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Introducing PITMOD – a microsimulation model of South Africa's personal income tax rules

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WIDER BACKGROUND NOTE

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Abstract: Static tax-benefit microsimulation models are used to analyse the direct impact of taxes and benefits on household incomes. With the emergence of tax-benefit microsimulation modelling, a range of policy scenarios can be modelled, alongside their impacts on government revenues, poverty levels, and inequality. A tax-benefit microsimulation model for South Africa called SAMOD was built in the 1990s with nationally representative survey data and was the first example of the EUROMOD microsimulation software being used in a Global South country context. A new model known as PITMOD now complements SAMOD. PITMOD is built with the narrower purpose of simulating changes to personal income tax for South Africa. One of PITMOD's special features is that it uses administrative data about individual incomes registered with SARS, rather than survey data, in the underpinning datasets.

Key words: tax-benefit microsimulation, personal income tax, administrative data, household income, South Africa

JEL classification: C63, C81, D31, H24

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Over 60 years ago, Guy Orcutt (1957) and colleagues pioneered the use of microsimulation models in the social sciences to analyse the impact of social and economic policies. Although computational and data constraints initially hampered progress, these barriers were overcome and microsimulation modelling became increasingly sophisticated and diverse (Harding and Zaidi 2009).

Static tax-benefit microsimulation models are used to analyse the direct impact of taxes and benefits on household incomes. They are referred to as 'static' as the socio-demographic characteristics of the micro-units are assumed to be fixed over time. They assess the 'next day' effect of policy changes, or the impact before individuals might adapt their behaviour to the policy change.

Tax-benefit microsimulation models are a critical item in the policymaker toolbox

Such models date back to the 1980s, when microdata from household surveys and accessible computing power became available. Today, static modelling is more widespread and refined due to developments in several areas, including data availability, methodology, computing capacity, and policymaker demand (Figari et al. 2014).

Prior to the emergence of tax-benefit microsimulation modelling, analysis of the effects of taxes and benefits on household income was restricted to 'model family' calculations for stylised households (Figari et al. 2014). Although useful for understanding policy impacts in certain standardized cases, such analysis reveals little about the impact on the income distribution. With tax-benefit microsimulation models, a range of policy scenarios can be modelled alongside their impacts on government revenues, poverty levels, and inequality.

Tax-benefit microsimulation models are used extensively in high-income countries to analyse tax and social transfer policy and they are increasingly being put to use in other country contexts by researchers and policymakers. An important example is EUROMOD, the pioneering European Union tax-benefit microsimulation model (Sutherland and Figari 2013). It has undergone continual refinement since its conception in 1996 and is widely used in policy-relevant research. The EUROMOD approach was subsequently adopted in many countries outside the European Union.

Tax-benefit microsimulation models are useful for examining both the status quo and the impact of policy reforms. Reforms of the tax system are often necessary. They support, for example, financing of social protection or other critical programmes, crisis response using tax policy measures, how most countries responded to COVID-19, or more broadly, improving the progressivity or the simplicity of the tax system. Microsimulation models are therefore a useful tool for estimating and understanding the financial and distributional impacts of reform options.

Modelling personal income tax rules

Personal income tax (PIT) is a key source of tax revenue in many countries. This background note focuses specifically on South Africa, where PIT is 35.5% of all tax revenue collected in 2022 (National Treasury and SARS 2022). It is important to understand the profile of personal income taxpayers and the distributional impact of the PIT rules. Without such information, it is difficult to justify changing policy rules or to estimate the impacts of proposals.

Microsimulation models combine details about PIT legislation with a representative sample or full dataset comprising information about the number and incomes of individuals. A tax-benefit microsimulation model for South Africa called SAMOD was built in the 1990s with nationally representative survey data (Wright and Mpike 2021). It was the first example of the EUROMOD microsimulation software being used in a Global South country context. The software proved to be eminently flexible and suitable for the South African context (Wilkinson 2009) and SAMOD is still maintained and updated by Southern African Social Policy Research Insights (SASPRI) (see Wright et al. 2016b).[1]

A new model known as PITMOD (Steyn et al. 2021) emerged from and complements SAMOD and is a joint endeavour by members of the South African Revenue Service (SARS) and SASPRI, as part of the Southern Africa – Towards Inclusive Economic Development (SA-TIED) programme, which is a collaboration between UNU-WIDER, the South African National Treasury, SARS, other universities and institutes, and is funded by the National Treasury, the Delegation of the European Union to South Africa, and UNU-WIDER through the institute's contributions from Finland, Sweden, and the United Kingdom to its research programme.

Also based on the EUROMOD platform, PITMOD is built with the narrower purpose of simulating PIT for South Africa. One of PITMOD's special features is that it uses administrative data about individuals registered with SARS, rather than survey data, in the underpinning datasets. Surveys are prone to income measurement issues, often underestimating the incomes of higher income respondents. They also do not contain the detail on different income sources which is required for simulating intricate tax rules.

PITMOD is enabled by increased access to administrative data

The recent increase in the availability of administrative tax data has resulted in a growing interest internationally in the use of administrative data for PIT analysis. Examples of countries with PIT models (based on EUROMOD) that are underpinned by administrative data include Belgium (Verbist, and Van Mechelen 2019) and Greece (Leventi et al. 2013). Examples of PIT models that are underpinned wholly or partially by administrative data (but which do not use the EUROMOD software) include France (Ben Jelloul et al. 2019), Germany (Flory and Stöwhase 2013), Italy (Miola and Manzo 2021), and Spain (Bover et al. 2017). PITMOD is the first model to use the EUROMOD software with administrative data in a Global South country.

Access to South African administrative data for research and policy purposes increased prior to the development of PITMOD, albeit on a limited basis, with several studies making use of administrative data on income tax. More recently, the National Treasury Secure Data Facility opened to provide researchers with access to partially anonymized tax data for research purposes, including an individual panel of taxpayers (Ebrahim and Axelson 2019). South Africa is one of only a handful of countries worldwide to permit access to this type of data for research purposes.

[1] Subsequent examples include NAMOD (see Wright et al. 2014), a tax-benefit microsimulation model for Namibia (since updated, see Wright et al. 2016a) and UNU-WIDER's SOUTHMOD project, which now has a suite of tax-benefit microsimulation models for selected Global South countries.

UNU-WIDER provided staff, expertise, and resources to the development of the secure data facility at the National Treasury and the results are a key contribution of the SA-TIED programme to South Africa's ability to conduct policy-relevant research.

What is PITMOD?

PITMOD is a microsimulation model which simulates PIT in South Africa using anonymized individual level administrative records supplied by SARS and a version of it will be housed at the secure data facility. The specially constructed underpinning datasets combine administrative data about individuals from two separate data systems—IRP5/IT3a tax certificates and ITR12 tax returns including assessed tax returns—supplemented with third party information on medical aid scheme contributions.[2]

The administrative data contains the fine-grained details about incomes that are necessary to simulate South Africa's PIT rules in detail. For each individual, information is harnessed about salaries and wages, allowances, fringe benefits, overtime, bonuses, pensions, annuities, relevant business and farming income, interest, dividends, capital gains, rental income and other income. PITMOD applies the PIT rules to the individuals in the detailed administrative dataset to calculate each individual's tax liability. The output dataset can then be analysed with the PITMOD Summary Statistics tool—a specially designed tool that accompanies the model—to produce summary PIT statistics in table and chart formats. The baseline outcome can be compared to simulated policy changes in terms of revenue outcomes and distributional gains or losses.

PIT rules change over time, so PITMOD has a separate set of rules and a separate underpinning dataset for each tax year. Currently, PITMOD simulates the rules for the 2018, 2019, and 2020 tax years, with later years in the process of being incorporated.

Models that use the EUROMOD software are usually underpinned by survey data, but they can also accommodate large administrative datasets. PITMOD's full datasets contain one record per individual and comprise approximately 15 million individuals for each tax year. In addition, 10% and 1% samples of the full datasets have been created which enable PITMOD to run more quickly on smaller datasets while still generating nationally representative results.

What does PITMOD do?

PITMOD simulates the main features of South Africa's PIT rules, including:

- Relevant income from employment (employee, business, and farming)
- Taxable interest, dividends, capital gains, and rental income
- Retirement contribution deductions

[2] IRP5/IT3a is the employee tax certificate submitted by the employer on behalf of the employee. ITR12 is the personal income tax return for individuals with employee income over a specified threshold, or individuals who work for more than one employer during the given tax year, or individuals with additional non-employment income, allowances or tax-related deductions or rebates not taken into account in the IRP5/IT3a employer return, or not otherwise exempt, or taxpayers who are not employees and are not part of the pay-as-you-earn system.

- Other deductions (including travel claim against allowance, employer-provided vehicle, donations allowable in terms of Section 18A of the Income Tax Act, subsistence allowances, depreciation, home office expenses, travel expenses, refunds, exemptions for interest, allowable accountancy fees, legal costs, bad and doubtful debt, losses, and holders of a public office)
- The tax schedule, comprising a different marginal rate of tax for different bands of taxable income
- Primary, secondary, and tertiary tax rebates
- Medical Scheme Fees Tax Credit and Additional Medical Expenses Tax Credit
- Tax on lump sums (retirement, severance, and withdrawal)

As well as simulating the PIT rules for each year, users can adjust those tax rules in the model to explore reform scenarios. Given the fine level of detail about incomes in the datasets, many reform options can be analysed with PITMOD.

PITMOD's population of interest is all individuals and trusts that are registered with SARS. It includes information on those submitting tax returns for assessment and those who pay tax through the PAYE system but who are not required to submit a tax return. It also contains information on employees whose income is below the minimum tax thresholds and for whom no tax is deducted through PAYE. PITMOD's dataset therefore includes registered individuals and trusts with incomes below and above the minimum tax thresholds, whether they are earning employee income, passive income, or foreign income, and/or receiving a monthly pension income.

The PITMOD Summary Statistics (PSS) tool accompanies the full model. The PSS tool automatically produces a set of tables and charts based on the output of the PITMOD microsimulation model. Although the tool is written in Python, the user does not need knowledge of the software to use the tool.

The tables and charts generated by the PSS tool were identified by SARS as being most relevant for tax practitioners and researchers. They summarize the most important aspects of the PIT system—a fiscal overview of income sources and government revenues, including various sources of income, deductions claimed, tax credits applied, and calculation of final tax liability; the distribution of taxable income and tax liability by income groups, age, and gender; the average tax liability and tax rates by income groups, age, and gender; income composition by income groups; and Gini coefficients by income concepts and tax elements. The tool allows for comparisons between a particular tax year and a reform scenario based on that tax year, and results can be produced at the national and/or provincial level.

Why is PITMOD useful?

PITMOD is a valuable policy research tool to simulate reforms to the PIT system such as changes to marginal tax rates, income brackets, minimum tax thresholds, inflationary adjustments for fiscal drag or bracket creep. Moreover, changes to the taxable income base such as the taxation of foreign income, capital gains, exemption of interest income, changes to the deductions of contributions to retirement income, plus monetary adjustments to medical tax credits, can all be simulated separately or in combination to determine the impact on taxable income and tax liability in total and by income group.

PITMOD is equally important for tax administration purposes. For instance, insight, knowledge, and understanding of the importance of the various sources of income—such as the number of taxpayers receiving employee income versus business income, and the distribution of that income—can guide tax administration efforts to optimize the use of resources and to strategically determine risks to revenue collection. The impact of tax policy reform measures on taxpayer behaviour can be monitored and assessed, including the impact on the accuracy of income declarations by taxpayers after, for example, an increase in the top marginal tax rate or a change in deductions claimed after a deduction policy change.

PITMOD enables more effective tax policy formulation in terms of stated taxation goals and higher efficiency outcomes in the administration of taxes to assist in the collection of revenues due.

Quality assurance and data cleaning steps in data preparation provide feedback loops for SARS and are being incorporated within SARS' main quality assurance procedures.

What are the limitations of PITMOD?

Although PITMOD is a valuable tool for both policy research and administration purposes, there are certain limitations to the model.

Certain policy rules cannot be simulated in PITMOD. Although tax on lump sums is included in the model, it has not been possible to identify appropriate source codes to enable the policy to be simulated accurately. It was therefore decided to use the administrative data variable relating to tax paid on lump sums. Regarding rental income, given the complexities of multiple property ownership and varying partnership splits, as well as ring-fencing of income, it was decided to use the assessed value from the administrative data. Finally, foreign tax credits are only partially included in the model. There is relief from double taxation on foreign income (imposition of taxes in a foreign country and in South Africa) in the form of rebates and/or deductions; the latter are included, but the rebate could not be satisfactorily modelled. As all these policy rules cannot be simulated, any reforms involving these elements can also not be examined.

Findings are restricted to individuals and trusts registered with SARS. As the data underpinning PITMOD includes only registered individuals, any findings using PITMOD are restricted to that subset of the population, which excludes non-compliant taxpayers and individuals who are not on the SARS registry for other reasons. To shed light on the entire income distribution in South Africa, it is necessary to use nationally representative survey data, such as the data that underpins SAMOD. Nevertheless, PITMOD has the advantage of capturing the upper part of the income distribution better than is possible using survey data.

Behavioural response assumptions are not usually possible. PITMOD is a static model which means that it calculates the next-day financial impact of hypothetical reforms and usually does not build in a behavioural response assumption, although that is possible in some instances.

Who can use PITMOD?

The primary user of PITMOD is SARS—the custodian of the data. Training for SARS and National Treasury staff took place in February 2023, and an online training course has been prepared for users at the National Treasury Secure Data Facility. SARS plans to share the

PITMOD model with various units including the legal division and regional offices. In the future, there is a plan to expand the use of PITMOD by locating a version of the model in the National Treasury Secure Data Facility.

How can I find out more about PITMOD?

The User Manual for PITMOD contains a detailed explanation of the model and the construction of the input dataset.

For more information about PITMOD, please contact: sarsmedia@sars.gov.za.

Conclusion

The development of PITMOD has been an important initiative in South Africa for research and policy efforts. Building on this experience, similar models could be developed for other taxes—such as for corporate income tax—using the common platform of the EUROMOD microsimulation software. It is also recommended that other countries in the region develop models similar to South Africa's PITMOD, to make better use of their rich administrative tax data. Such research tools enhance the capacity of researchers and policymakers alike to deepen their understanding of the tax system and explore policy reform options that are tailored to their particular context.

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