Incidence and Welfare Effects of Indirect Taxes*

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

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Abstract: The majority of microsimulation models are confined to 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 indirect taxes, mainly VAT, excises and other consumption taxes, in the EUROMOD-microsimulation model. We sharpen the distributional picture of the overall tax and benefit system by bringing the indirect tax incidence for five European countries into the picture. We investigate explanations for the regressivity, and study the distributional effect of an integrated simulation of changes in social security contributions and indirect taxes as compensating channels of collecting government revenue.

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. Table 1 and Figure 1 both illustrate how important indirect taxation has been and still is in the collection of governement revenue. The most important source of revnue in 1955 (37.8% on the last but one line of Table 1); indirect taxes are still far ahead in 2005 (30.2%).

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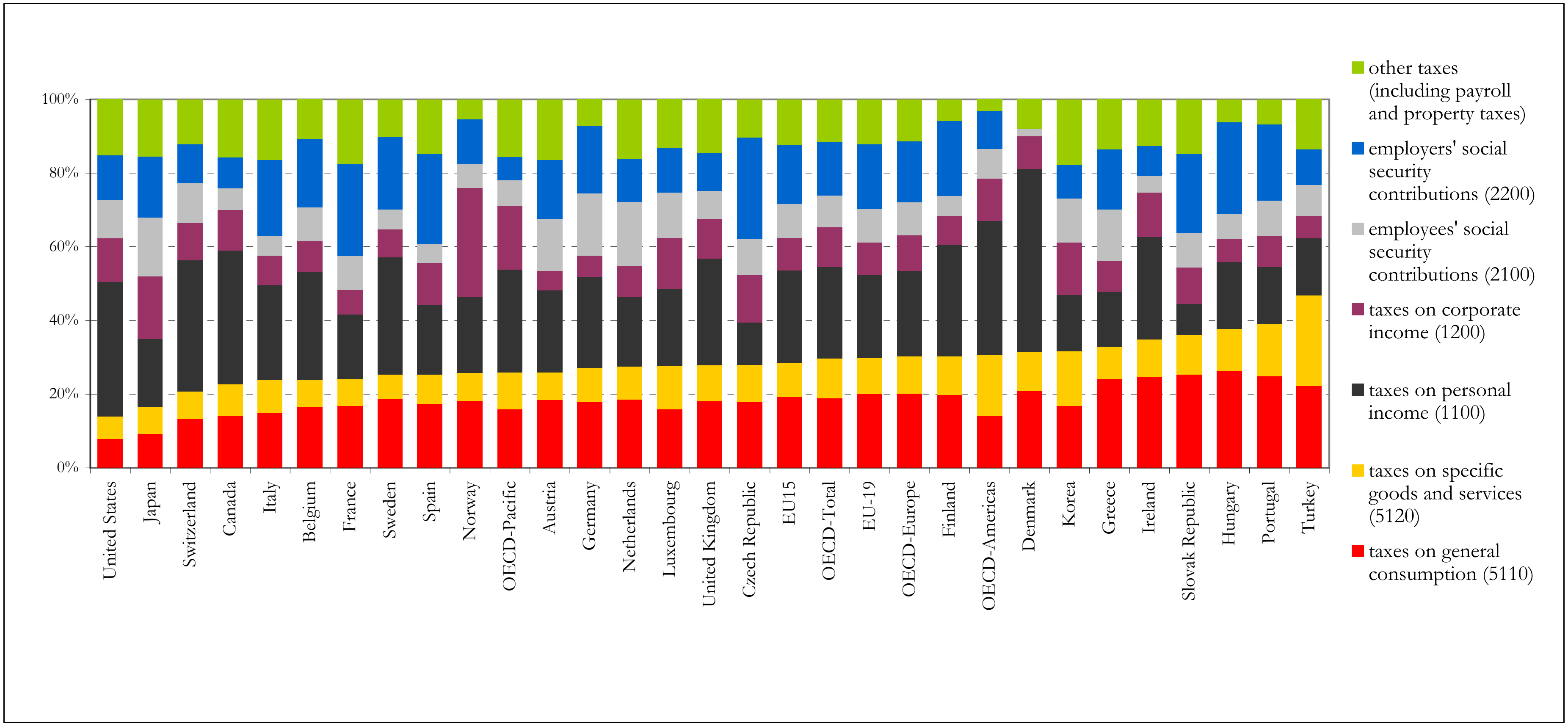
1 University of Leuven

2 Rural Economy Research Centre, Teagasc

TABLE 1: SHARE (%) OF DIFFERENT COMPONENTS OF GOVERNMENT REVENUE OECD 1955-2005

	1955	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005
Taxes on personal income (1100)	25.5	25.6	26.2	28.0	30.0	31.3	29.7	29.6	27.0	26.1	24.6
Taxes on corporate income (1200)	11.4	10.6	8.8	8.7	7.6	7.6	7.9	8.0	8.0	10.1	10.3
Employees' social security contributions (2100)	4.1	5.0	5.7	6.1	6.9	7.1	7.4	7.8	8.3	8.4	8.7
Employers' social security contributions (2200)	5.4	6.5	9.8	10.9	13.8	14.0	13.3	13.1	14.2	14.6	14.8
Other taxes (including payroll and property taxes)	15.8	15.1	11.5	10.8	9.6	8.0	9.0	11.1	11.7	11.0	11.3
Taxes on specific goods and services (5120)	26.8	26.8	24.3	20.7	17.7	16.7	16.2	12.9	13.0	11.5	11.2
Taxes on general consumption (5110)	10.9	10.4	13.6	14.8	14.5	15.4	16.4	17.4	17.7	18.4	19.0
Indirect taxes (5110+5120)	37.8	37.1	37.9	35.4	32.2	32.1	32.6	30.3	30.7	29.9	30.2
Social security contributions (2100+2200)	9.5	11.5	15.6	17.0	20.7	21.0	20.7	20.9	22.5	22.9	23.5

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



This prominent role of the indirect tax instrument 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.

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 detailed enough to calculate indirect tax liabilities. So, either, one designs a separate indirect tax micro-simulation model, running on a budget survey dataset (Baker et al, 1990 and Decoster, 2005) or one imputes expenditure information in the income data set (Sutherland et al., 2002).

However with rising unemployment again as recession hits the world, reducing the tax wedge on employment is rising up the agenda (OECD, 2008) with the potential of using revenue generated from indirect tax increases to reduce labor market distorting direct taxation (Bosch and van den Noord, 1990). Assessing the interaction between incentives and distributive trade-offs require the existence of a model that can simulate both direct and indirect taxes and contributions.

In this paper, we have been able to use budget surveys of five countries (Belgium, Greece, Hungary, Ireland and the UK) to enrich the EU microsimulation model EUROMOD (Immervoll et al, 1999) 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 study the distributional effect of an integrated simulation of changes in social security contributions and indirect taxes as compensating channels of collecting government revenue.

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[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.

By using micro datasets to study the distributional impact of indirect tax liabilities, we complement earlier research by e.g. Adema and Ladaique (2005) who correct, using primarily aggregate data, 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 *net* social expenditures.

The structure of the paper is as follows: in section 2 we describe the datasets we have available and the methodologies used for the imputation. In section 3 we sketch the crude picture of the indirect tax incidence in the different countries under analysis, whereas in section 4 we describe the distributional pattern of indirect tax liabilities. Section 5 investigates three explanations for the observed regressive pattern: a differentiation between VAT and excise taxes, the interplay of Engel curves with a differentiated indirect tax structure, and the influence of savings by shifting the rate base from disposable income to total expenditures.

II. DATA AND IMPUTATION

The countries for which the imputation of expenditures into an income dataset took place are Belgium, Greece, Hungary, Ireland and the UK. These countries were selected to get a broad representation of EU countries. Within this project we had access to budget surveys for these five countries, which allowed us to investigate and apply detailed imputation methods. Unavailability of micro-datasets with expenditure data made it impossible to extend the analysis towards more countries.[4]

To ensure comparability across these countries, we used the same expenditure aggregation, close to the highest level of the COICOP -scheme[5]. We developed a module which calculated an indirect tax rate for each aggregate, averaging VAT, ad valorem taxes and excises paid at a

[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).

detailed level available in the surveys over all commodities (hundreds) belonging to the respective aggregate. Via these implicit tax rates and the already imputed expenditures, this enabled the calculation of aggregate-specific indirect tax liabilities in the income surveys. More information on the calculation of these indirect tax liabilities can be found in Decoster et al. (2008).

We investigated in detail the relative performance of four different imputation methods (see Decoster et al. (2007) for a detailed discussion) using:

- a distance function,
- grade correspondence,
- non parametric Engel curves and
- parametric Engel curves.

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 datasets.

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 limitation on model specification. It also required a phase of thorough comparison and harmonization of these common variables.

Secondly, using disposable income in the estimation of expenditures per category was problematic for two reasons. Firstly, the income distributions in the expenditure dataset and the income dataset often differ, especially in the tails. 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 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. Any negative budget shares are set to zero and the shares are standardized to sum to one.

A third remark concerns the replication of 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 households have expenditures on zero expenditures: smokers/non-smokers, renters/ home owners, users/non-users of public transport and users/non-users of education. We assumed that the 16 resulting subgroups have different preference structures, estimating separate subgroup Engel curves. We used a Tobit model based on group identification in the budget survey to simulate subgroups in the income survey. For each zero expenditure variable, we estimated an underlying propensity model in the budget survey and then predicted its probability for observations in the income dataset using a monte carlo method to determine the classification (smoker etc) of each observation. Finally we predicted the budget shares in the income dataset with the subgroup Engel curves 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), increasing the number of observations, and hence reducing the variation of the estimates, by adding observations of other subgroups. However, because of the 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.

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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.

Table 2 summarizes for each countries the datasets used to estimate the Engel curves, and the income datasets in which the COICOP-aggregates have been imputed and in which we will assess the distributional impact of indirect taxes. We also added the policy year for which we estimated the indirect tax liabilities, which is the topic of the next section.

TABLE 2: 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

III. THE INDIRECT TAX STRUCTURE IN FIVE COUNTRIES

In Table 3 we summarize the VAT-structure for the five countries and the rates and budget shares of the three most important excise good categories. 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 included.

TABLE 3: VAT-STRUCTURE AND EXPENDITURE SHARES PER VAT-CATEGORY; EXCISE RATES AND SHARES FOR 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*

Except for Hungary, the standard rates are quite similar. The variation across the countries mainly occurs in the reduced rate(s) and in the list of commodities subjected to the different rates, represented here by the average budget shares for the differently taxed commodities. In this respect, the basket of goods exempted from VAT varies widely between the countries, with Greece and Hungary with the lowest zero share, while in Belgium, Ireland and the UK, about 40% of expenditures are VAT exempt. Without a detailed incidence analysis, it is difficult to see whether the smaller budget share of exempted goods in Greece and Hungary is compensated by lower standard and/or reduced rates in these countries.

The tax base for excise duties, is more or less the same across the different countries: mineral oil products (private transport), alcoholic products and tobacco products. The Ad Valorem excise tax mostly concerns tobacco products. The level of excise duties however differs a lot across the countries. We present them in Table 3 as a percentage of the producer price.Alcohol and tobacco, e.g. are most heavily taxed in the UK; Belgium has a substantially lower excise taxation on tobacco products and also has the lowest excise taxation on private transport (probably due to the low excise on diesel).

IV. INDIRECT TAX INCIDENCE

Table 4 presents the distributional effect of indirect taxes, calculated on the income datasets in which we imputed expenditures and on which we appended our indirect tax calculation module. The table shows the indirect tax liability as a percentage of disposable income, by decile of equivalised disposable income. The picture is clear and confirms most of previous research (as summarized recently in Warren, 2008): in all countries the pattern of indirect taxes with respect to disposable income is clearly regressive. The tax rate is monotonically decreasing across the equivalised income scale. In all countries the poorest ten percent pay at least twice as much indirect taxes as the richest ten percent.

This regressive effect is also confirmed at the bottom of the table, where we display the Suits-index of disproportionality of taxes. The index is negative for all countries, indicating that lower incomes bear a share of the total indirect taxes collected which exceeds their share in disposable income. This rate regressivity is highest in Greece, followed by the UK. It is substantially lower in Belgium.

TABLE 4: INDIRECT TAX PAYMENTS AS % OF DISPOSABLE INCOME – BY DECILE

Decile	BE	GR	HU	IE	UK
1	23.8	28.6	25.7	24.8	20.6
2	13.6	22.6	19.3	19.5	14.8
3	13.3	19.2	17.6	16.6	13.5
4	12.8	18.8	16.7	15.2	12.5
5	12.4	17.7	15.8	15.5	11.8
6	11.8	16.2	15.4	14.2	10.9
7	11.6	15.8	15.1	13.1	10.8
8	11.0	14.9	14.7	12.4	10.1
9	10.8	14.2	14.4	11.0	9.3
10	9.6	11.9	12.8	7.8	7.5
Average	11.8	15.7	15.3	13.2	10.3
Suits index of indirect taxes	-0.079	-0.101	-0.086	-0.143	-0.120
Gini equiv. disposable income (1)	0.319	0.324	0.318	0.331	0.368
Conc. index disp. Inc after indirect tax (2)	0.329	0.344	0.334	0.351	0.381
(1)-(2)	-0.010	-0.020	-0.015	-0.020	-0.013
Gini equiv. disp. income after indir tax (3)	0.330	0.348	0.334	0.346	0.383
Reynolds-Smolensky index: (1)-(3)	-0.011	-0.024	-0.016	-0.015	-0.015

The combination of the rate regressivity with the average tax rate, leads to a measure of impact of this tax instrument on the change in the income distribution before and after the tax instrument is applied. Note first, the much lower budget share of the basket of VAT exempt commodities in Greece and Hungary, results here in a much higher average tax rate: 18% and 15.3% respectively for Greece and Hungary, compared to 11.8% and 10.3% for Belgium and the UK. Together with the most pronounced regressivity, this produces the highest adverse distributional effects in Greece. We capture this effect by comparing the Gini coefficient of equivalized disposable income before taxes with the concentration index of the equivalized disposable income net of indirect taxes.[7] [8] For Greece, inequality goes up by not less than 2.4 percentage points, if we discard reranking. But also in the other countries, the use of the indirect tax instrument is increasing inequality: in Hungary inequality goes up by 1.6 percentage points, and in the UK and Ireland by 1.5 percentage points. The low rate regressivity in Belgium, combined with the lowest average indirect tax rate, bring the Belgian indirect tax system closest to distributional neutrality among the countries studied here.

Table 5 confirms and enriches this regressive picture for some selected groups: poor versus non-poor (with the poverty line at 60% of median equivalised income), households on income support, and households with more than 80% of disposable income originating from unemployment benefits, pensions. Certainly the divergence of the average indirect tax rate between the average population and households on income support is striking. The latter are paying more than a quarter of disposable income as indirect taxes in Hungary and the UK. Also the retired and the unemployed are hit more by indirect taxes, although this effect is less pronounced, due to their larger variation of disposable income.

TABLE 5: INDIRECT TAX PAYMENTS AS % OF DISPOSABLE INCOME – BY CATEGORY

Group	BE	GR	HU	IE	UK
income poor	21.1	20.5	23.0	20.9	16.7
income non-poor	11.3	15.1	14.8	15.5	9.3
on income support	36.0	14.1	25.8	17.5	26.1
retired	12.1	13.1	13.2	20.2	10.0
unemployed	12.2	17.6	16.1	18.9	13.6
average	11.8	15.7	15.3	13.2	10.3

7 Since disposable income net of indirect taxes can be read as some kind of quantity index (see Yithzhaki, 1994), we use the latter as a proxy for welfare in the household.

8 Loosely speaking, we will call this “the effect on inequality”. But note that this does not fully capture the effect on inequality, defined as the difference between the Gini-coefficients before and after the instrument is applied. This is captured by the “Reynolds-Smolensky index”. The difference is due to reranking of households, leading to a difference between the concentration index (ordered on income before indirect tax) and the Gini coefficient (ordered on disposable income after indirect tax). For an overview, see Lambert (2001).

The aim of this exercise is that we can now sketch a more comprehensive picture of the distributional effects for the complete transition from gross to net disposable income. A summary of the regressive character of the indirect tax instrument for the five countries is displayed in Table 6. We sharpen the picture by only looking at the erosion of the progressivity of the other instrument intended to generate general fiscal revenues (and hence not embedded in the insurance approach related to social risk): personal income taxes. The results are striking. In Ireland e.g. indirect taxes are about as regressive as the personal income tax system is progressive.[9] The indirect tax system is the least regressive in Belgium and Hungary. The rightmost part of Table 6 shows the erosion of the redistributive effect of the system, measured again as the difference between the Gini coefficient before taxes, and the concentration index after taxes. Indirect taxes nearly halve the redistributive effect of the progressive personal income tax system in Ireland. In Hungary and the UK the erosion of the redistributive effect is about a quarter. Belgium has the least erosive indirect tax system as far as the redistributive character of the general tax instruments is concerned.

TABLE 6: SUITS AND REYNOLDS-SMOLENSKY INDEX FOR PERSONAL INCOME AND INDIRECT TAXES

Country	π_S^{PIT}	π_S^{IND}	π_S^{TOT}	π_{RS}^{PIT}	π_{RS}^{IND}	π_{RS}^{TOT}
BE	0.219	-0.079	0.113	0.057	-0.010	0.046
GR	0.492	-0.101	0.094	0.035	-0.024	0.01
HU	0.424	-0.086	0.144	0.056	-0.015	0.041
IE	0.140	-0.143	0.044	0.043	-0.019	0.024
UK	0.200	-0.120	0.092	0.038	-0.011	0.026

The result of the combined operation of all taxes and benefits is shown in Table 7. We express the payment of indirect and personal income taxes as a percentage of market income plus social benefits and minus social contributions. The result is a clearly U-shaped pattern of tax liabilities. For some countries the decreasing part of this tax liability curve across the income scale stretches well beyond the first decile. But the decline is particularly sharp

9 The disproportionality of the indirect and personal income taxes combined is the weighted average of the Suits-indices for both instruments, the weights being the shares in the combined tax revenues.

between the first and the second decile. In the next section, we list and investigate some explanations for this regressive nature of indirect taxes.

TABLE 7: TOTAL TAX PAYMENTS AS % OF PRIMARY INCOME MINUS SOCIAL SECURITY CONTRIBUTIONS PLUS SOCIAL BENEFITS

Decile	BE	GR	HU	IE	UK
1	23.8	29.5	27.2	28.6	30.1
2	16.7	21.5	20.8	27.1	22.7
3	19.0	20.7	20.0	30.9	21.6
4	22.7	28.0	20.5	27.5	21.0
5	26.0	23.5	19.6	33.6	21.3
6	28.7	22.6	20.1	33.6	22.4
7	30.8	25.4	22.5	34.8	23.5
8	33.4	23.9	24.6	36.4	24.7
9	35.3	23.3	27.2	36.6	26.2
10	39.8	28.9	35.2	35.7	31.3
average	31.6	24.7	26.4	34.4	26.3

V. EXPLANATIONS

In this section we discuss three factors that may explain the regressive pattern found above: the difference between VAT on the one hand and excises and ad valorem taxes on the other; the interplay between differences in expenditure patterns, differentiated tax rates and the position in the distribution; and finally the choice for disposable income (as opposed to expenditures) as the variable on the basis of which we construct the distributional picture.

V.1. Differences in VAT and excises

Sometimes it is hypothesized that the regressivity of the consumption taxation as a whole is solely due to the influence of excises and that the VAT system, considered separately, might be progressive. Excise taxes, with often high implicit rates, are levied on products like petrol, tobacco etc. which are relatively more important for low income households, but are often considered legitimate as a compensation for some externalities associated with the commodities, e.g. bad health, pollution etc. Table 8 divides indirect taxes into excise duties and VAT. It is clear that the hypothesis can be rejected: VAT is regressive w.r.t. disposable income in each country, and in Belgium the VAT system is even more regressive than the excise system. Moreover, if one looks at the effects on redistribution (third last and last rows), the effect of the VAT system is more important than the excise system because of the larger average tax rate of the former.

V.2. Different expenditure patterns across deciles

From an efficiency point of view it makes sense to tax neccesities more heavily. Indeed, although minimizing excess burdens (or welfare losses) hinges on compensated own price elasticities (taxing the price-inelastic commodities more heavily), the Slutsky equation also shows that one can reasonably expect that commodities with low compensated price elasticities are also the ones with low total expenditure elasticities. This simply unveils the traditional trade-off between equity and efficiency. From an equity point of view, one would argue that necessary goods should be taxed less than luxury goods. But efficiency points in the other direction.[10]

Table 9 shows the budget shares in Belgium for the goods of different VAT rates, and for excise duties. Clearly, the reduced rate products are consumed more, amongst lower deciles and the reverse is true for the standard rate products. For the excise goods, the picture is more complicated. The shares of alcohol and car fuel consumed do not depend monotonically on the decile. For tobacco the shares are clearly negatively correlated with equivalent income. Nevertheless, one can conclude that these results do not support the view that lower income deciles spend relatively more on more heavily taxed commodities.

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[10] The trade-off has been formalised extensively in optimal tax theory, with numerous examples of numerical calculations of optimal indirect tax rates.

TABLE 8: VAT AND EXCISE PAYMENTS AS % OF DISPOSABLE INCOME – BY DECILE

Decile	BE		HU		UK		GR		IR	
	VAT	Excise	VAT	Excise	VAT	Excise	VAT	Excise	VAT	Excise
1	21.1	2.7	22.0	3.7	13.9	6.7	24.9	4.7	31.7	9.6
2	11.8	1.8	16.8	2.5	10.1	4.7	18.1	3.6	14.2	5.5
3	11.5	1.8	15.3	2.3	9.3	4.2	16.4	3.6	12.0	4.6
4	11.0	1.8	14.6	2.1	8.6	3.9	15.6	3.3	10.4	4.1
5	10.7	1.7	13.8	2.0	8.1	3.6	15.6	3.3	10.9	4.6
6	10.1	1.7	13.5	1.9	7.6	3.3	14.3	3.0	10.2	4.6
7	9.9	1.7	13.2	1.9	7.6	3.2	13.3	2.9	9.3	4.1
8	9.3	1.7	12.8	1.9	7.0	3.0	13.1	2.8	8.7	3.9
9	9.2	1.7	12.5	1.9	6.6	2.7	11.8	2.5	7.8	3.3
10	8.1	1.5	11.1	1.7	5.5	2.0	10.4	2.1	5.9	2.5
Average	10.1	1.7	13.3	2.0	7.3	3.1	13.1	2.7	9.0	3.8
Suits index of indirect taxes	**-0.083**	**-0.054**	**-0.084**	**-0.099**	**-0.108**	**-0.147**	**-0.101**	**-0.101**	**-0.171**	**-0.155**
Gini equiv. disposable income (1)	0.319	0.319	0.318	0.318	0.368	0.368	0.312	0.312	0.315	0.315
Conc. index disp. inc after indirect tax (2)	0.328	0.320	0.331	0.320	0.376	0.373	0.330	0.315	0.329	0.319
(1)-(2)	-0.009	-0.001	-0.013	-0.002	-0.008	-0.004	-0.018	-0.003	-0.014	-0.004
Gini equiv. disp. income after indir tax (3)	0.329	0.320	0.331	0.320	0.377	0.373	0.333	0.316	0.330	0.320
Reynolds-Smolensky index: (1)-(3)	**-0.010**	**-0.001**	**-0.013**	**-0.002**	**-0.009**	**-0.005**	**-0.021**	**-0.004**	**-0.015**	**-0.005**

TABLE 9: BUDGET SHARES BY TAX CATEGORY - BELGIUM

Decile	0%	6%	12%	21%	Alcohol	Tobacco	Car fuel
1	28.1	25.2	0.5	46.2	1.6	2.3	2.2
2	27.5	24.6	0.7	47.2	1.7	1.8	2.7
3	24.9	24.2	0.4	50.6	1.8	1.2	3.7
4	22.6	23.2	0.4	53.8	1.8	1.2	3.4
5	23.2	22.8	0.4	53.6	2.1	1.0	3.5
6	22.5	21.8	0.3	55.5	1.6	1.2	3.6
7	24.2	21.3	0.3	54.2	1.8	0.9	3.8
8	22.6	21.4	0.3	55.7	1.9	1.0	3.4
9	21.4	20.0	0.2	58.4	2.0	0.8	3.1
10	21.5	17.6	0.3	60.7	1.9	0.7	2.7
income poor	28.7	24.9	0.5	45.9	1.5	2.1	2.3
income non-poor	22.8	21.2	0.3	55.6	1.9	1.0	3.3
average	23.3	21.5	0.3	54.9	1.8	1.1	3.2

Synthesizing the information in table 9 in order to present the picture for the five countries, table 10 combines the total nondurable expenditure elasticities derived from the parametric imputation model with the implicit tax rates calculated per consumption aggregate. The story that emerges here is similar to table 9: lower expenditure elasticities correspond to lower indirect tax rates, pointing to a tax system more inspired by equity than by efficiency considerations.

As a crude measure, one can look at the correlation of elasticities with tax rates, weighted by the average budget shares. The value is between -1, indicating an efficiency based policy, and 1, indicating an equity-centred policy. The correlations are in the bottom row of the table. They are all close to zero, suggesting independence between tax rates and elasticities. But, if anything, the sign points to a slight preference for equity argumetns in Belgium and Hungary, and the reverse concern for efficiency in the UK and Ireland.

TABLE 10: TOTAL EXPENDITURE ELASTICITIES AND AVERAGE TAX RATES (%)

Commodity aggregate	BE		HU		IE		UK	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Food, non alcoholic beverages	0.42	8.1	0.66	15.5	0.55	4.2	0.51	2.1
Alcoholic beverages	0.94	43.9	1.19	64.3	1.15	26.6	1.13	89.7
Tobacco	0.54	162.9	0.42	273.0	0.44	299.3	0.60	414.7
Clothing and footwear	1.25	20.8	1.25	25.0	2.14	16.3	1.58	14.1
Home fuels and electricity	0.53	23.5	0.44	15.0	0.33	12.4	0.21	5.0
Rents	0.34	0.0	0.46	0.0	0.43	0.0	0.35	0.0
Household services	1.25	16.4	1.19	20.9	1.27	16.3	1.03	12.2
Health	1.00	2.8	1.01	5.5	2.46	1.0	1.51	0.0
Private transport	1.72	34.7	2.25	79.0	1.24	75.4	1.11	58.8
Public Transport	0.30	6.0	0.35	25.0	0.42	0.0	0.34	0.0
Communication	0.68	20.2	1.06	24.9	0.67	19.1	0.51	16.5
Recreation and culture	1.08	11.9	1.30	11.9	1.04	12.4	1.12	13.6
Education	0.15	1.8	0.28	0.0	0.23	1.9	0.18	0.0
Restaurants	1.63	12.8	2.23	14.0	1.40	12.4	1.46	17.5
Other goods and services	1.48	8.5	1.59	22.8	1.62	3.1	1.26	8.5
Home production			0.64	0.0				
Durables	0.85		1.64		1.00		0.64	
Saving	1.77		0.98		1.10		1.78	
Correlation betw. (1) and (2)	**0.041**		**0.0394**		**-0.0664**		**-0.0338**	

Notes:
(1): total expenditure elasticity, except for savings and durables where elasticity is w.r.t. disposable income
(2) indirect tax rate

V.3. Disposable income or expenditures?

There is a longstanding debate on whether income or expenditures are the best indicator to measure household welfare and empirical evidence on the impact of this choice on the incidence calculations of commodity taxes. We will not discuss this issue here, nor review the extensive literature.[11] The main reason for choosing expenditures instead of income is to flatten out short run volatilities in incomes, and/or to approximate some life-cycle income concept. Moreover, there is a conjecture that measurement error, although present in both variables, is less prominent in expenditures than in disposable income.

It is common knowledge that the savings rate is sharply increasing with income. This leads to a completely different picture of indirect tax incidence when using expenditures in the denominator as compared to income. We illustrate both aspects in Tables 11 and 12.

TABLE 11: SAVINGS AND DURABLES RATE PER DECILE

Deciles	BE	GR	HU	IE	UK
1	-52.3	-105.4	-48.4	-94.8	-15.8
2	-9.5	-50.8	-10.5	-54.5	18.3
3	0.5	-25.0	1.5	-25.3	26.1
4	6.9	-18.5	7.9	-13.0	31.9
5	13.1	-14.6	13.8	-9.9	36.7
6	18.7	-2.6	18.2	0.7	39.6
7	22.6	2.2	20.7	7.8	43.5
8	27.1	6.1	23.8	14.5	46.9
9	31.7	12.1	27.5	25.0	51.4
10	42.2	27.3	37.7	46.2	61.7
Mean	21.7	-16.9	18.8	8.0	45.2
Gini of disp. inc.	0.341	0.324	0.318	0.331	0.380
CI of inc. after saving.	0.225	0.202	0.208	0.180	0.255

[11] A reference contribution on the issue of choosing income or expenditures as a welfare standard is Blundell and Preston (1998). For a recent discussion of the sensitivity of poverty measurement and evolution in the UK with respect to the choice of income or expenditures as the measuring rod., see Brewer, Goodman and Leicester (2006). For the incidence of indirect taxes based on annual income, lifetime income or expenditures, see among others, Poterba (1989) Fullerton and Rogers (1991) or Caspersen and Metcalf (1994).

Table 11 illustrates the regressive nature of savings. For all countries, the savings rate is negative for the first decile. For some countries, like Greece, the amount of expenditures is double that of income. That desaving is so high, that in reality it is difficult to believe, is perhaps due to the instability of income measurement mentioned before. Nevertheless, the higher equivalent income, the higher the savings rate.

Table 12 reproduces table 4, but now presenting indirect tax payments as a fraction of nondurable expenditures. The conclusion however is opposite. With the exception of Greece, the tax system follows a (slightly) progressive schedule, as is indicated by the positive Suits indices in the bottom row and thus confirming that regressivity of savings is the most important explanation for the regressivity of indirect taxes. One can split table 12 in VAT and excise rates as before, which does reveal a difference now: the VAT system is progressive for all countries, while excises are regressive for all countries except Belgium.

TABLE 12: INDIRECT TAX PAYMENTS AS % OF NON DURABLE EXPENDITURES

Decile	BE	GR	HU	IE	UK
1	11.3	13.4	17.1	12.4	13.9
2	11.8	14.4	16.9	12.3	13.7
3	11.9	15.2	16.9	12.7	13.7
4	12.3	15.7	16.8	12.8	14.0
5	12.6	16.1	16.9	13.7	14.2
6	12.8	15.8	17.0	14.1	14.4
7	13.1	15.8	17.2	14.1	14.6
8	13.3	16.1	17.4	14.3	14.7
9	13.5	15.8	17.6	14.2	14.6
10	13.9	15.2	18.0	14.3	14.4
Average	12.9	15.4	17.3	13.5	14.3
Income poor	11.5	n/a	17.0	n/a	13.8
Income non-poor	13.0	n/a	17.3	n/a	14.4
Gini equiv. non durable expenditures	0.235	0.302	0.221	0.260	0.290
Concentration index post indirect tax	0.231	0.303	0.219	0.211	0.287
Suits	0.021	0.006	0.032	0.025	0.006

VI. SIMULATIONS OF INCREASED INDIRECT TAXES

Finally, we utilise the matched income and expenditure data to simulate changes in indirect taxation and evaluate the distributional consequences of these changes. In line with contemporary tax reform proposals, we consider here a shift from income to consumption taxes, decreasing social security contributions of 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. 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. The complete derivation can be found in Capéau et al. (2009). A summary is given below.

Denote Marshallian demand as:

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

where $\mathbf{x}$ and $\mathbf{q}$ are vectors of quantities and consumer prices of non durable commodities respectively. The expenditure function for the non durable commodities becomes:

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

U denoting the welfare level obtained from the preference function $u\left(f(\mathbf{q}, y)\right)$. This expenditure function is homogeneous of degree zero 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 e.g. King, 1983). E.g. for a household with non durable expenditures e^0 and facing prices $\mathbf{q}^0$ welfare is measured as:

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

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 13 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 14 and 15 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[12]. The second component represents the price effect, which captures the rise in price levels. As no goods have their

[12] 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%.

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 13: 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 14: 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 15: DECOMPOSITION OF WELFARE CHANGE INTO INCOME EFFECT AND PRICE CHANGE – BY GROUP

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
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

VII. CONCLUSION

In this paper, we present the results of imputing expenditure information into income and tax datasets within the context of the EUROMOD microsimulation environment. With respect to disposable income deciles, the indirect tax system is regressive for all countries, and, because of its relative importance in the government budget, also significantly influences the progressivity of the tax system as a whole. Because indirect taxes are often overlooked in microsimulation modelling, the results are a clear case for integration of expenditure data into models like EUROMOD.

We then looked for reasons behind this regressivity. First, it was shown that there is no considerable difference in regressivity between the VAT and excise systems in the countries investigated. The regressivity therefore is not due to excise taxes alone. Moreover, differences in expenditure patterns across deciles cannot account for the degree in regressivity. For the UK, a slight preference for efficient taxation can be discerned, but for Belgium and Hungary, low elasticity (necessary) commodities tend to have lower aggregate tax rates. Finally, the regressivity of savings seems to be the major determinant of the patterns discerned: because the higher deciles save so much more, they spend relatively less of their income on indirect taxation.

The change from disposable income to total nondurable expenditures as a welfare concept and for analytic purposes can be justified by the conjecture that income measurement may be more vulnerable to errors, but most importantly that from a life cycle point of view disposable income can be considered too volatile to measure someone’s welfare level. The question is whether progressivity should be defined as only considering the current income of households or the income earned over the entire lifetime. This discussion can be taken further by making a distinction between characteristics that households are respectively responsible and not responsible for. “True progressive taxes” would then decrease inequality between households of different endowments which they are not responsible for, but not affect other differences that can be described as “tastes”. Of course this provokes the normative debate about how far the responsibility of people reaches.

Finally, we used the EUROMOD model to simulate a possible contemporaneous tax reform: an increase of social security contributions, followed by an increase in standard VAT rate to maintain neutrality of the government budget. The results show that the weaker groups in society are adversely affected by this measure, while richer households benefit from it. This was true even while keeping savings constant.

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