Microsimulation of indirect taxes*

André Decoster[1], Jason Loughrey[2], Cathal O'Donoghue[2], Dirk Verwerft[1]

May, 14th 2009

Abstract: In most cases microsimulation methods are used to create ex ante evaluations of reforms in the personal income tax system or in social security contributions and benefits. This paper reports on an incorporation of expenditure data and indirect taxes, mainly VAT, excises and other consumption taxes, in the EUROMOD-framework. Imputed expenditures are used to simulate a decrease of social security contributions compensated by a rise in standard VAT rate to maintain government budget neutrality.

I. INTRODUCTION

The inclusion of indirect taxes in microsimulation models (MSM), the tools par excellence for assessing the distributional impact of policy instruments, is far from widely spread. The prominent role of the indirect tax instrument (see figure 1 and 2) stands in sharp contrast with the poor attention it got within the microsimulation community. Most MSM's have focussed on the arithmetic micromodelling of personal income taxes, social security contributions and benefits; not indirect taxes. This is not due to an insufficient theoretical basis to analyze indirect taxation. Both indirect taxation and the direct-indirect tax mix have figured prominently in theoretical public finance research[3]. Neither can it be caused by the complexity of the indirect tax legislation. Compared with the complexity of direct tax legislation, indirect taxes are relatively simple systems. Hence, the reason must be found elsewhere.

---

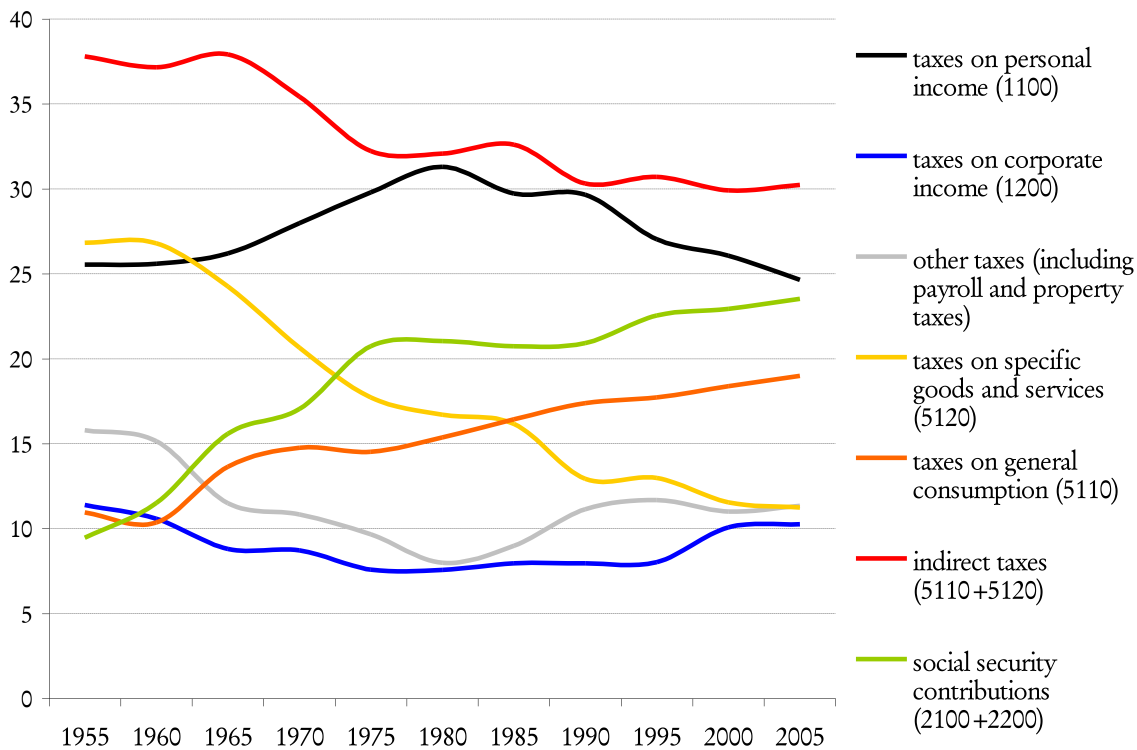
* This research was carried out in the context of the AIM-AP-project: Accurate Income Measurement for the Assessment of Public Policies (AIM-AP) – FP6 Contract no 028412.

1 University of Leuven

2 Rural Economy Research Centre, Teagasc

3 Besides Atkinson and Stiglitz (1980) which, even after more than 25 years, is still the reference to start with when studying the topic, see, among many others, Ahmad and Stern (1984), Boadway and Pestieau (2003) and Auerbach (2006) for recent theoretical contributions on the direct-indirect tax mix.

FIGURE 1 : SHARE OF DIFFERENT COMPONENTS OF GOVERNMENT REVENUE
OECD 1955-2005

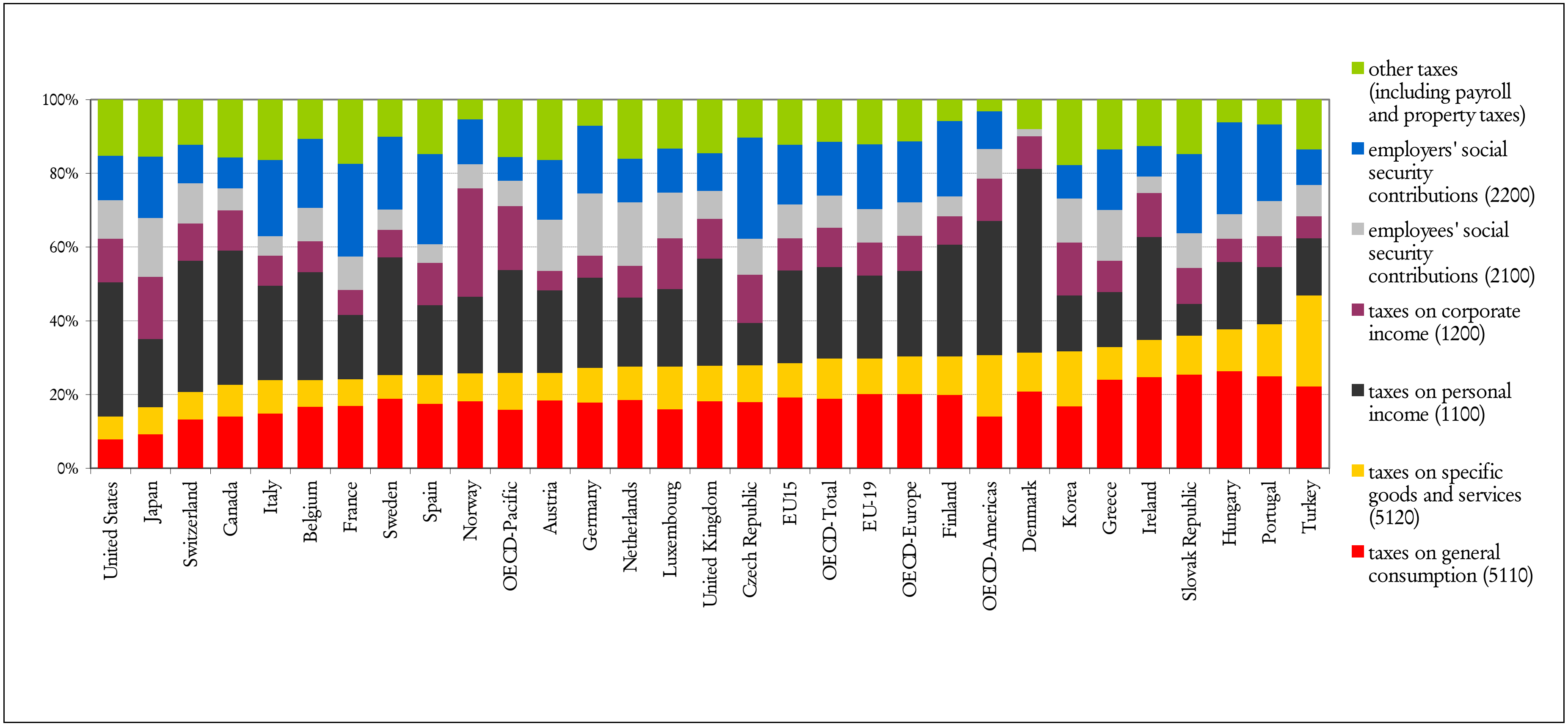


Indeed, the basic reason for the omission of indirect taxes in standard MSM-modelling is of a practical nature: often the micro level income datasets used in tax benefit microsimulation do not contain information on expenditures which is detailed enough to calculate indirect tax liabilities with sufficient precision. So, either, one designs a separate indirect tax micro-simulation model, running on e.g. a budget survey dataset. Or, and this is the strategy adopted in this paper, one imputes expenditure information in the income data set. In practice, we have been able to use budget surveys of five countries (Belgium, Greece, Hungary, Ireland and the UK) to enrich the microsimulation model EUROMOD with detailed expenditure data and an indirect tax calculation routine. This allows us to sharpen the distributional picture of taxes and benefits by also taking indirect taxes into account. We will investigate the indirect tax incidence for the five European countries, give some explanations for it, and also use the enlarged MSM to study the distributional effect of an integrated simulation of changes in social security contributions and indirect taxes as compensating channels of collecting government revenue.

By using microdatasets to study the distributional impact of indirect tax liabilities, we complement earlier research by e.g. Adema and Ladaique (2005) who correct the picture of cross country comparisons of gross social expenditures. The correction consists of a subtraction of the amount of taxes paid by the recipients of social benefits to arrive at what they call *net* social expenditures. However, they mostly have to rely on national accounts and aggregate data for their exercise.

This paper relies on a cross country comparison, and does not offer a time series analysis of changes over time in the incidence picture of indirect taxes. It is embedded in a partial equilibrium framework where producer prices are taken as exogeneously given, and – except for the Engel curves which are used to match expenditures into the income datasets - does not contain behavioural models. This should be borne in mind when interpreting the distributional effects of the kind of simulations presented in section VI, since a shift of revenue collection from social security contributions towards indirect taxes is mostly intended to stimulate labour market participation and/or labour supply.

FIGURE 2 : SHARE OF DIFFERENT COMPONENTS OF GOVERNMENT REVENUE - OECD 2005



The structure of the paper is as follows: in section 2 we describe the datasets that are available to us and the implementation of the indirect tax system in the model. The imputation of expenditure data in the EUROMOD datasets is considered in section 3. Finally, section 4 contains the description and the results of the combined direct-indirect tax simulations.

II. EXPENDITURE AND TAX DATA

The countries for which the imputation of expenditures into an income dataset took place are Belgium, Greece, Hungary, Ireland and the UK. These countries formed the subject of project 3 in the AIM-AP-project, the aim of which it was to enrich the microsimulation model EUROMOD with expenditure information and an indirect tax module. Within this project we disposed of the microdata of the budget surveys for these five countries. This allowed us to investigate and apply detailed and rather sophisticated imputation methods, to be briefly described in the next paragraph. Unavailability of micro-datasets with expenditure data made it impossible to extend the analysis towards more countries.[4] Table 1 summarizes the EUROMOD and expenditure datasets used for each country.

To ensure comparability across these five countries, we used the same expenditure aggregation across the countries, close to the highest level of the COICOP -scheme[5]. We developed an indirect tax module which calculated the average indirect tax rates for each COICOP-aggregate, by aggregating the VAT, ad valorem taxes and excise paid at the most detailed level of the available budget surveys (often hundreds of items) across all commodities belonging to a specific COICOP-aggregate. This implicitly defined a VAT- and excise-rate for this specific COICOP-aggregate, which was then applied to calculate indirect tax liabilities in the income surveys. More information on the calculation of these indirect tax liabilities for aggregate commodity groups can be found in Decoster et al. (2008).

4 We did some preliminary and experimental calculations for a second group of countries for which we did not dispose of the microdata on expenditure behaviour (i.e. the budget surveys). This group consists of Denmark, Finland, France, Italy, Luxemburg, the Netherlands, Portugal and Spain. Engel curves were estimated by the owners of the budget surveys themselves, who sent us the estimated coefficients. Although this forced us to adopt a much more pragmatic matching strategy than in the AIM-AP-case, preliminary results – not reported in this paper - show that the results obtained in this paper are confirmed for this broader group of countries.

5 The aggregates involved are: Food and Non-alcoholic drinks, Alcoholic drinks, Tobacco, Clothing and Footwear, Home fuels and electricity, Rents, Household services, Health, Private transport, Public transport, Communication, Recreation and Culture, Education, Restaurants and hotels, Other goods and services, Durables and Home production (wherever applicable).

TABLE 1: EXPENDITURE DATASETS AND INCOME DATASETS FOR THE FIFTEEN COUNTRIES

Country	budget survey	# of households	income survey	# of households	policy year indirect taxes
BE	Household Budget Survey 2003	3550	EU-SILC 2004	5275	2003
GR	Household Budget Survey 2005	6555	Household Budget Survey 2005	6555	2004
HU	Household Budget Survey 2005	8710	EU-SILC 2005	6924	2005
IE	Household Budget Survey 1999	7644	Living In Ireland 2000	3644	2001
UK	Family Expenditures Survey 2003/2004	7048	Family Resources Survey 2003/2004	28768	2003

In Table 2 we summarize the VAT-structure for the five countries. We used the indirect tax legislation of the year of the expenditure survey. The main change in indirect tax legislation between the year of the survey and the current legislation has occurred in Hungary, where the standard rate has been lowered from 25 to 20% and the reduced rate from 15 to 5 %. This substantial change has to be kept in mind when interpreting the results. Also the temporary reduction of the VAT-rate from 17.5% to 15% in the UK as part of the macro-economic stimulus package, decided end 2008, is not taken up.

TABLE 2: VAT-STRUCTURE AND EXPENDITURE SHARES PER VAT-CATEGORY; EXCISE RATES AND SHARES FOR THE 3 MOST IMPORTANT EXCISE GOOD CATEGORIES

Country and policy year		VAT				Excise		
		standard rate 18-25%	not taxed or exempted	reduced rate 1 4-6%	reduced rate 2 8-15%	Alcohol	Tobacco	Private transport
BE-2005	Rates	21	0	6	12	43.9	162.9	34.7
	Shares	*41.9*	*37.9*	*19.8*	*0.4*	*1.7*	*1.3*	*8.9*
GR-2004	Rates	18	0	4	8	24.8	278.6	40.6
	Shares	*46.5*	*16.4*	*0.5*	*36.7*	*1.7*	*3.2*	*7.5*
HU-2005	Rates	25	0	5	15	64.3	273.0	79.0
	Shares	*42.7*	*8.1*	*4.1*	*45.1*	*0.6*	*2.6*	*4.1*
IE-2001	Rates	20	0	-	12.5	26.6	300.0	75.4
	Shares	*36.2*	*42.0*	-	*21.8*	*4.5*	*3.4*	*5.3*
UK-2004	Rates	17.5	0	5	-	89.7	414.7	58.8
	shares	*57.7*	*36.3*	*6.1*	-	*1.9*	*2.2*	*8.0*

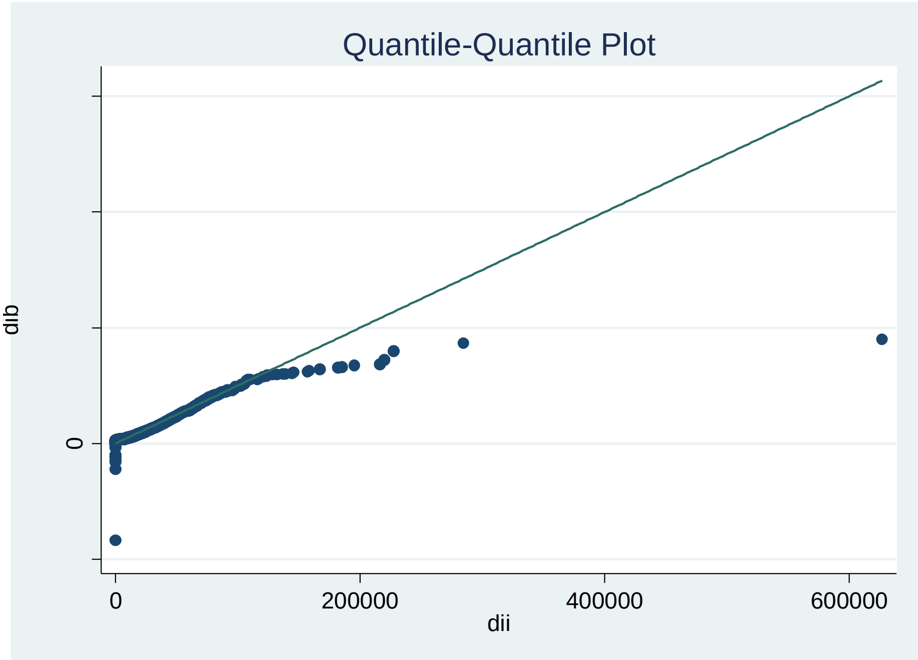
The excise duties differ a lot across the five countries. The tax base for excise duties however, i.e. the commodities on which an excise tax is levied, are more or less the same across the different countries. In summary, the excise products are: mineral oil products (gasoline, (un)leaded petrol, …), alcoholic products (spirits, beer, wine, …) and tobacco products (cigarettes, cigars,…). The Ad Valorem excise tax mostly concerns tobacco products.

III. IMPUTATION OF EXPENDITURES

As stated earlier, we started from income datasets that are used in EUROMOD but contain no expenditure information. As far as the imputation of COICOP-expenditures in these income datasets is concerned, we investigated in detail the relative performance of four different imputation methods: using a distance function, grade correspondence, non parametric Engel curves and parametric Engel curves. A detailed account of this comparison is found in Decoster et al. (2007). Our final choice, based both on theoretical, empirical and practical arguments of future implementation in MSM-models, was to use the parametric Engel curves. We estimate an Engel curve for each COICOP-aggregate on the expenditure dataset and subsequently impute predicted values in the income data, using common explanatory variables in both the income and the expenditure dataset.

Three considerations are relevant in this context. Firstly, since the regressors used in the Engel curve have to be selected from variables that are common to both datasets, this puts a serious limitation on model specification. It also required a phase of thorough comparison and harmonization of these common variables. As an example, figure 3 plots the quantiles of the disposable income in the budget dataset in function of the quantiles in the EUROMOD dataset for Belgium. Two conclusions can be drawn: first that there is a straight line component, pointing to equality of distributions, containing 98.7 % of the data; second, that there are divergences in the tails of the distributions. So for extremely low or high incomes, the matching procedure may not be very accurate.

FIGURE 3: QQ-PLOT FOR DISPOSABLE INCOME QUANTILES IN BUDGET DATASET (DIB) VERSUS QUANTILES IN INCOME DATASET (DII), BELGIUM (EUROS PER YEAR)



Secondly, using disposable income in the estimation of expenditures per category was problematic for two reasons. Firstly, the income distributions in the expenditure dataset used for estimation and the income dataset on which we impute often differ, especially in the tails, as indicated above. If the latter distribution has the fatter tails, the imputation has the character of an extrapolation and is hence much less stable. This leads to some undesirable imputation properties, such as a large proportion of negative expenditures in each category and a large proportion of very high expenditures for some consumption categories. In the latter case, the implied savings rate becomes extremely negative in the income dataset. Secondly, disposable income in the expenditure datasets is negative in a non-negligible number of cases. Note that this already makes the estimation of income shares very cumbersome. Moreover, it excludes the specification in terms of the logarithm of disposable income and its square, which is dominantly present in the literature.

To deal with these problems we have split up the imputation in two steps. Since the relation between disposable income and total expenditures is smoother and hence more robust to problems of the kind described, we first estimated total expenditures, or equivalently the savings function[6], and durable expenditures on the basis of disposable income and a number of socio-demographic characteristics in the budget survey. This estimation was used to determine non durable expenditures in the income survey. In the second step, we estimated nondurable budget shares on the basis of the logarithm of the total expenditures and its square and used these estimated relationships and the imputed non durable expenditures to impute the non durable expenditure shares in the income dataset. A priori, it cannot be excluded that this yields negative budget shares in the imputation. But since there are no observed negative values and because of the smoothening effect on extreme incomes in the first step, this happens much less often than in a one-step scenario. Whenever it happens, the negative budget shares are set to zero and the shares are standardized to sum to one.

A third remark concerns the replication of so called zero expenditures in the target dataset. Estimating a regression on a consumption aggregate like tobacco, which is not consumed by a majority of households, and then imputing tobacco expenditures fails to reproduce a sufficient number of exact zeroes. For distributional analyses, this might produce a significant bias in the target dataset. We therefore divided the population into subgroups according to whether or not the households have expenditures on the different zero expenditure aggregates: smokers and non smokers, renters and home owners, users and non-users of public transport and users and non-users of education. Then we assumed that all the 16 resulting subgroups have different preference structures. Hence, the Engel curves are estimated for each subgroup separately. To determine to which group a household in the income dataset belonged, we used a Tobit regression model for the group identification in the budget survey. For each zero expenditure variable, like smoking, we estimated an underlying propensity to smoke model in the budget survey. We then used this model to predict this probability for the observations in the income dataset. For each observation a random number was drawn from the inverse normal distribution function: if this number was smaller than the estimated probability, the observation was categorized as respectively a smoker, renter, … Finally we predicted the budget shares in the income dataset with the Engel curves for the right subgroup to complete the imputation procedure. When the subgroups were too small to estimate a model we used the technique of subgroup-referencing (see Decoster et al., 2009). This boils down to increasing the number of observations, and hence reducing the variation of the estimates, by adding observations of other subgroups. However, because of the

---

6 In fact, for the estimation of total expenditures (and also durables), a specification was used including disposable income and disposable income squared as independent variables. Hence, the direct estimation of the savings function instead of total expenditures would yield exactly the same imputed values.

different preference structures of the groups, this introduces estimation bias. To reduce this bias a weighting scheme and dummy variables for the different subgroups are introduced.[7]

Table 3 gives a comparison between average observed expenditures per consumption aggregate in the budget survey and the average imputed value in the EUROMOD dataset, for four countries. Greece is not included here, since the dataset underlying EUROMOD also includes expenditure information. Hence, no imputation is needed. The results show that the imputation was fairly accurate. Home production is not included in the table.

[7] First, it makes sense only to use subgroups in the estimation that are "alike" to some degree. The explanation is straightforward: the less the true population parameters differ, the less the bias in estimated parameters if both groups are mixed together. Second, one can apply a weighting scheme so that observations in the subgroup itself have the highest weight, while other subgroups get a lower weight corresponding to their level of similarity with the original group. Notice that the first provision is a special case of the second one, in that subgroups considered to be not alike at all, get a weight of zero. Third, dummy variables can be used to draw off part of the bias. For instance, if one uses smokers to estimate the budget shares of a non-smoker, including a dummy for smoking will decrease the bias on other coefficient estimates. If there is no correlation between smoking or not and the other covariates, the bias will be zero.

TABLE 3: AVERAGE EXPENDITURES PER CONSUMPTION CATEGORY IN BUDGET AND EUROMOD DATASET

Commodity	expenditures in €, BE		expenditures in €, HU		expenditures in €, IE		expenditures in GBP, UK	
	Budget Survey	EURO-MOD	Budget Survey	EURO-MOD	Budget Survey	EURO-MOD	Budget Survey	EURO-MOD
food, non-alcoholic beverages	4183	4050	1813	1675	4620	8215	2617	2121
alcoholic beverages	466	400	82	36	1663	1513	325	296
tobacco	275	279	191	170	644	1098	280	321
clothing and footwear	1395	1284	442	380	1848	1493	1183	916
home fuels and electricity	1321	1284	831	844	1128	1987	623	590
rents	1418	1560	59	62	681	913	691	543
household services	1268	1157	666	685	1230	1365	999	818
health	1608	1507	245	323	582	391	174	144
private transport	2660	2214	590	325	1394	1808	1814	1413
public transport	161	158	185	148	513	534	292	242
communication	803	758	460	437	739	1223	551	457
recreation and culture	2058	1752	390	384	1931	2171	1760	1472
education	207	141	76	76	405	368	529	248
restaurants and hotels	2344	1972	246	153	1695	1652	2105	1746
other goods and services	2491	2175	471	466	4869	3917	1408	1210
durables	2671	2372	656	658	5306	3384	3405	3212
all	25330	23062	7645	7056	29248	32032	18754	15748

IV. SIMULATIONS OF DIRECT AND INDIRECT TAXATION

Finally, we use the matched income and expenditure data to simulate changes in indirect taxation and evaluate the distributional consequences of these changes for the five AIM-AP countries. In line with contemporary tax reform proposals in most countries, the simulation here is an example of a shift from labour to consumption taxes. It starts by decreasing the social security contributions of the employees by 25%. Assuming government budget neutrality, we then calculate the rise in the standard VAT rate necessary to compensate fully for this loss. Further assumptions are that the savings of the households are constant, as well as the amount of durable goods they purchase. Note that expenditure on durables can increase due to a rise in the VAT-rate. The households have the possibility to change their behaviour according to the Engel curves estimated in the imputation step. This means that only the direct effect of a rise in total nondurable expenditures on the budget shares of the aggregates is taken into account, not the cross price effects between the aggregates.

To evaluate the distributional implications of the tax reform, a measure of consumption based welfare gain was adopted, as explained in Capeau et al. (2008). A summary is given below.

Write the Marshallian demand functions as:

$$\mathbf{x} = f\left(\mathbf{q}, e\right),$$

where $\mathbf{x}$ and $\mathbf{q}$ denote quantities and consumer prices respectively. In this case the expenditure function for the non durable commodities becomes:

$$e = c\left(\mathbf{q}, U\right),$$

U denoting the welfare level obtained from the preference representation function $u\left(f\left(\mathbf{q}, y\right)\right)$. This expenditure function is homogeneous of degree 0 in the level of non durable expenditures and consumer prices, allowing to transform each proportionate price change into a corresponding change of e. The function $c(.)$ is the building block of the money metric welfare function (see King, 1983). E.g. for a household with non durable expenditures e^0 and facing prices $\mathbf{q}^0$ welfare is measured as:

$$m(\mathbf{q}^r, \mathbf{q}^0, e^0) = c\left(\mathbf{q}^r, u\left(f\left(\mathbf{q}^0, e^0\right)\right)\right),$$

where $\mathbf{q}^r$ is a set of reference prices to convert welfare U^0 in the situation $(\mathbf{q}^0, e^0)$ into monetary units. Now use as reference prices the baseline prices $\mathbf{q}^0$. The welfare change due to the change in nominal non durable expenditures (from e^0 to e^1) and in consumer prices (from $\mathbf{q}^0$ to $\mathbf{q}^1$) is then calculated as follows:

$$\begin{aligned} WG(\mathbf{q}^0, \mathbf{q}^1, e^0, e^1) &\equiv c\left(\mathbf{q}^0, U^1\right) - c\left(\mathbf{q}^0, U^0\right) \\ &= c\left(\mathbf{q}^0, u\left(f\left(\mathbf{q}^1, e^1\right)\right)\right) - c\left(\mathbf{q}^0, u\left(f\left(\mathbf{q}^0, e^0\right)\right)\right), \end{aligned}$$

where $U^1 \equiv u\left(f\left(\mathbf{q}^1, e^1\right)\right)$ denotes the utility level in the post-reform situation.

The second term in the last equation equals e^0. The first term in the right hand side of equation embodies the counterfactual situation of reaching the post-reform utility level at the pre-reform prices. This can be calculated by means of the Hicksian, or compensated demand functions, denoted here as:

$$\mathbf{x} = h\left(\mathbf{q}, U\right),$$

leading to:

$$c\left(\mathbf{q}^0, U^1\right) \equiv e^* = \sum_{i=1}^{15} q_i^0 h\left(\mathbf{q}^0, U^1\right).$$

These compensated demands only take-up the real income effect, leaving relative prices unchanged. Hence they correspond to the quantities calculated as follows:

$$x_i^* = \frac{e_i^*}{q_i^0} \quad i = 1, \ldots, 15.$$

e^* is therefore calculated as:

$$e^* = \sum_{i=1}^{15} q_i^0 x_i^*.$$

The welfare gain is then calculated as:

$$WG(\mathbf{q}^0, \mathbf{q}^1, e^0, e^1) = e^* - e^0.$$

Note that this welfare gain can be decomposed into three different effects: one effect coming from the change in nominal non durable expenditures, an effect coming from the change in the aggregate price level of the nondurable consumer items, discarding the relative price change, and an effect coming from the change in the relative prices of the non durable consumer items. The decomposition is as follows:

$$\begin{aligned} WG(\mathbf{q}^0,\mathbf{q}^1,e^0,e^1) &= e^* - e^0 \\ &= e^1 - e^0 - \left(e^1 - e^*\right) \\ &= \Delta e - \left[\sum q_i^1 x_i^1 - \sum q_i^0 x_i^*\right] \\ &= \Delta e - \left[\sum q_i^1 x_i^1 - \sum q_i^0 x_i^* + \sum q_i^1 x_i^* - \sum q_i^1 x_i^*\right] \\ &= \Delta e - \left[\sum \left(q_i^1 - q_i^0\right) x_i^* + \sum q_i^1 \left(x_i^1 - x_i^*\right)\right] \\ &= \Delta e - \left[\Delta^1 \mathbf{q} + \Delta^2 \mathbf{q}\right]. \end{aligned}$$

The first term in the above expression is the change in nominal non durable expenditures. But this difference would be an overestimation of the welfare gain. The other two terms in squared brackets give the effect of the changing consumer prices. The first is the change in the general price level, discarding the relative price change. Concretely, it is an aggregate measure of price changes, namely the weighted average of the individual price changes, weighted by the quantities x_i^* (to be interpreted as the Hicksian quantities, after adjusting the price level in a proportionate way). The inclusion of this term is intuitive: a rise in the general price level decreases the gain in welfare as measured by nominal expenditures alone, since one can purchase fewer quantities with the same money. The second term between square brackets, $\Delta^2 \mathbf{q}$, accounts then for the relative price effect, i.e. for the changing of the slope of the budget constraint.

With our specific assumptions, $x_i^* = x_i^1$, and hence the third price-change-term $\Delta^2 \mathbf{q}$ vanishes. The term between square brackets then simplifies to:

$$\sum_{i=1}^{15} \left(q_i^1 - q_i^0\right) x_i^1,$$

and the welfare gain to

$$
\begin{aligned}
WG &= \Delta e - \sum_{i=1}^{15} \left(q_i^1 - q_i^0 \right) x_i^1 \\
&= e^1 - e^0 - \left(e^1 - \sum_{i=1}^{15} q_i^0 x_i^1 \right) \\
&= \sum_{i=1}^{15} q_i^0 x_i^1 - \sum_{i=1}^{15} q_i^0 x_i^0 \\
&= \sum_{i=1}^{15} q_i^0 \left(x_i^1 - x_i^0 \right).
\end{aligned}
$$

The last expression is very intuitive: to measure the welfare impact one looks at changes in quantities. These changes are evaluated at pre reform prices. The first expression allows for a decomposition of the welfare gain in an expenditure and a price effect. This decomposition will be used in the tables.

The results are summarized in the following three tables. Table 4 presents the changes in the government budget. The decrease of the social security contributions of the employees by 25% leads to a substantial necessary increase in the standard VAT-rate: 4 to 5 percentage points in Belgium, Ireland and the UK. But up to 9 percentage points for Hungary. It is clear that the rise in standard VAT rate is proportional to the relative importance of the social security contributions and the indirect tax system. Note that for some countries, like Belgium, part of the government's loss is recuperated by an increase in taxable income and hence by a rise in personal income tax. Other countries do not exclude social security contributions from the taxable base and hence their PIT revenue stays the same.

Table 5 and 6 show the welfare consequences for different subgroups of society. For each group and country, the average change in welfare WG is depicted, together with its two components: the change in nondurable expenditures and the price effect. The first component is everywhere positive, explained by the fact that disposable income can only increase by the tax reform and because savings are kept constant[8].

[8] There is a possibility, however, that the price rise of durables outweighs the increase in disposable income. E.g. a household that pays no social security contributions and therefore cannot enjoy the benefits of the tax reform will see its total nondurable expenditures diminished if it has strictly positive expenditures on durables. On the aggregated levels that are used here, this effect is not directly observable. In Belgium, this group of households constitutes 0.6% of the population, in Hungary 0.4% and in the UK 1.9%.

The second component represents the price effect, which captures the rise in price levels. As no goods have their prices decreased, this effect is negative for every household. Taken together, one can see from the second table that the price effect dominates the change in expenditures in the lower equivalized expenditure deciles, so that the welfare effect of the reform is negative for those groups (up to the fifth decile for Belgium and the UK, up to the sixth decile for Hungary). For the higher deciles, the situation is reversed and these groups become better off after the reform.

This analysis of gainers and losers can be carried out for other subgroups of the population as well. The upper rows of the third table show the effects along the division poor – non poor, where poverty is defined as having equivalized expenditures lower than 60% of the median equivalized expenditures. As can be expected from the previous table, the reform is beneficiary to the group of non poor as a whole, but the group of poor is affected very badly. The same conclusion can be drawn for socio-economic divisions as in the lower part of the third table: people in more vulnerable positions, like the unemployed (except for Hungary, where they are almost unaffected), retired people and people receiving income support, lose by the reform, while employed workers gain by it.

TABLE 4: REVENUE EFFECTS OF THE SIMULATION

	BE		HU		IE		UK	
	baseline	simulation	baseline	simulation	baseline	simulation	baseline	simulation
SIC employee	17,490	-3,900	2,777	-693	168,875	-33,902	42,283	-9,713
PIT	35,500	+1,763	4,608	+0	1136,416	+0	164,813	+0
Indirect tax	14,400	+2,309	4,300	+731	443,139	34,791	71,717	+10,655
VAT rate	21%	26%	25%	34%	20%	23.5%	17.5%	21.5%

TABLE 5: DECOMPOSITION OF WELFARE CHANGE INTO INCOME EFFECT AND PRICE CHANGE – BY DECILE

Decile equiv. non durable expend.	BE			HU			IE			UK		
	Change nondur. exp.	Price effect	WG	Change nondur. exp.	Price effect	WG	Change nondur. exp.	Price effect	WG	Change nondur. exp.	Price effect	WG
1	43	-193	-150	22	-70	-47	0	-59	-58	9	-50	-42
2	79	-262	-183	34	-90	-56	38	-152	-114	39	-99	-60
3	159	-308	-149	57	-105	-48	108	-202	-94	90	-134	-44
4	237	-366	-129	82	-124	-41	213	-277	-64	134	-168	-34
5	389	-417	-28	112	-139	-27	321	-313	8	196	-200	-4
6	482	-455	26	141	-157	-16	364	-328	36	278	-233	45
7	614	-509	105	192	-183	9	390	-338	52	360	-269	91
8	735	-557	178	231	-205	26	483	-403	80	473	-316	158
9	837	-607	230	310	-237	73	523	-399	124	620	-376	245
10	1162	-858	305	527	-339	188	722	-531	191	764	-570	194
Mean	473	-453	20	171	-165	6	316	-300	16	296	-241	55

TABLE 6: DECOMPOSITION OF WELFARE CHANGE INTO INCOME EFFECT AND PRICE CHANGE – BY GROUP

group	BE			HU			IE			UK		
	Change nondur. exp.	Price effect	WG	Change nondur. exp.	Price effect	WG	Change nondur. exp.	Price effect	WG	Change nondur. exp.	Price effect	WG
poor	55	-367	-312	30	-90	-60	4	-22	-18	17	-177	-160
non poor	554	-470	84	197	-178	18	329	305	24	362	-257	106
on income support	848	-571	277	333	-226	106	0	-24	-24	518	-286	232
retired	112	-289	-177	117	-120	-3	22	-46	24	35	-164	-130
unem-ployed	54	-323	-269	35	-107	-72	2	-7	-5	16	-148	-133
mean	473	-453	20	171	-165	6	316	-300	16	296	-241	55

V. CONCLUSION

This paper proposes a method to integrate indirect taxes within the EUROMOD microsimulation framework. Expenditure information is imputed by means of Engel curves estimated on expenditure surveys. The indirect tax system for each country is summarized by calculating implicit tax rates per consumption aggregate, so that indirect taxes can be calculated as a fraction of the imputed expenditures.

We used the combination of income and direct tax data on the one hand and expenditures and indirect tax data on the other hand in a hotly debated policy relevant topic. A 25% decrease of social security contributions is simulated in EUROMOD. The loss in government revenue is compensated by raising the standard VAT-rate. Behavioural responses are allowed by recalculating budget shares with Engel curves.

The increase in VAT-rate ranges from 2.5 to 9%. The precise percentage is a function of the possibility of other sources for compensation of government revenue loss (as in Belgium) and the relative size of indirect taxes and social security contributions.

The consumption based welfare measure shows that the policy change has a regressive effect with the lower total nondurable expenditure deciles losing. Although the disposable income rises in every decile, for the lower deciles this effect is surpassed by the effect of rising prices, even with savings kept constant.

VI. REFERENCES

Adema, W. and Ladaique, M. (2005), *Net social expenditure, 2005 edition - More comprehensive measures of social support*, OECD Social, Employment and Migration Working Papers no. 29, Paris, OECD.

Ahmad, E. and Stern, N. (1984), The Theory of Reform and Indian Indirect Taxes, *Journal of Public Economics* 25, 259-298.

Atkinson, A. B. and Stiglitz J.E. (1980), *Lectures on Public Economics*, Mc Graw Hill.

Auerbach, A. (2006), *The choice between income and consumption taxes: a primer*, NBER Working Paper 12307.

Blundell R. and Preston, I. (1998), Consumption inequality and income uncertainty, Quarterly Journal of Economics, 113(2), 603.640.

Boadway, R. and Pestieau P. (2003), Indirect taxation and redistribution: the scope of the Atkinson-Stiglitz theorem, In: R. Arnott et al. (eds.), *Economics for an Imperfect World: Essays in Honor of Joseph Stiglitz*, Cambridge, MA: MIT Press.

Brewer, M., Goodman, Alissa and Leicester, A. (2006), Household spending in Britian. What can it teach us about poverty? The Policy Press.

Capéau, Bart, Decoster, André, De Swerdt, Kris, and Orsini, Kristian (2008), *Welfare effects of alternative financing of social security. Some calculations for Belgium*. Leuven, Centre for Economic Studies, Discussion Paper DPS 08.12.

Caspersen, E. and Metcalf, G. (1994), Is a value added tax regressive? Annual versus lifetime incidence measures, *National Tax Journal*, 47(4), 731-746.

Decoster, A., De Swerdt, K., Loughrey, J., O'Donoghue, C. & Verwerft, D. (2008). *Matching indirect tax rates on budget surveys for five selected countries*. AIM-AP-deliverable, available at:http://www.iser.essex.ac.uk/files/msu/emod/aim-ap/deliverables/AIM-AP3.3.pdf.

Decoster, A., De Swerdt, K., Loughrey, J., O'Donoghue, C. & Verwerft, D. (2009). *Imputation of expenditures into the income datasets of five European countries*. AIM-AP-deliverable, soon available at:http://www.iser.essex.ac.uk/files/msu/emod/aim-ap/deliverables.

Decoster, A., De Rock, B., De Swerdt, K., Loughrey, J., O'Donoghue, C. & Verwerft, D. (2007). *Comparative analysis of different techniques to impute expenditures into an income data set*. AIM-AP-deliverable, available at:http://www.iser.essex.ac.uk/files/msu/emod/aim-ap/deliverables/AIM-AP3.4.pdf

Decoster, A., Schokkaert, E. and Van Camp G., (1997a) Horizontal Neutrality and Vertical Redistribution with Indirect Taxes, in Zandvakili, S. (ed.), *Inequality and Taxation*, Vol. 7., JAI Press, Greenwich, Connecticut.

Decoster, A., Schokkaert, E. and Van Camp G., (1997b), Is Redistribution through Indirect Taxes Equitable? *European Economic Review*, 41(3-5), 599-608.

Fullerton, D. and Rogers, D.L. (1991), Lifetime versus annual perspectives on tax incidence, *National Tax Journal*, 44(3), 277-287.

King M. A. (1983), Welfare analysis of tax reforms using household data, *Journal of Public Economics*, 21, 183-214.

Lambert P. (2001), *The distribution and redistribtuion of income*, Manchester University Press, 3rd edition.

O'Donoghue C., Baldini, M. and Mantovani, D. (2004), *Modelling the redistributive impact of indirect taxes in Europe: an application of EUROMO*, Euromod Working Paper EM7/01.

Poterba J.M. (1989), Lifetime incidence and the distributional burden of excise taxes, *American Economic Review*, 79(2), 325-330.

Warren, N. (2008), *A review of studies on the distributional impact of consumption taxes in OECD countries*, Paris, OECD.