] From calculations on the 2007 Community Survey.

Multiple marriage is not common in South Africa but is still a phenomenon which is widespread enough to be worthy of consideration in terms of its impact on the simulations in SAMOD. It is not clear the extent to which multiple marriages were accurately or comprehensively captured in the survey data as an individual's partner could only be identified if they were physically living in the same household. However, there were some incidences where multiple women in a household were recorded as having the same partner so clearly polygamous households were captured in some cases. EUROMOD is not designed to process multiple-marriage arrangements. Individuals are linked to a partner, and their partner is likewise linked to the original individual. In other words both people must be recorded as being each other's partner in order for the model to recognise that they are a couple. Hence it is not possible for one individual to be the partner of more than one other person. This has implications for the way in which means tests are applied as these generally relate to the income of an individual and their spouse (if they have one). Thus, the means test may not be properly applied if the spouse cannot be identified due to multiple marriage. The number of cases in which this occurs is small; however, it is worth noting that multiple marriage structures cannot be recognised in SAMOD simulations.

6. Summary and conclusions

This paper has provided an overview of the construction of the South African microsimulation model (SAMOD). The need for a new microsimulation model arose due to a need in government to carry out policy simulations internally without reliance on support from outside. The model design had to be flexible so that new policies could be added and tested. In addition, the model needed to be designed so that minimal specialist software or IT expertise was required. The EUROMOD microsimulation model constructed for countries in the European Union fulfilled many of the requirements for the South African model and was selected as the base from which to develop SAMOD.

The main challenge in building SAMOD was constructing an up-to-date base micro-data set that contained all the information necessary to model the main components of tax and benefit policy in South Africa. In the end a combination of data-sets drawn from national surveys were used and various techniques employed to update the data and impute missing information.

Re-designing EUROMOD to fit the requirements of South Africa and adapting it from a multi-country to a single-country model proved to be reasonably straightforward. Given this, it would not be a major task to update SAMOD as the EUROMOD model is improved over time and new features are added.

Many of the issues that had to be considered and addressed in the development of SAMOD are ones that commonly arise in the creation of any microsimulation model, for example, where to source appropriate micro-data, how to replicate the tax and benefit system as closely as possible and how to interpret the output. However, constructing a microsimulation model for South Africa based on the European model EUORMOD presented some particular challenges due to the differing nature of social structures in South Africa. In particular, the differing nature of household and family structures cannot always be properly captured in the model simulations. These differences are not thought to have a significant impact on the model's validity.

References

Adelzadeh, A. (2005) *The South African Tax and Transfer Simulation Model (SATTSIM)* [online]. World Institute for Development Economics Research. Available from: <http://models.wider.unu.edu/africa_web/za_intro.php> [Accessed 18th June 2007].

Adelzadeh, A. (2007) *Halving poverty and unemployment in South Africa: Choices for the next ten years*, Oxfam Research Report.

Ardington, C., Lam, D., Leibbrandt, M. and Welch, M. (2005) *The Sensitivity of Estimates of Post-Apartheid Changes in South African Poverty and Inequality to Key Data Imputations*, Centre for Social Science Research, University of Cape Town.

Armstrong, P., Lekezwa, B. and Siebrits, K. (2008) *Poverty in South Africa: A profile based on recent household surveys*, Stellenbosch Economic Working Papers 04/08, Bureau for Economic Research, University of Stellenbosch.

Barnes, H. and Noble, M. (2006) *Modelling Eligibility for the Child Support Grant*, National Department of Social Development, Republic of South Africa.

Bourguignon, F. and Spadaro, A. (2006) Microsimulation as a Tool for Evaluating Redistribution Policies, *Journal of Economic Inequality*, 4 (1), 77-106.

Deaton, A. (1997) *Household surveys - a microeconometric approach to development policy*, London: The John Hopkins University Press.

Department of Social Development (2003) *Social Grants - Beneficiary Trends: Presentation to Social Development MinMec*, Department for Social Development.

Department of Social Development (2006) *Linking Social Grant Beneficiaries to Poverty Alleviation and Economic Activity*, Discussion Document.

Department of Social Development (2007) *Gaps in the System of Comprehensive Social Security and an Assessment of the Policy Options*.

Department of Social Development (2008) *Creating our shared future: Strategic considerations for a comprehensive system of social security*, Draft paper.

Department of Welfare (1997) *White Paper for Social Welfare*, Department of Welfare, Republic of South Africa.

Dorrington, R., Johnson, L. and Budlender, D. (2005) *ASSA2003 Aids and Demographic Models User Guide*, Actuarial Society of South Africa.

Haarman, C. (2000) PhD thesis. *Social assistance in South Africa: Its potential impact on poverty*, University of the Western Cape.

Haarman, D. (1999) *The Living Conditions of South Africa's Children*, Research Monograph No. 9 Applied Fiscal Research Centre.

Herault, N. (2005) *A Micro-Macro Model for South Africa: Building and Linking a Microsimulation Model to a CGE Model*, Working Paper No. 16/05, Melbourne Institute, University of Melbourne.

Hoogeveen, J. and Özler, B. (2004) Mimeo. *Not separate, not equal: Poverty and inequality in post-apartheid South Africa*, World Bank.

Leibbrandt, M., Poswell, L., Naidoo, P., Welch, M. and Woolard, I. (2005) *Measuring Recent Changes in South African Inequality and Poverty using 1996 and 2001 Census Data*, DPRU Working Paper 05/94, University of Cape Town, Development Policy Research Unit.

Lieberman, E. (2001) National political community and the politics of income taxation in Brazil and South Africa in the twentieth century. *Politics and Society*, 29 (4), 515-555.

Lietz, C. and Mantovani, D. (2006) *Lessons from building and using EUROMOD*, EUROMOD Working Paper No. EM5/06.

Meth, C. (2006) *What was the poverty headcount in 2004 and how does it compare with recent estimates by van der Berg et al?*, SALDRU Working Paper No 1, Southern African Labour and Development Research Unit, University of Cape Town.

Meth, C. (2007) *Flogging a dead horse: Attempts by van der Berg et al to measure changes in poverty and inequality*, SALDRU Working Paper Series No. 9, Southern Africa Labour and Development Research Unit, University of Cape Town.

Meth, C. (2008a) *Costing and justifying (if possible) a Workseeker's Grant*, Draft working paper.

Meth, C. (2008b) *Social income in South Africa, an economy marred by high unemployment, poverty and extreme inequality*, Version 7, Unpublished paper.

Mitton, L., Sutherland, H. and Weeks, M. Eds.(2000), *Microsimulation Modelling for Policy Analysis.* Cambridge University Press.

Noble, M., Ntshongwana, P. and Surender, R. (2008) *Attitudes to work and social security in South Africa*, Human Science Research Council.

Noble, M., Wright, G., Barnes, H., Noble, S., Ntshongwana, P., Gutierrez-Romero, R. and Avenell, D. (2005) *The Child Support Grant: A Sub-Provincial Analysis of Eligibility and Take Up in January 2005*, Take Up of Social Grants: Key Report 2, Centre for the Analysis of South African Social Policy, University of Oxford.

Samson, M., Babson, O., Haarman, C., Haarman, D., Khathi, G., Mac Quene, K. and van Niekerk, I. (2002) *Research Review on Social Security Reform and the Basic Income Grant for South Africa*, EPRI Research Report No. 31, International Labor Organisation and the Economic Policy Research Unit.

Samson, M., Lee, U., Ndlebe, A., Mac Quene, K., van Niekerk, I., Gandhi, V., Harigaya, T. and Abrahams, C. (2004) *The Social and Economic Impact of South Africa's Social Security System*, Economic Policy Research Unit.

Sanlam Employee Benefits (2008) *Annual Survey of Retirement Benefits in South Africa*, Sanlam Employee Benefits.

Sautory, O. (1993) *La macro CALMAR: Redressement d'un echantillon par calage sur marges*, Working paper no. F9310, Institut National de la Statistique et des Etudes Economiques.

Simkins, C. (2004) *What happened to the distribution of income in South Africa between 1995 and 2001?*, Unpublished paper, University of the Witwatersrand.

South African Reserve Bank (2008) *Quarterly Bulletin, March 2008*, South African Reserve Bank.

Statistics South Africa (2007a) *Consumer Price Index, July 2007*, Statistical release P0141, Statistics South Africa.

Statistics South Africa (2007b) *A national poverty line for South Africa*, Statistics South Africa and the National Treasury.

Statistics South Africa (2008a) *Income and expenditure of households 2005/06: Analysis of results*, Statistic South Africa.

Statistics South Africa (2008b) *Quarterly Labour Force Survey - Additional aspects of the labour market in South Africa: Informal employment; Underemployment and underutilised labour; Unemployment*, Statistical Release P0211.1, Statistics South Africa.

Streak, J., Yu, D. and van der Berg, S. (2008) *How invariant is South African child poverty to the choice of equivalence scale or poverty measure*, Stellenbosch Economic Working Papers 13/08, Department of Economics, University of Stellenbosch.

Surender, R., Ntshongwana, P., Noble, M. and Wright, G. (2007) *Employment and Social Security: A Qualitative Study of Attitudes towards the Labour Market and Social Grants*, Centre for the Analysis of South African Social Policy and the Department of Social Development, Republic of South Africa.

Sutherland, H. (2001) *EUROMOD: an integrated European Benefit-Tax model - Final Report*, EUROMOD working paper, EM9/01.

Sutherland, H. Ed.2005), *Micro-level analysis of the European Social Agenda: Combating poverty and social exclusion through changes in social and fiscal policy - Final Report.* EUROMOD working paper, EM8/05.

Sutherland, H., Figari, F., Lelkes, O., Levy, H., Lietz, C., Mantovani, D. and Paulus, A. (2008) *Improving the capacity and usability of EUROMOD - Final report*, EUROMOD Working Paper EM4/08.

The Taylor Committee (2002) *Transforming the Present - Protecting the Future: Report of the Committee of Inquiry into a Comprehensive System of Social Security for South Africa*.

van der Berg, S., Burger, R., Burger, R., Louw, M. and Yu, D. (2005) *Trends in poverty and inequality since the political transition*, Trade and Uneven Development: Opportunities and Challenges, 30-31 November.

van der Berg, S., Burger, R., Burger, R., Louw, M. and Yu, D. (2007) *A Series of National Accounts-Consistent Estimates of Poverty and Inequality in South Africa*, Stellenbosch Economic Working Papers, No. 09/07, Department of Economics, University of Stellenbosch.

van der Berg, S. and Louw, M. (2004) Changing Patterns of South African Income Distribution: Towards Time Series Estimates of Distribution and Poverty. *South African Journal of Economics,* 72 (3).

Whitworth, A. and Noble, M. (2008) A Safety Net without Holes: An Argument for a Comprehensive Income Security System for South Africa. *Journal of Human Development*, 9 (2), 247-263.

Wilkinson, K., Wright, G. and Noble, M. (2009) *SAMOD User's Handbook: Installing and running the South African Microsimulation Model Version 1.1 February 2009,* Centre for the Analysis of South African Social Policy.

Woolard, I. (2003) *Social assistance grants, poverty and economic growth in South Africa,* DPRU/TIPS Conference, Johannesburg 8-10 September 2003.

Woolard, I., Simkins, C., Oosthuizen, M. and Woolard, C. (2005) *Final Report - Tax Incidence Analysis for the Fiscal Incidence Study being conducted for National Treasury*.