SOUTHMOD

Technical note

Integration of indirect taxation to GHAMOD

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1   Introduction

Indirect taxes are an important component of tax systems across the world. In developing countries, the share of tax receipts through indirect taxes such as value-added tax (VAT) has seen a pronounced increase at the expense of the revenue share of trade tax in the last decades. Therefore, modelling indirect taxes coherently and transparently in tax-benefit microsimulation models is key.

This technical note illustrates how indirect taxes, specifically VAT and excise taxes, are dealt with in the context of GHAMOD, a tax-benefit microsimulation model for Ghana. GHAMOD is based on the EUROMOD software and the built-in Statistics Presenter Tool supports simple analyses of ex ante policy (reform) on distributional outcomes. GHAMOD has been developed in the context of the SOUTHMOD project under which tax-benefit microsimulation models have been developed and are maintained for a set of developing countries.[1] The approach chosen for GHAMOD will in the future also be reflected in other country models under the SOUTHMOD umbrella. The models are available free of charge for non-commercial research purposes by researchers, government officials, and the interested public.

The implementation of indirect taxation in GHAMOD needs to address how changes of the indirect tax burden affect poverty and inequality. Different approaches imply different assumptions and implementation regarding, for example, whether poverty and inequality are based on consumption or disposable income. At the same time GHAMOD offers simple and efficient options to modify existing indirect tax policies and implement reform scenarios. Given the often complex and highly fine-grained distinction of goods and services subject to full, reduced, or no indirect tax in many countries, a concise presentation of different goods and services in relevant groupings is necessary.

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[1] Countries include: Ghana, Ecuador, Ethiopia, Mozambique, Tanzania (mainland), Uganda, Vietnam, Zambia. Existing models for Namibia and South Africa were updated.

This technical note is based on GHAMOD v1.5. Screenshots and results are shown for 2013 which is currently the latest available year of the underlying survey, the Ghana Living Standards Survey (GLSS).

This note will first set out how expenditure data are introduced into the model in a way that allows easy composition of alternative lists of expenditure items subject to VAT and/or excises (or not) using the example of Ghana and GHAMOD (Section 2). Section 3 shows how the VAT and excise taxes of Ghana are implemented in GHAMOD. Section 4 presents the respective choices the user can make when running the Statistics Presenter Tool in GHAMOD.

2   Introduction of expenditure items to the model

The various expenditure items are introduced to the model according to the Classification of Individual Consumption by Purpose (COICOP). Thirteen income lists collect expenditure items in the respective COICOP lists for individual consumption expenditure at the household level (Figure 1). Income lists are named according to the aggregate they refer to *ils_vat_coicop01* to *ils_vat_coicop13*.

Figure 1: COICOP lists for individual consumption expenditure at the household level in GHAMOD

ildef_exp_gh	on	DEF: EXPENDITURE INCOME LISTS (COICOP)
Defll	on	COICOP 01
Defll	on	COICOP 02
Defll	on	COICOP 03
Defll	on	COICOP 04
Defll	on	COICOP 05
Defll	on	COICOP 06
Defll	on	COICOP 07
Defll	on	COICOP 08
Defll	on	COICOP 09
Defll	on	COICOP 10
Defll	on	COICOP 11
Defll	on	COICOP 12
Defll	on	COICOP 13

Source: see text.

Each COICOP list is then composed by all the respective goods and services that fall into this group; (see Figure 2 for an example of a selection of goods that are part of COICOP 01 income list).

Figure 2: Excerpt of income list il_vat_coicop01 that collects expenditures included in the COICOP 01 income list in GHAMOD

DefIl	on	COICOP 01
Name	ils_coicop01	Expenditure Food and Non-alcoholic Beverages
x0111101	+	Expenditure on guinea corn/sorghum
x0111102	+	Expenditure on maize
x0111103	+	Expenditure on millet
x0111104	+	Expenditure on rice-local
x0111105	+	Expenditure on rice-imported
x0111106	+	Expenditure on other cereals
x0111301	+	Expenditure on bread sugar bread

The goods and services subject to the current VAT policy are in turn collected in the income list *ils_vat_std* (see Figure 3).

Figure 3: Excerpt of income list *ils_vat_std* that collects goods and services subject to standard VAT rates in GHAMOD

DefIl	on	Taxed Expenditure Items
Name	ils_vat_std	Standard Rated Items
x0111105	+	Expenditure on rice-imported
x0111303	+	Expenditure on Biscuits
x0111902	+	Expenditure on Baby Food (cerelac etc.)
x0113302	+	Expenditure on fish(canned)
x0112201	+	Expenditure on Corned Beef
x0114102	+	Expenditure on Milk(powder)

If a user wants to modify the list of expenditures subject to VAT, they can thus simply add an item to income list *ils_vat_std* or take an item out. Should the hypothetical reform be of a larger size, they can simply compose *ils_vat_std* using the COICOP based income lists and adding or taking out specific items that shall or shall not be subject to the hypothetical reform VAT policy.

3   Modelling of VAT and excise policies

In this section we present a quick and easy way to modelling indirect taxes. This is underpinned theoretically by De Agostini et al. (2017). Two approaches allow consistent modelling. The first approach assumes that households consume a fixed share of their disposable income (constant budget shares) whereas the second approach assumes that households consume a fixed quantity of goods and services, irrespective of the consumer price (constant quantities). Both methods require observed information or data on expenditures.

In GHAMOD we model indirect taxes using the constant budget shares approach. We assume that a household always spends the same share of its budget on a certain commodity or service, irrespective of increases or decreases in its overall budget. In case of a reform scenario that changes the budget available to the household, the absolute expenditure on a good and service thus is scaled proportionally to the budget change.

Let E^{obs} denote the household's observed budget, $\omega_k{}^{obs}$ the expenditure share spent on goods or services k, x_k^{obs} the observed expenditure on goods or services k, ils_dispy^{obs} the observed income and ils_dispy the new disposable income under the reform scenario at the household level. Under the assumption of constant budget shares, expenditure on commodity k, (e_k) can be written as:

$$e_k = \frac{ils\_dispy}{ils\_disp^{obs}} \omega_k^{obs} E^{obs} = \frac{ils\_dispy}{ils\_disp^{obs}} x_k^{obs} \qquad (1)$$

At the aggregate level this entails that total expenditures, E, equal the observed total expenditures multiplied by the growth in disposable income with respect to the observed disposable income.

When practically implementing this approach in a developing country context, we have to deal with the fact that many households, even after imputing the monetary value of own produce, have zero or very low incomes. Therefore, we replace disposable income by expenditure in formula (1), after which it reads:

$$e_k = \frac{ils\_con}{xhh^{obs}} \omega_k^{obs} E^{obs} = \frac{ils\_xhh\_s}{xhh^{obs}} x_k^{obs} \qquad (2)$$

where xhh^{obs} is the observed expenditure in the base year and *ils_con* captures the household's expenditure possibilities under a reform scenario. This concept is also referred to as 'simulated consumption', and assumes that a hypothetical benefit (tax) adds to (reduces) household consumption by the same amount.[2]

Similar to the case of disposable income this adjustment implies that the newly simulated expenditure on each good equals the observed expenditure multiplied by the overall rate of expenditure growth, captured by $\frac{ils\_con}{xhh^{obs}}$.

We can then deduce indirect taxes (T_k) given these new expenditures as $T_k \equiv \frac{\tau_k}{1+\tau_k} e_k$. Moreover, specific values for value-added taxes T_k^t, specific excises T_k^a and ad valorem excises T_k^v can equally be calculated as follows:

$$T_k^t \equiv \frac{t_k}{1+t_k} e_k$$
$$T_k^v \equiv v_k e_k$$
$$T_k^a \equiv \frac{a_k}{q_k} e_k$$

where t_k is the VAT rate applicable for good k, v_k is the ad valorem rate, a_k the excise, and q_k the consumer price (in the survey year). In the practical implementation in GHAMOD, this requires stripping off taxes from expenditures as recorded in the survey in the input data for the model, thus basically generating expenditures valued at producer prices.

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[2] Refer to the SOUTHMOD modelling conventions (available from the authors upon request) for more details on the definition of the *ils_con*.

Practically, for modelling VAT for example, we gather from the previous section the different goods and services subject to the current VAT policy in the income list *ils_vat_std* (see Figure 3). We slightly rewrite equation (2) using the notation the names of the of variables used in GHAMOD model after we have defined our constant VAT rate ($VAT_rate) before applying it to income list *ils_vat_std*. We collect all simulated VAT into our output variable as tva01_s (see Figure 4).

Figure 4: Excerpt of VAT calculation based on consumption expenditure

▾ ● vat_gh		on	**TAX: Value-Added Tax**
▸ *fx* DefIl		on	Taxed Expenditure Items
▾ *fx* DefConst		on	VAT rates
$VAT_rate		0.125	VAT rate
▾ *fx* ArithOp		on	Calculate total VAT paid (constant expenditure shares)
Formula		ils_vat_std*ils_con/xhh*$VAT_rate	Calculate the amount of VAT
Output_Var		tva01_s	Amount paid in VAT
TAX_UNIT		tu_household_gh	

Source: see text.

In modelling excise taxes, a similar approach is adopted. Input data for excisable goods are prepared by stripping off excise taxes (and if applicable also other indirect taxes) and calculating where necessary quantities in the input data (variables starting with the letter *q*).

In Ghana excisable goods are not subject to VAT and excise duties on alcohol and most tobacco products are ad valorem, whereas excise duties on petroleum products are per litre. Figure 5 shows the modelling of ad valorem excise duties regarding spirits and Figure 6 the modelling of per litre excise duties for petrol. Excise duties simulated for all goods subject to excise duties are then collected in the end of the policy (not shown in the Figures for brevity).

Figure 5: Excerpt of modelling of simulation of ad valorem excise tax on spirits in GHAMOD

▾ *fx* DefConst			on	Excise rate
	$AdVal_rate01	1	0.25	Excise rate for Spirits
	$AdVal_rate02	2	0.20	Excise rate for Akpeteshie
	$AdVal_rate03	3	0.225	Excise rate for Wine
	$AdVal_rate04	4	0.475	Excise rate for Imported Beer
	$AdVal_rate05	5	0.10	Excise rate for Local Beer
	$AdVal_rate06	6	1.50	Excise rate for Cigarrette/Cigar
	$AdVal_rate07	7	1.7065	Excise rate for Tobacco
	$petrol_ed_rate_per_litre	8	0.2193	Excise Duty Rate for Petrol (per litre)
	$diesel_ed_rate_per_litre	9	0.1325	Excise Duty Rate for Diesel (per litre)
	$kerosene_ed_rate_per_litre	10	-0.0371	Excise Duty Rate for Kerosene (per litre)
	$lpg_ed_rate_per_litre	11	0	Excise Duty Rate for LPG (per litre)
▾ *fx* ArithOp			on	Calculate excise duty on Spirits-Ad Valorem (constant expenditures shares)
	Formula		ils_con/xhh * (x021101 + x021102 + x021104) * $AdVal_rate01	Duty on Spirits in GHS
	Output_Var		tvl01_s	Exsice paid on Spirits
	TAX_UNIT		tu_household_gh	

Source: see text.

Figure 6: Excerpt of modelling of simulation of per liter excise duty on petrol in GHAMOD

fx ArithOp		on	Calculate excise duty on Petrol
Formula		(ils_con/xhh * q0722201 * $petrol_ed_rate_per_litre)	Quantity of Petrol*duty rate in GHS
Output_Var		texsx01_s	Exsice paid on Petrol
TAX_UNIT		tu_household_gh	

Source: see text.

3   Implementation in the Statistics Presenter tool

The Statistics Presenter tool calculates poverty and inequality measures on the basis of either simulated consumption or simulated disposable income by comparing households' consumption or income to the poverty line. When not considering indirect tax the poverty line is inflated by the CPI and it is based on tax-inclusive consumption. Statistics Presenter also allows the user to compute the so-called post-fiscal concepts of disposable income and consumption. 'Post-fiscal' refers to income or consumption minus indirect taxes in this context.

To deduce the corresponding poverty line net of indirect taxes, the monetary value of simulated indirect taxes by households close to the poverty line (+/- 2.5%) is subtracted from the official poverty line. This is done outside of the model based on simulation results for the base year. Then, poverty and inequality numbers are calculated for post-fiscal income (or simulated consumption) using the new, lower, poverty line, denoted in the model as *splpf*. The household is poor, considering indirect taxes, if its disposable income or simulated consumption minus indirect tax payments fall below the new poverty line, *splpf*.

Based on expenditure, using the notation of the model, the household is poor, if its adult-equivalent consumption lies below the poverty line net of indirect taxes (*splpf*):

$$ils\_con\_pf = ils\_con - ils\_taxind < splpf,$$

where *ils_taxind* is an income list comprised of the household's indirect tax payments. In the case of income-based welfare measures, one compares $ils_{dispy_{pf}} = ils_{dispy} - ils_{taxind}$ with the post-fiscal poverty line *splpf*. Similarly, inequality indices are also computed in the space of post-fiscal income or consumption, *ils_dispy_pf or ils_con_pf*.

When opening the Statistics Presenter in practice the user thus first has to choose between compiling results for one scenario ('SOUTHMOD Statistics – Default') or for comparing scenarios ('SOUTHMOD Statistics – Baseline/Reform'); see Figure 7. After this initial choice the user is next prompted to choose between poverty and inequality results based on consumption or income and taking into account indirect tax (post-fiscal concept) or not.

Figure 7: Excerpt of SOUTHMOD Statistics Presenter
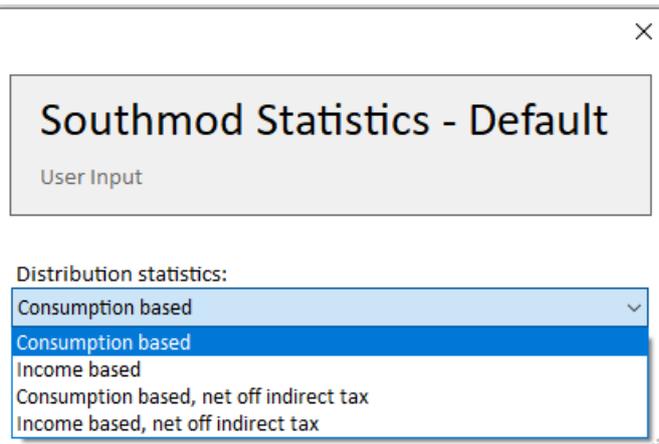
Source: see text.

References

De Agostini, P., B. Capéau, A. Decoster, F. Figari, J. Kneeshaw, C. Leventi, K. Manios, A. Paulus, H. Sutherland and T. Vanheukelom (2017). EUROMOD Extension to Indirect Taxation: Final Report, EUROMOD Technical Note EMTN 3.0, Colchester: Institute for Social and Economic Research, University of Essex.