

USING THE GAUSS ENGINE TO MODEL AFRICAN ECONOMIES

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Version 6 of GAUSS Engine has recently been used to develop Tax Benefit models of African countries in a project coordinated by the World Institute for Development Research (WIDER; part of the United Nations University)¹ and funded by the Swedish International Development Cooperation Agency (Sida)² and the UK Department for International Development³. Five countries were involved: Cameroon, Uganda, Nigeria, Botswana and South Africa; work is now underway to extend the project to a further seven.

The resulting models have been web enabled and are available for all of you to experiment with. Just go to the following address: http://models.wider.unu.edu/africa_web

Tax Benefit Models are used to calculate the effects of changes to tax policies (for example increasing income taxes, cutting VAT, or changing pensions) on the country's population. They answer questions such as:

- Which kinds of family gain or lose?
- What is the effect on numbers in poverty or the level of inequality?
- What is the cost to the Government of the proposed changes?

To do this, the models use survey data on a representative sample of a country's households; they run through each household in the survey, calculate the detailed effects of the proposed changes, and then aggregate the results.

These models are amongst the first built for African Countries. Just as important to the project as the models themselves, however, was to develop modeling skills within the countries themselves; as such, the models were all produced by teams from the within the countries, with guidance and coordination from WIDER. Teams from the following institutions worked on the project:

- Applied Development Research Solutions (ADRS) (South Africa/USA)
- National Center for Economic Management and Administration (Nigeria)⁴
- Botswana Institute for Development Policy Analysis⁵
- University of Yaoundé II (Cameroon)⁶
- Economic Policy Research Centre (EPRC) (Uganda)⁷

Dr Asghar Adelzadh⁸ of ADRS and WIDER took the coordinating role.

All the models are written in GAUSS. It was clearly important that a single language was used, so code could be shared between groups and a common set of skills developed. GAUSS was chosen because of its excellent data handling abilities, the large number of statistical facilities available, and because it was already widely used in the economics community, including lead developer Dr. Adelzadh. The models were developed using GAUSS 6.0 for Windows. The largest and most

¹ <http://www.wider.unu.edu>

² <http://www.sida.se>

³ <http://www.dfid.gov.uk>

⁴ <http://www.ncema.gov.ng>

⁵ <http://www.bidpa.bw>

⁶ <http://www.uninet.cm>

⁷ <http://www.eprc.or.ug>

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comprehensive of them is the South African which models a wide range of direct and indirect taxes and state benefits; in all it has around 60,000 lines of code. The other models are slightly less complex, in large part because the country's fiscal systems are simpler than South Africa's.

The Web interface to these models was developed by the author, and Keri Christian of DBG, Inc.⁹ Web Enabling these models posed several challenges. The models have large datasets: this makes them relatively slow for a Web application – usually web users expect an almost instantaneous response from pressing a “submit” button, and we couldn't always offer this here. Further, quite a lot of surgery had to be carried out on the models to allow input and output in a form that a Web application could cope with. The live site uses the compiled versions of the models and GAUSS Engine 6.0. These are wrapped in small programs written in C which handle basic input and output to and from the web interface.

In turn, the web interface is written in the PHP language¹⁰. This handles:

- parsing and validating user input;
- invoking the GAUSS models and monitoring their progress;
- collecting and formatting the output; and
- housekeeping chores like maintaining a database of users and generating user statistics.

In addition, a queuing system was developed – this is a little like the batch queues the more experienced GAUSS developments amongst us might be familiar with from 1970s and 80s Mainframes. Jobs likely to take a long time are submitted to this rather than run directly, and code was written to allow users to either monitor the progress of their job on-line, or receive notification of its completion by email.

So, with the next phase of the project already underway, within a year there will be skilled GAUSS and Tax Benefit model developers across much of Africa.

⁹ keri@dbg-inc.com

¹⁰ <http://www.php.net>