# How Regressive Are Indirect Taxes? A Microsimulation Analysis for Five European Countries

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***Abstract***

*Shifting the tax burden from labor to consumption is proposed in many developed countries as a way to make the tax system more incentive compatible. This article deals with the simulation of such a policy change to sharpen the distributional picture. Expenditures are imputed into the EUROMOD microsimulation program. Then social security contributions are lowered and the standard VAT rate is increased to maintain government revenue neutrality. The main conclusions are that (1) indirect taxes are regressive with respect to disposable income but proportional or progressive with respect to total expenditures, and (2) indirect taxes are in any case less progressive than other components of the tax system, making the proposed measure a regressive one. A possible solution exists in increasing the progressivity of the remaining income tax. © 2010 by the Association for Public Policy Analysis and Management.*

## INTRODUCTION

Indirect taxation forms part of a mix of different tax and revenue-raising instruments including taxes on income, property, and social security levies on employment income that households and other economic agents face. As Table 1 illustrates for the OECD, indirect or consumption taxation is a substantial component in the tax system of most industrialized countries. Despite a decline in relative importance mainly taking place during the '70s, the total share of government revenue raised via consumption seems to have stabilized at around 30 percent,[1] which still is substantially more than, for instance, the income tax. Note that this stabilization since 1980 hides two distinct evolutions partly offsetting one another: the implosion of taxes on special goods and services (excise taxes[2]) from 1960 onward and the rise of taxes on general consumption (mainly VAT and sales taxes) in the same period. Lacking an adequate political economy model of tax system formation, it is difficult to give a conclusive interpretation of these opposite evolutions. Theoretically there are (productive efficiency) arguments contra and (externality) arguments pro excise

[1] We only consider relative trends in this paper. In absolute terms there is evidence of a correlation between the share of tax raised by VAT and the overall tax burden in a country (Keen & Lockwood, 2006).
[2] It should be noted that import duties also belong to this category, suggesting that the promotion of free trade might be responsible for the decreasing influence of this revenue type. Detailed figures, such as in OECD (2008a), show nevertheless that (1) the share of import duties is too small to provoke an effect of this magnitude and that (2) for the more restricted category of excise duties without import duties the evolution is analogous.

Journal of Policy Analysis and Management, Vol. 29, No. 2, 326–350 (2010)

Published by Wiley Periodicals, Inc. Published online in Wiley InterScience
(www.interscience.wiley.com)
DOI: 10.1002/pam.20494

**Table 1.** Share (percent) 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 |

*Source:* OECD (2008a). The codes in brackets refer to the OECD classification of taxes. The category "other taxes" contains all other codes.

taxes (see Crawford, Keen, & Smith, 2008, for an overview). In practice, the growing unpopularity of these measures seems to be embedded in a much broader historical process starting at the beginning of the 19th century.[3]

On the other hand, the growing popularity of general consumption taxes could be explained by the widespread point of view that taxing consumption has a less distortive effect on the labor market than taxing labor income (Bosch & van den Noord, 1990), since taxing labor is equivalent to subsidizing leisure (making leisure relatively cheaper with respect to labor) and decreasing labor supply. In the present times of rising unemployment as recession hits the world, reducing the tax wedge on employment is indeed high up the agenda (Organisation for Economic Co-operation and Development [OECD], 2008b). Nevertheless, this view has not remained unopposed. In principle, a consumption tax with a constant uniform rate is equivalent to a constant proportional tax on labor and profit income and transfers. Although tax systems in the real world as a rule do not have this structure, the principle might indicate that shifting the tax burden from income to consumption will not result in a significant rise in labor supply (Crawford, Keen, & Smith, 2008). All this disregards matters about the evasion of taxes, which could legitimate implementing both kinds of taxes just to reduce the probability of successful evasion, as in Boadway, Marchand, and Pestieau (1994).[4]

In discussions about efficiency aspects, a distinction is made between the two most common forms of general consumption taxes, namely the sales tax and the Value Added Tax (VAT). The VAT is theoretically equivalent to a sales tax imposed on final goods, although each of them has distinct attractive features from the perspective of countering evasion. Indeed, the VAT is implemented as a sales tax on intermediate and final goods, where the tax on intermediate goods is refunded. This last property makes the VAT theoretically superior because of the productive efficiency theorem of Diamond and Mirrlees (1971). The focus in this paper will mainly lie on the VAT, since it is the dominant form of indirect taxation in the European Union, where all of the data were obtained.

A related issue concerns the differentiation of VAT rates. From an efficiency point of view, it is argued that higher taxes should be levied on goods with low own price elasticities[5] and goods complementary to leisure (essentially an extra tax on leisure). From an equity point of view, it makes sense to have a relatively lower tax on goods consumed relatively more by poorer households. This point underlies the fact that a lot of goods deemed necessary, like food and household fuels, enjoy reduced or even zero tax rates in many countries. However, since Atkinson and Stiglitz (1976), it has become clear that the more the government disposes of other redistributive instruments, like progressive personal income taxes or social benefits, the less convincing the argument to use the differentiation in the indirect tax structure to pursue distributional objectives becomes.

[3] Cnossen (1977) argues that excises are "among the oldest forms of taxation in the world" (p. 1). Indeed, without a developed central administration, the simplicity of the tax base and the relative easiness of practically imposing the tax played a decisive role here. Moreover, (import) excise duties provide for more flexibility to the sovereign in case of war, famine, or in the bargaining with different professional groups (see Dowell, 1884, for an extensive overview for England). From the 19th century onwards, gradually the "small" excises (yielding little revenue) disappeared or were replaced by more general consumption taxes, leaving only the "big" ones, namely tobacco, alcohol, sugar, and petroleum, in place. The apparent fact that excises are gradually abolished as soon as suitable alternatives have been developed is an object of study on its own.

[4] For some canonical and some more recent theoretical contributions on the direct–indirect tax mix, see Atkinson and Stiglitz (1980), which, even after more than 25 years, is still the reference to start with when studying the topic; see also Ahmad and Stern (1984), Boadway and Pestieau (2003), and Auerbach (2006).

[5] This, of course, is a simplification of the optimal tax formula obtained in the so-called Ramsey formulation, where it is the compensated own (please confirm that "own" is appropriate in this context) and cross-price elasticities, which determine the optimal tax. Optimality is to be interpreted here in terms of minimization of welfare losses as compared to a nondistortionary, lump sum tax.

Shifts in tax policy can be evaluated *ex ante* by applying the old and new tax rules on a representative sample of households and comparing the results, which is the general principle underlying so called "microsimulation models" (MSMs). Most MSMs focus on a combination of income taxation and social insurance contributions and benefits,[6] which will be referred to as direct taxation in what follows. This paper, however, assesses the effects of enriching a particular MSM,[7] EUROMOD (for a description, see paragraph 2 and Immervoll, O'Donoghue, & H. Sutherland, 1999), with household expenditure data and indirect tax systems, and uses this combination of income, expenditure, direct, and indirect tax information to simulate shifts between direct and indirect taxation.

The choice for microsimulation as a method stems from the need to provide alternative policy proposals with at least a first-order approximation of their distributional consequences, which are often difficult to obtain in a closed formula. Moreover, the integration of income and tax information coming from different data sources, which is so characteristic for microsimulation, is very useful from a poverty measurement point of view because of the measures of after-government income it provides. But the reliance on microdata also constitutes the main danger of working with these models. First, data measurement error can evidently bias conclusions about incidence and progressivity of taxes. This is especially the case in our approach, which relies on expenditure surveys that show some clear data inconsistencies at the tails of the income distribution. A second caveat concerns the fact that most household surveys do not contain all the information needed to implement the tax system in a strict sense (for example, whether one is the widow of a war victim in some countries). The level of detail in the underlying micro data set thus creates an upper boundary to the accuracy of the MSM. Related to this is the fact that a significant part of benefits may not be taken up (for example, due to stigmatization) and an equally significant part of taxes may be avoided. This is often overlooked in MSMs.[8] Notwithstanding these potential flaws, we believe that proper use of MSMs can add valuable information to the evaluation of a policy proposal—particularly as one tool among many others.

The main objectives of this paper are (1) to carry out a detailed household-level simulation and distributional analysis of a shift from direct to indirect taxation while keeping the government budget constant in four European countries; (2) to give a clear indication that the often-mentioned regressivity of the indirect tax system in general and the VAT system in particular critically depend on the welfare classifier one uses—disposable income versus total expenditure; and (3) to create an empirical illustration of the theoretical prediction (Atkinson & Stiglitz, 1976; Mankiw, Weinzierl, & Yagan, 2009) that a consumption tax—even allowing for differentiated tax rates—is a crude measure with respect to redistribution purposes and is likely to be more regressive than other (direct) components of the tax system, regardless of which classifier is used.

The rest of the paper is structured as follows. In the second section we describe the data sets we have available and the methodologies used for the imputation. In the third section we sketch the crude picture of the indirect tax incidence in the different countries under analysis, whereas in the fourth section we describe the distributional pattern of indirect tax liabilities. The fifth section investigates three explanations for the observed regressive pattern: a differentiation between VAT and

[6] However, examples of consumption tax microsimulation can be found in Baker, McKay, and Symons (1990) and Decoster (2005). Also, Sutherland, Taylor, and Gomulka (2002) explore the possibility of validly imputing expenditure information into EUROMOD income data sets to simulate policy changes. Yet they do not perform combined changes in direct and indirect taxation.

[7] However, the indirect tax routine is formulated in a more abstract way and could be used in combination with other direct tax MSMs. See Decoster et al. (2007, 2008, 2009a, 2009b) for an extensive description of the routine.

[8] For an exception, see Flemotovou and Matsaganis (2009) and Matsaganis et al. (2009).

**Table 2.** Expenditure data sets and income data sets for the five countries.

| Country | Budget Survey | No. of Households | Income Survey | No. of Households | Policy Year Indirect Taxes |
|---|---|---|---|---|---|
| Belgium | Household Budget Survey 2003 | 3,550 | EU-SILC[a] 2004 | 5,275 | 2003 |
| Greece | Household Budget Survey 2005 | 6,555 | | | |
| Hungary | Household Budget Survey 2005 | 8,710 | EU-SILC 2005 | 6,924 | 2005 |
| Ireland | Household Budget Survey 1999 | 7,644 | Living in Ireland 2000 | 3,644 | 2001 |
| UK | Family Expenditures Survey 2003/2004 | 7,048 | Family Resources Survey 2003/2004 | 28,768 | 2003 |

[a] The European Union Statistics on Income and Living Conditions is a harmonization of country-level surveys on income, poverty, social exclusion, and living conditions. Rather than being organized as a common survey, it consists of a common framework of harmonized variables, concepts (like income and household), classifications, and procedures to ensure comparability across countries.

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. The sixth section contains the method and results of the actual simulation.

## DATA AND IMPUTATION

As already stated briefly in the introduction, the quasi-absence of microsimulation of combined indirect and direct taxation changes can be mainly attributed to the lack of data sets containing detailed income, direct tax, and social security data and the consumption of households and indirect tax data. Undoubtedly, the most adequate way of tackling this problem consists in conducting more comprehensive socioeconomic surveys where both types of information are registered for every household. Yet in the short run, the only possibility that the individual analyst has, though conceptually much less satisfying and methodologically much harder, is to start from one data set (in this case the EUROMOD income and direct tax data set) and enrich it household per household with information from external sources (the country-specific expenditure data set) according to some predefined algorithm (see the following).

Due to these strong data requirements, the following analysis will necessarily be restricted to four European countries:[9] Belgium (BE), Hungary (HU), Ireland (IE), and the United Kingdom (UK). Greece (GR) will be included to extend the distributional picture, but we did not run a simulation due to issues in relation to model access. The respective income and expenditure data sets available to us are given in Table 2. In terms of indirect taxation, these countries represent a selection from across the distribution of countries included in EUROMOD, with Belgium one of the countries with the lowest proportion of revenue coming from indirect taxation, the U.K. in the middle, and the remaining three grouped at the top of the distribution.

[9] Some preliminary and experimental calculations were carried out for a larger group of countries where only estimated Engel curve coefficients were made available by the owners of the expenditure surveys, rather than the micro-data themselves. This larger group consists of Denmark, Finland, France, Italy, Luxemburg, the Netherlands, Portugal, and Spain. Although a much more pragmatic matching strategy had to be adopted 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.

The imputation step itself can best be described by starting from the structure of both data sets used. A EUROMOD data set contains socio-demographic background variables (such as age, sex, employment status, and highest education level achieved) and information about income and direct taxation, on both the household and individual level. Different income variables are constructed referring to the source of income, such as income from employment, self-employment, capital, and real estate. A broad category of social benefit variables represents the social correction of primary income: state pensions,[10] family, unemployment and illness benefits, and many other, often country-specific benefits. Deducted from these are a range of tax variables such as income and property taxation, social contributions from employees, and those from employers. Treating market incomes and socio-demographic characteristics as given, EUROMOD then implements a number of policy modules (representing the existing or a reformed tax–benefit system) to obtain disposable income, which is conceptualized as the sum of market income plus benefits minus taxes and contributions. Note that some variables cannot be simulated as the micro data sets do not contain enough information. The most classical example is the state pension, which in most countries depends on the income path of an individual during his or her life, whereas budget data sets often contain merely cross-sectional or insufficient longitudinal information. In these cases, the variables are taken directly from the data set and are not simulated.

Expenditure surveys, on the other hand, contain socio-demographic information, disposable income, and a list of (very) detailed expenditure variables such as bread, gasoline, and refrigerators. To simplify the analysis and allow for cross-country comparisons, the consumption data were aggregated according to a scheme close to the highest level of the Classification of Individual Consumption by Purpose (COICOP) scheme[11] (for example, food, private transport, and durables).

The actual imputation was carried out by using estimated Engel curves.[12] For each country a list of variables was identified that is common to both the EUROMOD and the expenditure data sets, and expenditures per aggregate category were estimated upon these common variables in the expenditure survey. Because disposable income belongs to the list of common variables, the estimations obtained were Engel curves. Then the estimated models were used for predicting expenditures in the EUROMOD data set. Note that expenditures are often only registered on the household level, so the imputation was necessarily restricted to this level.

One will appreciate that there are a lot of methodological issues involved in this step. We use the best data sources of this type available, of which each contributes to harmonized cross-European analysis by Eurostat and underpins significant inequality analysis. Therefore, in this article, we will not deal with these data issues in detail, but believe it sufficient to recognize eventual failings and to refer readers to other sources for more detailed discussions and debates (for example, Atkinson & Brandolini, 2001). Besides issues in relation to the measure of welfare used, we had to deal with methodological issues in relation to the statistical matching of the data,

[10] Information about private pension schemes is often missing, a shortcoming likely to become more and more important in the traditional welfare states in Europe, where the public pension funds are under pressure from demographic evolutions.

[11] The COICOP is a legal obligation imposed by the EU on the national statistical agencies and specifies the aggregation of goods in calculating the Consumer Price Index. The aggregates involved are: food and nonalcoholic drinks, alcoholic drinks, tobacco, clothing and footwear, home fuels and electricity, rent, 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).

[12] Part of the research in the EU-funded project "Accurate Income Measurement for the Assessment of Public Policies" (AIM-AP) consisted in identifying the most efficient and robust technique to impute expenditure data. The four techniques tested were parametric and nonparametric Engel curve estimation and "copy-pasting" expenditure data by means of a distance function between observations or by grade correspondence. See Decoster et al. (2007).

differences in nature of distributions between data sets, and those related to the presence of zero expenditures, among others. The interested reader is referred to Decoster et al. (2009a) for a detailed discussion of these issues.

The second part of the imputation involves the calculation of the indirect tax liabilities. Here we constructed a file containing the VAT rate and excise information for each of the detailed consumption variables in the expenditure data set. From this a general indirect tax rate was constructed for every COICOP category by calculating a weighted average over all households and all items belonging to the respective category. With these rates, we then calculated indirect taxes from the already imputed expenditure information in the EUROMOD data set. More information can be found in Decoster et al. (2008).

## 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 for 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 percent and the reduced rate from 15 to 5 percent. This substantial change has to be kept in mind when interpreting the results. Also, the temporary reduction of the VAT rate from 17.5 percent to 15 percent in the U.K. as part of the macroeconomic stimulus package, which was approved at end of 2008, is not included. Irish VAT rates have also changed during the period, falling from 21 percent in the reference year to 20 percent, before rising back to 21 percent and 21.5 percent at the end of 2008.

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 having the lowest zero share, while in Belgium, Ireland, and the U.K., about 40 percent of expenditures are VAT exempt. As a synthetic measure to compare the degree to which the VAT covers consumption across the five countries, we include the C-efficiency introduced by Keen and Lockwood (2006). The value indicates the proportion of maximum VAT revenue, considered to be the revenue if all consumption were uniformly taxed at the standard rate, raised by the actual system including exemptions and reduced rates. Hungary and Greece have a relatively large share of consumption taxed at the standard rate, which is translated as a higher C-efficiency. On the other hand, the fact that Belgium and Ireland have a large proportion of zero-rated and exempt consumption is reflected in a lower tax coverage. The U.K. has both a high share of standard taxed goods and exempted or zero-rated goods, which results in an intermediate coverage. Overall tax coverage is the highest in Hungary, while the opposite is true for Belgium and Ireland. Our results are in general similar in rank but higher than Keen and Lockwood's calculations. However, it must be remembered that there are substantial methodological differences between the two measures, with our model only accounting for household expenditure, with the assumption of no fiscal evasion.

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, which differs from normal excise taxes in that it is levied on the consumer price rather than on quantities, mostly concerns tobacco products; however, the level of excise duties differs substantially across the countries. We present the rates in Table 3 as a percentage of the producer price. Alcohol and tobacco, for example, are most heavily taxed in the U.K.; Belgium has

**Table 3.** VAT structure and expenditure shares per VAT category; excise rates and shares for important excise good categories.

| | | VAT | | | | | Excise | | |
|---|---|---|---|---|---|---|---|---|---|
| Country and Policy Year | | Standard Rate 18–25% | Not Taxed or Exempted | Reduced Rate 1 4–6% | Reduced Rate 2 8–15% | C-Efficiency VAT | Alcohol | Tobacco | Private Transport |
| Belgium—2003 | Rates | 21 | 0 | 6 | 12 | 47.7 | 43.9 | 162.9 | 34.7 |
| | *Shares* | *41.9* | *37.9* | *19.8* | *0.4* | | *1.7* | *1.3* | *8.9* |
| Greece—2004 | Rates | 18 | 0 | 4 | 8 | 62.9 | 24.8 | 278.6 | 40.6 |
| | *Shares* | *46.5* | *16.4* | *0.5* | *36.7* | | *1.7* | *3.2* | *7.5* |
| Hungary—2005 | Rates | 25 | 0 | 5 | 15 | 70.6 | 64.3 | 273.0 | 79.0 |
| | *Shares* | *42.7* | *8.1* | *4.1* | *45.1* | | *0.6* | *2.6* | *4.1* |
| Ireland—2001 | Rates | 20 | 0 | — | 12.5 | 49.8 | 26.6 | 300.0 | 75.4 |
| | *Shares* | *36.2* | *42.0* | — | *21.8* | | *4.5* | *3.4* | *5.3* |
| United Kingdom—2004 | Rates | 17.5 | 0 | 5 | — | 59.4 | 89.7 | 414.7 | 58.8 |
| | *shares* | *57.7* | *36.3* | *6.1* | — | | *1.9* | *2.2* | *8.0* |

All rates are percentages of the producer price. For excises, the (effective) rates were calculated as the total amount of excise tax paid on the specific good divided by the total expenditure on that good minus excise taxes paid. C-efficiency is the total VAT received relative to the total VAT that could be raised by applying the standard rate uniformly under constant quantities and producer prices, and is expressed in percent.

**Table 4.** Indirect tax payments as percent 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 equivalent disposable income | 0.319 | 0.324 | 0.318 | 0.331 | 0.368 |
| Reynolds–Smolensky index | −0.011 | −0.024 | −0.016 | −0.015 | −0.015 |

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).

## INDIRECT TAX INCIDENCE

Table 4 presents the distributional effect of indirect taxes, calculated on the income data sets 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 equivalized 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, meaning that the tax rate is lower the higher the household's disposable income. Indeed, the tax rate clearly decreases monotonically across the equivalized income scale for every country, with the exception of the fifth decile in Ireland. In all countries the poorest 10 percent pay at least twice as much indirect tax relative to their income as the richest 10 percent.

The regressive effect is also confirmed at the bottom of the table, where we display the Suits index, which measures the ratio between the cumulative proportion of tax and the cumulative proportion of income. Under the Suits index, a progressive tax means that the poorest households, who together earn $q$ percent of total income, will pay less then $q$ percent of taxes, and vice versa for a regressive tax. In Table 4, the index is negative for all countries, indicating that lower incomes bear a share of the total indirect taxes collected that exceeds their share in disposable income. The rate regressivity is highest in Greece, followed by the U.K. It is substantially lower in Belgium.

The last row in Table 4 gives a measure of redistributive effect: the Reynolds–Smolensky index. It is calculated as the difference in Gini before (second last row) and after tax. The redistributive effect is negative for every country, pointing out that inequality rises because of taxation and so, again, taxes are regressive. The reason why we include the redistributive effect in our analysis is that it is a combination of a progressivity measure (like the Suits index) and the average tax rate. Indeed, taxing the richest person in a society 1 currency unit and all others 0 units will turn out to be a very progressive tax. However, the resulting redistribution will be very modest. Taking into account the average tax rate, and hence the importance

**Table 5.** Indirect tax payments as percent of disposable income—by category.

| Group | BE | GR | HU | IE | UK |
|---|---|---|---|---|---|
| Income poor | 21.1 | 20.5 | 23.0 | 20.9 | 16.7 |
| Income nonpoor | 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 |

**Table 6.** Suits and Renolds—Smolensky indices for personal income and indirect taxes.

| Country | $\pi_S^{PIT}$ | $\pi_S^{IND}$ | $\pi_S^{TOT}$ | $\pi_{RS}^{PIT}$ | $\pi_{RS}^{IND}$ | $\pi_{RS}^{TOT}$ |
|---|---|---|---|---|---|---|
| Belgium | 0.219 | −0.079 | 0.113 | 0.057 | −0.010 | 0.046 |
| Greece | 0.492 | −0.101 | 0.094 | 0.035 | −0.024 | 0.01 |
| Hungary | 0.424 | −0.086 | 0.144 | 0.056 | −0.015 | 0.041 |
| Ireland | 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 |

*Note:* $\pi_S^Y$ denotes the Suits index for tax component Y, $\pi_{RS}^Y$ the Reynolds–Smolensky index; the superscript *PIT* refers to personal income taxes, *IND* to indirect taxation, and *TOT* to personal income taxes and indirect taxation.

of the tax in the composition of incomes, corrects for this.[13] Note, for instance, that the much lower budget share of the basket of VAT-exempt commodities in Greece and Hungary in Table 3 results in a much higher average tax rate in Table 4: 18 percent and 15.3 percent, respectively, for Greece and Hungary, compared to 11.8 percent and 10.3 percent for Belgium and the U.K. Together with the most pronounced regressivity, this produces the highest adverse distributional effects in Greece: Inequality goes up by not less than 2.4 percentage points. 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 U.K. and Ireland by 1.5 percentage points. The low rate regressivity in Belgium, combined with the lowest average indirect tax rate, brings 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 nonpoor (with the poverty line at 60 percent of median equivalized income), households on income support, and households with more than 80 percent of disposable income originating from unemployment benefits and 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 U.K. 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.

The aim of matching of income and expenditure data 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

[13] See Yithzhaki (1994) and Lambert (2001) for a more extensive discussion.

**Table 7.** Total tax payments as percent 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 |

in the insurance approach related to social risk): personal income taxes. The results are striking. In Ireland, for example, indirect taxes are about as regressive as the personal income tax system is progressive.[14] 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 Gini after taxes. Indirect taxes nearly halve the redistributive effect of the progressive personal income tax system in Ireland. In Hungary and the U.K. 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.

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

## 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 their 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.

### Differences in VAT and Excises

It is hypothesized that the regressivity of 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

[14] 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.

like petrol and tobacco, which are relatively more important for low-income households, but are often considered legitimate as a compensation for some externalities associated with the commodities, for example, bad health and pollution. Table 8 divides indirect taxes into excise duties and VAT. It is clear that the hypothesis can be rejected: VAT is regressive with respect to 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 to the 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.

### Different Expenditure Patterns Across Deciles

From an efficiency point of view it makes sense to tax necessities more heavily. Although minimizing excess burdens (or welfare losses) hinges on compensated own price elasticities (taxing 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 scenario 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.[15]

Table 9 shows the budget shares in Belgium for goods of different VAT rates and excise duties. Clearly, the reduced rate products are consumed more among 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.

Synthesizing the information in Table 9 to present the picture for the four countries for which an imputation was performed, Table 10 combines the total nondurable expenditure elasticities derived from the estimated coefficients of 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-centered 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 arguments in Belgium and Hungary, and the reverse concern for efficiency in the U.K. and Ireland, although it is not very convincing. This suggests at least that equity considerations do play a role in the design of the indirect tax system by rate differentiation, which is in contrast with the theoretical result referred to in the introduction that redistribution can be achieved more efficiently via other tax channels. We come back to this point when discussing the simulation results.

### Disposable Income or Expenditures?

There is a long-standing debate on whether income or expenditures best indicate household welfare. In short, there are two main reasons why we could consider

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

**Table 8.** VAT and excise payments as percent of disposable income—by decile.

| | BE | | HU | | UK | | GR | | IR | |
|---|---|---|---|---|---|---|---|---|---|---|
| Decile | 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 equivalent disposable income | 0.319 | 0.319 | 0.318 | 0.318 | 0.368 | 0.368 | 0.312 | 0.312 | 0.315 | 0.315 |
| Reynolds–Smolensky index | −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 nonpoor | 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 |

**Table 10.** Total expenditure elasticities and average tax rates (percent).

| | BE | | HU | | IE | | UK | |
|---|---|---|---|---|---|---|---|---|
| Commodity Aggregate | (1) | (2) | (1) | (2) | (1) | (2) | (1) | (2) |
| Food, nonalcoholic 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 between (1) and (2) | 0.041 | | 0.0394 | | −0.0664 | | −0.0338 | |

*Notes:* (1) Total expenditure elasticity, except for savings and durables where elasticity is with respect to disposable income.

(2) Indirect tax rate.

expressing tax rates in terms of total expenditures rather than in terms of disposable income. The first reason is conceptual and consists of an attempt to flatten out short-run volatilities to approximate some life-cycle income concept. For instance, for someone who is temporarily unemployed or retired, looking only at their current income probably does not give an accurate idea of their welfare level, whereas looking at expenditures may be an improvement if consumption behavior is not

**Table 11.** Savings rate per decile.

| Deciles | BE | GR | HU | IE | UK |
|---|---|---|---|---|---|
| 1 | −63.4 | −117.3 | −50.4 | −109.9 | −37.1 |
| 2 | −17.5 | −62.8 | −14.3 | −67.3 | 1.7 |
| 3 | −8.1 | −36.3 | −3.9 | −38.8 | 10.4 |
| 4 | −2.1 | −3.2 | 1.6 | −25.0 | 16.3 |
| 5 | 3.8 | −26.2 | 6.4 | −22.3 | 21.3 |
| 6 | 9.3 | −14.3 | 10.1 | −11.2 | 24.2 |
| 7 | 13.3 | −8.5 | 12.1 | −2.9 | 28.6 |
| 8 | 18.0 | −5.0 | 14.4 | 4.5 | 32.5 |
| 9 | 22.7 | 1.6 | 17.6 | 15.4 | 37.8 |
| 10 | 33.3 | 15.8 | 27.1 | 38.5 | 50.4 |

guided by fluctuations in income but rather by an average level of wealth over a lifetime. Put somewhat differently: Given that savings are postponed consumption, it makes sense to assume that eventually they will be taxed at the same rate as the household currently faces, and this scenario should be taken into account when evaluating the progressivity of the tax. Table 11 shows the regressive nature of savings for all countries, indicating that changing the tax rate denominator to total expenditures may yield entirely different results in terms of progressivity.

The second reason concerns measurement problems. Indeed, the observed relationship between income and expenditures in budget surveys is often problematic. Especially for lower quantiles, average expenditure always seems to lie much higher than average income. This is not only true for the five countries observed here, as indicated by the unbelievably low savings rate for all countries in the first decile in Table 11, but also for the U.S. (Wolff & Zacharias, 2007). Sabelhaus (1993) measured savings alternatively as the difference between the change in assets and the change in liabilities and found that this method, although theoretically equivalent to income minus expenditures, yields very different results. As a consequence, performing sensitivity analyses by using other possible welfare and poverty indicators seems like a good idea, as in Meyer and Sullivan (2003). We limit ourselves here to the expenditures approach, because both our own work and that of Sabelhaus and Groen (2000) suggests that measurement error in expenditure surveys is more likely to originate from income reporting than from expenditure reporting.

Table 12 reproduces Table 4, but presents indirect tax payments as a fraction of nondurable expenditures. The conclusion, however, is opposite, indicating the crucial role of the tax rate denominator. 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, thus confirming that regressivity of savings is the most important explanation for the regressivity of indirect taxes. The rates in Table 12 can be decomposed into VAT and excise rates (as was done for Table 4 in Table 8), which does reveal a difference: The VAT system is progressive for all countries, and excises are regressive for all countries except Belgium.

## SIMULATIONS OF INCREASED INDIRECT TAXES

Finally, we utilize the matched income and expenditure data to simulate changes in indirect taxation, and evaluate the distributional consequences of these changes. We consider here a shift from labor income to consumption taxes, decreasing social security contributions of employees by 25 percent in EUROMOD. The disposable incomes before and after reform are then used as input to our indirect tax routine. Assuming government budget neutrality, we calculate the rise in the standard VAT

**Table 12.** Indirect tax payments as percent 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 nonpoor | 13.0 | n/a | 17.3 | n/a | 14.4 |
| Gini equivalent nondurable expenditures | 0.235 | 0.302 | 0.221 | 0.260 | 0.290 |
| Reynolds–Smolensky index | 0.004 | −0.001 | 0.002 | 0.049 | 0.003 |
| Suits | 0.021 | −0.006 | 0.032 | 0.025 | 0.006 |

rate necessary to compensate fully for the loss the government runs because of the tax reduction. This is done as follows.

The rise in disposable income flows entirely into expenditures, so household savings are assumed constant. Since durables have a hybrid consumption–saving character (see preceding), we made the assumption that the quantity of durables is constant. Hence, the rise in disposable income is translated into (1) the price rise in durable goods (due to an increase in VAT) at an unchanged quantity and (2) a possible rise in nondurable consumption items. The rise of nondurable expenditures was allocated over the different expenditure aggregates according to the Engel curves estimated in the imputation step. The rise in total nondurable expenditures will indeed alter the predicted budget shares and hence the expenditures and quantities consumed of the nondurable commodities.

In a second step, the increase in the indirect tax rate to compensate for the foregone revenues from social security contributions, is calculated by incrementally increasing the standard VAT rate with 1 or 0.5 percent. In each iteration step, the new aggregate tax rates (as a fraction of consumer prices) are calculated as a weighted average (see above) and applied to the new expenditure levels in order to derive the total revenue from indirect taxation. This is then compared to the revenue loss of lowering the social insurance contributions. The iteration process stops whenever budget neutrality is obtained.

Note that our model only incorporates changes in consumption behavior caused by changes in income. We do not (yet) account for possible changes in labor market behavior, and the change in the relative prices does not affect the allocation of total nondurable expenditures across the categories. Finally, we assume producer prices to be constant.

To evaluate the distributional implications of tax reform, a measure of consumption-based welfare gain (WG in the tables) was adopted. The complete derivation can be found in Capéau et al. (2009).[16] For now, it suffices to say that WG represents the

[16] For a summary of Capéau et al. (2009), please see the Appendix. All appendices are available at the end of this article as it appears in JPAM online. Go to the publisher's Web site and use the search engine to locate the article at http://www3.interscience.wiley.com/cgi-bin/jhome/34787.

money cost of obtaining a certain welfare level by purchasing a basket of goods. This implies that two adverse forces act upon WG. On the one hand, the welfare level increases due to the rise of total nondurable expenditures—at given prices households can buy more quantities—but on the other hand, rising prices also decrease the affordable quantities of goods for a given budget. The price rise therefore exerts a downward pressure on WG.[17]

The results are summarized in the following four tables. Table 13 presents the changes in the government budget. The decrease of the social insurance contributions (SIC) of the employees by 25 percent leads to a substantial necessary increase in the standard VAT rate of 4 to 5 percentage points in Belgium, Ireland, and the U.K. and up to 9 percentage points for Hungary. It is clear that the rise in standard VAT rate is proportional to the relative importance of social security contributions and the indirect tax system. Note that for some countries, like Belgium, part of the government's loss is recovered by an increase in taxable income and subsequently a rise in personal income tax (PIT). Other countries do not exclude social security contributions from the taxable base and hence their PIT revenue stays the same.

Tables 14, 15, and 16 show the welfare consequences for different subgroups of the population. 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. In Tables 14 and 16 we give the absolute changes in euros per year. In Table 15 we also give the percentage changes by dividing the absolute change by total nondurable expenditures. In Table 14 the first component of the welfare change is positive everything, which is explained by the fact that disposable income can only increase by tax reform and because savings are kept constant.[18] The second component represents the price effect, which captures the rise in price levels due to the VAT increase. As no goods have decreased prices, this effect is negative for every household. Taken together, Table 14 indicates 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 U.K., up to the sixth decile for Hungary). For the higher deciles, the situation is reversed and these groups become better off after the reform.

Table 15 shows the same figures, but they are now expressed as a percentage of total expenditures. The relative change in total nondurable expenditures is clearly increasing over the deciles, indicating that the higher deciles benefit relatively more from the rise in disposable income and making the reform regressive. The percentage loss in welfare due to the relative price effect is mainly increasing over the deciles. For Belgium, the effect decreases from the ninth decile onward, and for Ireland there seems to be no clear monotonic pattern. Yet the underlying trend for all countries is downward, making this part of the reform a progressive move (the poor lose less). Overall, however, the regressivity of the increased total nondurable expenditures outweighs the progressivity of the price effect, resulting in a clearly regressive change in WG, as indicated by the fact that percentage changes in WG increase over the deciles.

In the preceding we found that indirect tax rates, and especially VAT, were progressive with respect to total expenditures. Raising the standard VAT rate should then result in a more redistributive system rather than the regressive pattern of Tables 14 and 15.

[17] Since the welfare gain WG is derived from the expenditure function of the consumer (which is the inverse of the indirect utility function), it also takes into account maximizing behavior and captures the fact that households can try to counteract (partially) the effect of price rises on their welfare level by altering their consumption baskets.

[18] There is a possibility, however, that the price rise of durables outweighs the increase in disposable income. For example, 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 percent of the population, in Hungary 0.4 percent, and in the U.K. 1.9 percent.

**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% |

*Note:* VAT rate is in percent. Amounts are in million €s for BE, HU and IE; in million £s for UK.

**Table 14.** Decomposition of welfare change into income effect and price change—by decile in €s or £s per year.

| Decile Equiv. Nondur. 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 |

*Note:* In million €s for BE, HU and IE; in million £s for UK.

**Table 15.** Decomposition of welfare change into income effect and price change—by decile in percent of nondurable expenditures.

| Decile Equiv. Nondur. 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 | 0.37 | −1.67 | −1.30 | 0.71 | −2.22 | −1.51 | 0.01 | −0.83 | −0.82 | 0.20 | −1.17 | −0.96 |
| 2 | 0.51 | −1.70 | −1.19 | 0.87 | −2.29 | −1.41 | 0.23 | −0.90 | −0.68 | 0.55 | −1.39 | −0.85 |
| 3 | 0.89 | −1.72 | −0.83 | 1.28 | −2.36 | −1.08 | 0.47 | −0.88 | −0.41 | 0.97 | −1.45 | −0.48 |
| 4 | 1.12 | −1.74 | −0.61 | 1.63 | −2.45 | −0.82 | 0.67 | −0.87 | −0.20 | 1.19 | −1.49 | −0.30 |
| 5 | 1.63 | −1.75 | −0.12 | 2.03 | −2.52 | −0.49 | 0.89 | −0.87 | 0.02 | 1.49 | −1.51 | −0.03 |
| 6 | 1.88 | −1.78 | 0.10 | 2.34 | −2.61 | −0.27 | 0.99 | −0.89 | 0.10 | 1.84 | −1.54 | 0.30 |
| 7 | 2.18 | −1.81 | 0.37 | 2.81 | −2.67 | 0.14 | 1.01 | −0.88 | 0.13 | 2.11 | −1.58 | 0.53 |
| 8 | 2.45 | −1.86 | 0.59 | 3.14 | −2.78 | 0.36 | 1.13 | −0.94 | 0.19 | 2.40 | −1.60 | 0.80 |
| 9 | 2.54 | −1.84 | 0.70 | 3.73 | −2.85 | 0.88 | 1.18 | −0.90 | 0.28 | 2.67 | −1.62 | 1.05 |
| 10 | 2.43 | −1.79 | 0.64 | 4.83 | −3.10 | 1.72 | 1.30 | −0.96 | 0.35 | 2.17 | −1.62 | 0.55 |
| Mean | 1.86 | −1.78 | 0.08 | 2.78 | −2.68 | 0.10 | 0.95 | −0.90 | 0.05 | 1.91 | −1.55 | 0.35 |

**Table 16.** Decomposition of welfare change into income effect and price change—by group in €s or £s per year.

| Decile Equiv. Nondur. 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 |
| Nonpoor | 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 |
| Unemployed | 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 |

*Note:* In million €s for BE, HU and IE; in million £s for UK.

The reason for this can be found in the fact that for the population as a whole, the indirect tax system is less progressive than the system of social insurance contributions of the employees. This is mainly due to the fact that the nonworking population is disproportionately overrepresented in the lower deciles and does pay indirect taxes but does not pay social contributions. Hence, the gain in progressivity by raising indirect taxes is (more than) offset by the loss of progressivity by decreasing the social insurance contributions of employees. There is an important caveat for this kind of taxation shift: If one wants to retain redistribution at the same level, there are only two possibilities. First, one could make the indirect tax system more progressive by equity-driven rate differentiation, but as stated above, this is relatively ineffective. Second, one could increase the progressivity of what is left of the direct tax system to restore the redistributive power of the entire tax–-benefit system. If this second option is also barred, one has to accept the adverse distributional consequences of the tax shift.

This analysis of gainers and losers can be carried out for other subgroups of the population as well. The upper rows of Table 16 show the effects along the division of poor and nonpoor, where poverty is defined as having equivalized expenditures lower than 60 percent of the median equivalized expenditures. As can be expected from Tables 14 and 15, the reform is beneficial to the nonpoor group as a whole, but the poor group is affected very badly. The same conclusion can be drawn for socioeconomic divisions as in the lower part of Table 16: People in more vulnerable positions, like the unemployed (except for Hungary, where they are almost unaffected), retired people, and people receiving income support, do not benefit from this type of reform, while employed workers do.

## CONCLUSION

In this article, we have presented the results of imputing expenditure information into income and tax data sets 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 modeling, 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 U.K., 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 and 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 a 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 for which they are not responsible, but not affect other differences that can be described as "tastes." Of course, this provokes the normative debate about how far

people's responsibility reaches. In any case, the results here show that the results in terms of tax progressivity are very sensitive to the welfare identifier one uses.

Finally, we used the EUROMOD model to simulate a possible contemporaneous tax reform—a decrease 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, and richer households benefit from it. This was true even when keeping savings constant. The underlying reason is that although the indirect taxes are progressive with respect to total expenditures, they are less progressive than the systems of social insurance contributions of employees. This is an important caveat for possible policy change plans in this direction: If one wants to keep redistribution levels untouched, the shift to direct taxes has to be accompanied by an increase in the progressivity of the direct tax system.

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## ACKNOWLEDGMENTS

This research was carried out under FP6 contract no. 028412, "Accurate Income Measurement for the Assessment of Public Policies" (AIM-AP). An earlier version of the paper was presented at the joint OECD–University of Maryland conference, Measuring Poverty, Income Inequality, and Social Exclusion: Lessons from Europe, held in Paris March 16–17, 2009. We are very grateful for the helpful comments made by the anonymous referees.

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## APPENDIX

Write the Marshallian demand functions as:

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

where **x** and **q** denote quantities and consumer prices, respectively. In this case, the expenditure function for the nondurable commodities becomes:

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

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

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

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 nondurable expenditures (from $e^0$ to $e^1$) and in consumer prices (from $\mathbf{q}^0$ to $\mathbf{q}^1$) is then calculated as follows:

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

where $U^1 \equiv u(f(\mathbf{q}^1, e^1))$ 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 the 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:

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

leading to:

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

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 nondurable 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 nondurable 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 nondurable expenditures. But this difference would be an overestimation of the welfare gain. The other two terms in square 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, that is, the changing of the slope of the budget constraint.

With our specific assumptions, $x^* = x_i^1$, 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.