

Accurate Income Measurement for the Assessment of Public Policies (AIM-AP)  
Contract no 028412.

## **Workpackage 3.3**

### **Matching indirect taxes rates on budget surveys for five selected countries**

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**Abstract:** This workpackage contains a description of the methods by which we have linked the indirect tax code with the detailed items of the budget survey by means of the generic STATA do-file “aggrtax.do”. The program produces average tax rates for the COICOP aggregation of consumption expenditures. We present results for the five selected countries: Belgium, Greece, Ireland, Hungary and the UK.

#### **I. INTRODUCTION**

This paper documents workpackage 3.3 of the EU financed AIMAP sub-project modelling indirect taxes in 5 EU countries (Belgium, Greece, Hungary, Ireland and the UK). This workpackage links the indirect tax rates outlined in workpackage 3.1 and expenditure data from the national Household Budget Surveys (HBS) and is therefore a crucial step in the AIM-AP project which seeks to incorporate the effects of indirect taxes along with income taxes and social benefits into redistribution analysis. Workpackage 3.1 described the scope of the indirect taxes covered in this sub-project, namely VAT, excise duties and ad-valorem taxes.

This paper describes the process of linking the good specific indirect tax rates to individual goods and services in the national HBS's and then using the data to assess the redistributive characteristics of the indirect tax systems. Merging the taxation and

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expenditure data requires the assumption that pre-tax prices are independent of tax rate. However the results remain a very useful inter-country comparison of distributional features in the various indirect tax systems.

This paper focuses solely on the distributional implications of a single policy, indirect taxation. Although a prototyping study was conducted in the past to include indirect taxes in EUROMOD (See O'Donoghue et al., 2004), indirect taxes have not yet been included within the model. Incorporating indirect taxation into analyses of the distributional impact of tax-benefits is important from a distributional perspective as existing instruments do not fully capture the redistributive nature of the system because one instrument may be designed to offset the inequality inducing effects of another instrument. For instance an indirect tax system may display low inequality aversion on the part of government but adequate consideration of the benefit system could suggest otherwise. We therefore advise caution regarding the interpretation of the results of a partial redistributive analysis of a single policy instrument given the inter connection of policy instruments.

Indirect taxation is considered a regressive form of taxation as it imposes taxation that does not explicitly account for the ability to pay principle. The design of the indirect tax system can be such that items considered essential are not subject to high rates of taxation. However the results will show that the low taxing and sometimes exemption of necessities does not prevent tax liabilities from being roughly proportional to total expenditure regardless of income level in all five selected countries. This means that indirect taxation is very regressive when expressed as a proportion of household income.

Indirect taxation therefore plays an important role in determining the distribution of economic welfare. It is therefore important to quantify the extent of inequality variation according to country, commodity group, the form of taxation i.e. VAT or excise duty and according to the different rates and exemptions. Basic summary statistics and calculation of the Kakwani Index illustrate the redistributive impact of the indirect tax system. There is a description of the methods used to produce average tax rates for commodity aggregates in all five countries. There is an additional examination of 'the savings dilemma' which poses question marks over the accuracy of some results in terms of their redistributive impact. We find this 'savings dilemma' to be particularly evident in the case of Greece and to a lesser extent Ireland.

This study is also important from a competition and efficiency perspective given that differences in indirect tax rates for tradable goods can prevent fairer competition between countries. The establishment of the Single European Market in 1992 required a degree of harmonization between countries in relation to indirect taxation. The arrival of the Euro in 2002 means that transaction costs are lower between member countries and price

comparisons of tradable goods easier to construct. Two of the EU countries selected (Hungary and the United Kingdom) are currently not members of the EMU.

## II. BUDGET SURVEYS AND COICOP AGGREGATION

The budget survey data for the five selected countries represent the most recent household budget micro data from each country. For Greece and Hungary we have budget data for the 2004/05 period whilst for Belgium, Ireland and the United Kingdom we rely upon less recent data from 2000/01 and 1999/00 in the case of Ireland. Sample sizes in terms of number of households vary from 3,698 in the case of Belgium to 8,710 for Ireland. The Belgian data has the smallest number of households but the greatest number of expenditure items amounting to 974. This greatly outnumbers the number of expenditure items for the other four countries. Ireland is next highest with 579 items and Hungary has the lowest with 453 items (table 1). The analysis uses the taxation systems of the same year as the budget surveys so that we do not have to account for the relative price effects of indirect tax changes upon consumption between both years.

TABLE 1: BUDGET SURVEYS FOR THE SELECTED COUNTRIES

Country	Name of Survey	Provider	Year	# of hh	# of items
Belgium	Household Budget Survey	N.I.S.	2001	3698	974
Greece	Household Budget Survey	National Statistics of Greece	2004/2005	6555	502
Hungary	Household Budget Survey	Hungarian Central Statistical Office	2004	8710	453
Ireland	Household Budget Survey	CSO	1999/2000	7644	579
UK	Family Expenditures Survey	Office for National Statistics	2000/2001	6100	518

TABLE 2: PER CAPITA EXPENDITURES IN EURO FOR THE COICOP AGGREGATION IN THE FIVE BUDGET SURVEYS

	Aggregate	BE	GR	HU*	IR	UK*
1	Food, non alcoholic beverages	1630	1848	563	1491	1597
2	Alcoholic beverages	172	142	27	501	198
3	Tobacco	104	263	58	198	171
4	Clothing and footwear	573	673	128	572	722
5	Home fuels and electricity	593	303	273	369	380
6	Rents	532	486	21	193	422
7	Household services	512	703	220	399	610
8	Health	627	739	89	181	106
9	Private transport	1040	627	177	465	1107
10	Public Transport	60	112	54	145	178
11	Communication	280	368	147	233	336
12	Recreation and culture	830	372	123	596	1074
13	Education	81	241	21	126	323
14	Restaurants and hotels	939	401	79	520	1285
15	Other goods and services	1024	193	146	1546	859
16	Home production	0	0	73	0	0
	Total non durable expenditure	8996	7470	2198	7535	9367
17	Durables	1139	830	203	1721	2078
18	Saving**	1438	-1009	96	-253	3281
	Disposable income	11573	7291	2498	9003	14726

\* 1HUF=0.004EUR; 1GBP=1.481EUR  
\*\* saving is income minus total expenditures, including durables

Table 2 above shows the amount in euros of expenditure per capita for each commodity group. The results show that the United Kingdom has the highest level of disposable income per capita. However comparisons are not entirely reliable given that the survey years differ between countries and there is the added savings dilemma revealed above and by tables 4 and 5 which pose question marks over the accuracy of the reported income results for Greece and Ireland in particular.

The above table provides an outline of the aggregation. The appendix provides a more detailed description of the aggregation process. The chief objective of aggregation is to pool expenditure items of similar uses and characteristics together in one commodity group.

Avoiding the pitfalls of zero expenditures is an important motivation behind the aggregation process. Pooling expenditures items together reduces the likelihood of there being a zero level of consumption for a particular commodity type. This helps us in our efforts to overcome the shortness of the survey period. It is of further importance for the computation of price elasticities of demand and consideration of behavioural responses. Presenting tax rates in terms of aggregates is more concise and readable.

Our aggregation method is a hybrid of the national accounts and COICOP methods but lies closer to the latter. For instance the national accounts method treats food and non-alcoholic beverages separately and home fuels and electricity separately whereas the COICOP method amalgamates both. In both instances we use the COICOP method. There is no difference between national accounts and COICOP in relation to clothing and footwear, health, communications and education and restaurants. We isolate rents and durables as separate groups something that is not explicitly part of either method. Private and public transport expenditures are treated separately because in most countries the former is taxed heavier than the latter. This separation is more consistent with the national accounts than COICOP which treats public and private together.

Perhaps most important is the treatment of durables which tend to exhibit characteristics very different to other expenditure items. We have been severe in our categorisation of durables by including most items whose consumption is of a one-off nature in the durables commodity group e.g. cutlery, burglar alarms and television sets. A stricter interpretation of COICOP would have placed these items into different categories. However the importance of isolating such durables becomes apparent in the use of regression techniques for statistical matching and behavioural response.

Table 3 provides the budget shares for each commodity group in all five countries. Ireland has the highest share for alcohol, Greece for tobacco, Hungary for home fuels and electricity and the United Kingdom for restaurants. The results show that the savings rates are negative in the case of Greece and Ireland. This poses a number of problems. One of the objectives of AIM-AP is measuring the impact of taxation upon the income distribution. If there are doubts about the accuracy of the disposable income variable, this will impact negatively upon the accuracy of the results. Negative savings rates certainly place doubt on the accuracy of income variables indicating that income may be under-reported or expenditures over-estimated. Our experience suggests that the former is more likely than the latter.

TABLE 3: BUDGET SHARES FOR THE COICOP AGGREGATION IN THE FIVE BUDGET SURVEYS

	Aggregate	BE	GR	HU	IR	UK
1	Food, non alcoholic beverages	16.1	22.3	23.4	16.1	14.0
2	Alcoholic beverages	1.7	1.7	1.1	5.4	1.7
3	Tobacco	1.0	3.2	2.4	2.1	1.5
4	Clothing and footwear	5.6	8.1	5.3	6.2	6.3
5	Home fuels and electricity	5.9	3.7	11.3	4.0	3.3
6	Rents	5.2	5.9	0.9	2.1	3.7
7	Household services	5.1	8.5	9.2	4.3	5.3
8	Health	6.2	8.9	3.7	2.0	0.9
9	Private transport	10.3	7.5	7.4	5.0	9.7
10	Public Transport	0.6	1.3	2.2	1.6	1.6
11	Communication	2.8	4.4	6.1	2.5	2.9
12	Recreation and culture	8.2	4.5	5.1	6.4	9.4
13	Education	0.8	2.9	0.9	1.4	2.8
14	Restaurants	9.3	4.8	3.3	5.6	11.2
15	Other goods and services	10.1	2.3	6.1	16.7	7.5
16	Durables	11.2	10.0	8.5	18.6	18.2
17	Home production	0	0.0	3.0	0.0	
	With respect to income					
18	Saving	12.4	-13.8	3.8	-2.8	22.3

A further investigation of savings rates is revealed by Tables 4 and 5 which show the savings rates by income deciles with and without durable expenditures. A common feature of all country results is that saving rates are positively related to income. Table 4 shows that savings are positive in the top quintile of all countries. The bottom quintiles are dominated by negative savings. There may be some consumption smoothing taking place in that households suffering short periods of low income use their savings to maintain a certain long run standard of living.

TABLE 4: SAVINGS RATE BY DECILE IN THE FIVE BUDGET SURVEYS (IN %): SAVING DEFINED AS INCOME MINUS TOTAL EXPENDITURES

Decile	BE	GR	HU	IR	UK
1	-60.3	-117.3	-133.3	-63.2	-73.5
2	-11.6	-62.8	-25.6	-25.6	-0.6
3	-2.9	-36.3	-11.8	-23.2	0.2
4	-1.3	-32	-4.2	-18.6	7.9
5	1.1	-26.2	1.0	-13.4	9.5
6	6.6	-14.3	5.4	-11.8	16.7
7	11.4	-8.5	7.7	-4	20.3
8	11.1	-5	10.8	0.5	23.7
9	20.9	1.6	14.7	5.8	27.9
10	38.6	15.8	24.6	21.4	44.6

Note: Deciles are defined as deciles of equivalised disposable income.

TABLE 5: SAVINGS RATE BY DECILE IN THE FIVE BUDGET SURVEYS (IN %): SAVING DEFINED AS INCOME MINUS TOTAL NON-DURABLE EXPENDITURES

Decile	BE	GR	HU	IR	UK
1	-48.6	-105.4	-119.9	-40.8	-51.8
2	-0.6	-50.8	-19.1	-8.3	11.1
3	6.4	-25.0	-5.1	-4	14.3
4	7.2	-18.5	2.4	0.7	22.5
5	11.1	-14.6	8.7	6.2	26.3
6	16.5	-2.6	12.8	9.2	32.0
7	21.5	2.2	15.8	16.1	34.9
8	23.4	6.1	18.8	19	38.6
9	31.2	12.1	23.2	24	41.6
10	46.6	27.3	33.5	37.2	56.7

Note: Deciles are defined as deciles of equivalised disposable income.

There is also the possibility explored in table 5 that durables are responsible for a large degree of the negative savings. This appears to be a reasonable assertion in the case of Ireland where savings rates become positive for all but the bottom three income deciles after the removal of durables. A similar pattern is true for all of the other countries in particular Belgium and the United Kingdom. The removal of durables from the calculation does not solve the problem in the case of Greece and it is likely that this will require further research.

TABLE 6: % OF HOUSEHOLDS WITH ZERO EXPENDITURES FOR THE COICOP AGGREGATION IN THE FIVE BUDGET SURVEYS

	Aggregate	BE	GR	HU	IR	UK
1	Food, non alcoholic beverages	0.0	0.0	0.0	0.2	0.4
2	Alcoholic beverages	25.2	28.8	40.3	26.6	47.6
3	Tobacco	66.3	34.8	56.3	55.7	70.6
4	Clothing and footwear	18.9	10.2	4.1	33.0	30.5
5	Home fuels and electricity	0.0	0.0	0.1	0.7	5.5
6	Rents	67.0	80.1	91.8	83.5	80.5
7	Household services	0.1	0.0	0.1	3.6	1.4
8	Health	11.4	2.0	17.2	42.0	50.7
9	Private transport	18.3	30.2	46.7	27.4	22.3
10	Public Transport	66.7	36.9	49.3	57.7	56.2
11	Communication	21.7	0.5	7.5	6.0	4.2
12	Recreation and culture	0.8	0.1	5.2	1.4	1.2
13	Education	84.0	70.6	72.5	78.7	90.8
14	Restaurants	11.6	38	52.8	18.8	10.0
15	Other goods and services	1.9	31.8	2.4	2.0	1.8
16	Durables	20.8	15.2	19.4	9.7	21.6

Table 6 above details the percentage of household with zero expenditures for each commodity group. The results appear to correspond with those of table 3 in that a high budget share for a particular commodity is generally matched by a low level of abstinence from that commodity. There are however unusual results such as the high degree of abstinence from expenditure on clothing in both Ireland and the United Kingdom. This could be attributed to the duration of the survey period being so short, two weeks in the case of Ireland. The existence of such zero records is detrimental for statistical matching.

High abstinence from healthcare expenditure in Ireland and the United Kingdom is likely due to the high provision of public healthcare relative to private healthcare in both countries. The converse is true for Greece. It is interesting that Greece has the highest budget share for rents but abstinence from rent expenditure is greater than that of Belgium. It can be assumed that home ownership accounts for the differences in abstinence levels between Greece and Belgium in relation to rents as imputed rents are excluded from the analysis. Perhaps the high budget share for Greece can be attributed to different price levels.

The impact of prices upon budget shares in the case of Hungary may be influenced by its stage of economic development. For instance budget shares for communication and home fuels and electricity appear much higher than in the other four countries. This may be influenced by the degree of regulation, monopoly and poorer infrastructural structure for technology adoption. Ireland has relatively high prices for alcohol which may partially explain the high budget share for that commodity.

### III. THE DO-FILE `aggrtax.do`

The “`aggrtax.do`”-file is the generic STATA dofile which translates the tax legislation for a given year and country into tax rates for the COICOP-aggregates. It also produces some standard tables of distributional analysis of the indirect tax liabilities. We list the program in the appendix.

The program reads in two input files:

- `HBSdetail_country_year.dta`: with the detailed expenditures for hundreds of items in the survey for country “*country*” in year “*year*”, both parts of the filename. This file is structured on the basis of two identification numbers: one which identifies the household, and one that identifies the expenditure item in the very detailed classification of the budget survey. Most of the budget surveys also contain a weighting variable which accounts for non-response and is used to render the sample representative for the underlying population.
- `taxcode_country_year.dta`: with the tax legislation for all items of the household budget survey. For each of these items we have in the file:
  - the VAT rate
  - the excise duty
  - the consumer price (corresponding to the year for which the excise duty is registered)
  - the commodity group of the COICOP-aggregation where the user wants this item to belong to.

As the extension `.dta` reveals, both datasets are STATA-datasets.

The STATA -program “`aggrtax.do`” essentially links the two datasets by calculating first indirect tax liabilities on each separate item for each household, then aggregating these tax liabilities into COICOP-aggregates, and expressing this as implicit tax rates on these COICOP-aggregates. The way in which we calculate these indirect tax liabilities was spelled out in WP 3.1. For completeness, we briefly summarize here the technique of the calculation.

In the expenditure survey we observe household expenditures at *consumer prices*. Most of the indirect tax legislation is expressed in terms of *producer prices* (i.e. prices before taxes). Therefore, the basic relationship in the linking program “`aggrtax.do`” is the one which links consumer price to producer price through the different elements of the tax system:

$$q_i = (1 + t_i)(p_i + a_i + v_i \cdot q_i), \quad (1)$$

in which  $q_i$  denotes the consumer or retail price for commodity  $i$ ,  $p_i$  the producer price,  $a_i$  the excise tax,  $v_i$  an ad valorem tax rate applied on the consumer price and  $t_i$  the VAT-rate.

To focus on the effect of changes in indirect taxes on household budgets, we will assume that producer prices are fixed. Hence, changes in the consumer price of (1) can only be induced by changes in the tax parameters, not in changes in producer prices. To implement this assumption of constant producer price in the simulation program, it is convenient to express the producer price in function of the consumer price and the tax parameters. This is done by re-arranging (1) and solving for the producer price  $p_i$ , and gives:

$$p_i = \left[ \frac{1 - (1 + t_i)v_i}{1 + t_i} \right] q_i - a_i. \quad (2)$$

Equation (2) is implemented for the baseline situation in line 89 of the program.<sup>3</sup> Note that consumer prices  $q_i$ . Yet, for commodities where there is no specific excise duty ( $a_i = 0$ ), we can without loss of generality put the consumer prices equal to one. That is what is done in practice. For the commodities that are amenable to specific excise duties we have entered the retail price in the baseline in the input dataset “`taxcode_country_year.dta`”.

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<sup>3</sup> Note that the subtraction of the excise in equation (2) might for a given consumer price lead to negative producer prices. We therefore add in line 91 a “count” of these cases.

As explained in WP 3.1 (and also see below), the program “`aggrtax.do`” calculates indirect tax liabilities on the basis of expenditures. When running the program for a *reform situation*, this means that we need a first estimate of the expenditures at the new consumer prices.<sup>4</sup> In this stage of the project, where we only want to calculate implicit tax rates on the COICOP-aggregation, we have opted to calculate this reform expenditure levels by assuming that quantities are constant. Denoting expenditures in the baseline on commodity  $i$  as  $e_i^0$ , where the superscript 0 refers to the baseline, and  $x_i^0$  as the quantity consumed in the baseline we have:

$$e_i^0 = q_i^0 x_i^0, \quad (3)$$

Hence in the reform situation, with new consumer prices  $q_i^1$ , and with the assumption  $x_i^0 = x_i^1$ , we easily derive that the reform expenditures will be:

$$e_i^1 = q_i^1 x_i^1 = q_i^1 x_i^0 = \frac{q_i^1}{q_i^0} e_i^0. \quad (4)$$

The reader can check this on line 171 of the program. The post reform consumer price is calculated on the basis of the fixed producer price, obtained from (2), and the eventually changed tax parameters (see line 96 of the code).

It is often more practical to express the excise duty  $a_i$  as a fraction of the producer price  $p_i$ . With  $\alpha_i$  denoting this fraction, the relation between consumer and producer price in (1) can be rewritten as:

$$q_i = (1+t_i) \cdot (p_i + \alpha_i \cdot p_i + v_i \cdot q_i), \quad (5)$$

or also as:

$$q_i = \frac{(1+t_i) \cdot (1+\alpha_i)}{1-v_i \cdot (1+t_i)} \cdot p_i = z_i \cdot p_i, \quad (6)$$

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<sup>4</sup> This first estimate should not be considered as a “behavioural” model. It does not replace some form of a demand system that might be used in a later stage to model the reaction of households on changed relative prices. But the essence of this program is the mapping of the tax legislation onto the COICOP-aggregation, not the behavioural modelling.

where  $z_i = \frac{(1+t_i) \cdot (1+\alpha_i)}{1-v_i \cdot (1+t_i)}$  is the ratio of consumer to producer price for commodity  $i$ .<sup>5</sup>

The total tax rate  $\tau_i$  on commodity  $i$  can then be expressed as:

$$\tau_i = z_i - 1 \quad (7)$$

$$= \frac{t_i(1+\alpha_i+v_i)+v_i}{1-(1+t_i)v_i} + \frac{\alpha_i}{1-(1+t_i)v_i} \quad (8)$$

$$= \tau_i^t + \tau_i^a. \quad (9)$$

In (8) and (9) the total tax rate  $\tau_i$  has been decomposed into an implicit VAT-rate  $\tau_i^t$  and an implicit excise tax rate  $\tau_i^a$ . The VAT paid on the excise duty, and the ad valorem duty are taken included in the ‘‘VAT’’-component. Equations (8) and (9) are implemented in lines 175-180 of the program.

These tax rates are used to calculate tax liabilities on the basis of observed expenditures:

$$\begin{aligned} T_i &= \frac{\tau_i}{1+\tau_i} e_i \\ &= \tilde{\tau}_i e_i, \end{aligned} \quad (10)$$

where we have switched from the tax rate  $\tau_i$  on a tax exclusive basis, to tax rate  $\tilde{\tau}_i$  on a tax inclusive basis. Evidently the total indirect tax liability in (10) can be decomposed into the VAT- and the excise duty component:

$$\begin{aligned} T_i &= \frac{\tau_i^t}{1+\tau_i} e_i + \frac{\tau_i^a}{1+\tau_i} e_i \\ &= T_i^t + T_i^a, \end{aligned} \quad (11)$$

where  $T_i^t$  and  $T_i^a$  refer to VAT and excise tax liability for commodity  $i$  respectively.

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5 See WP 3.1 for a note on an alternative empirical estimation of  $\alpha_i$ , viz. on macro-economic revenue figures.

All the above formulae are applied to individual commodities. The final step consists of aggregating these tax liabilities (and also the expenditures) into the COICOP aggregates. This will provide us with implicit indirect tax rates on the aggregated commodity groups, which can then be used to calculate indirect tax liabilities on e.g. EUROMOD datasets that only will contain these broader aggregates.

The tax liability for commodity aggregate  $K$ , denoted by  $T_K$ , is obtained as the sum of the tax liabilities paid on the individual commodities:

$$\begin{aligned} T_K &= \sum_{i \in K} T_i \\ &= \sum_{i \in K} T_i^t + \sum_{i \in K} T_i^a \\ &= T_K^t + T_K^a. \end{aligned} \tag{12}$$

The sets of aggregates, containing the individual commodities, are defined by the user in the file `taxcode_country_year.dta`.

The *implicit tax rates on the aggregates* are then defined as:

$$\begin{aligned} \tau_K &= \frac{T_K}{e_K - T_K} \\ &= \frac{T_K^t}{e_K - T_K} + \frac{T_K^a}{e_K - T_K} \\ &= \tau_K^t + \tau_K^a. \end{aligned} \tag{13}$$

Hence, also the tax rates on the aggregates are defined on a tax exclusive basis. Equation (13) is implemented on lines 293-295 of the code of “`aggrtax.do`”. Of course the “aggregate” tax rates are weighted averages of the tax rates on the individual commodities, with as weights the share of the tax exclusive expenditures on commodity  $i$  in total tax exclusive expenditures for aggregate  $K$ .

Again, there is the alternative of rewriting the tax rate on the aggregate on a tax inclusive basis:

$$\tilde{\tau}_K = \frac{T_K}{e_K} = \frac{\tau_K}{1 + \tau_K}, \tag{14}$$

with analogous expressions for the separate VAT- and excise rate. In the tables below we will report both the tax rate  $\tau_K$  (on the tax exclusive base), as the tax rate  $\tilde{\tau}_K$  (on the tax inclusive base).

Moreover, and certainly for distributional analysis, there is a possibility to express the tax burden, to wit w.r.t. disposable income instead of w.r.t. expenditures (tax inclusive or tax exclusive). We denote the share of indirect taxes in disposable income by  $\delta$  (suitable subscripts and superscripts can be added to refer to the share of separate tax liabilities related to separate commodities or commodity groups). We then finally have three different candidates to summarize the tax burden:

$$\tau = \frac{T}{e-T}, \quad (15)$$

$$\tilde{\tau} = \frac{T}{e} = \frac{\tau}{1+\tau} \quad (16)$$

$$\delta = \frac{T}{y}. \quad (17)$$

Defining disposable income  $y$  as the difference between total expenditures and saving  $S$ , we have:

$$\begin{aligned} y &= e + S \\ &= (e - T) + T + S, \end{aligned} \quad (18)$$

which allows one to rewrite the share of indirect taxes in disposable income as a function of the tax rate on expenditures and of the savings rate:

$$\begin{aligned} \delta &= \frac{\tau}{1+\tau} (1-s) \\ &= \tilde{\tau} (1-s). \end{aligned} \quad (19)$$

Equation (19) shows that a distributional analysis of indirect tax shares will crucially hinge upon the choice of expenditures or disposable income in the denominator.

The results of the program “`aggrtax.do`” are stored in stata-outputfiles that later can be used for calculations of indirect tax liabilities in other databases. The program also produces some standard Tables detailing the tax rates and amounts for each commodity group. It is to these descriptive tables for the different countries that we now turn in the next section.

#### IV. RESULTS

The results are chiefly concerned with the aggregate tax rates and the inequality effects of those tax rates. An important point is that tax rates represent the average rate for the sample population.

Tax rates are calculated by dividing the tax liability for that population by the total pre-tax expenditure for that population. Therefore we are not providing an average of household tax rates which can be a very inaccurate reflection of the population average. This is especially important given the often short survey period and the resultant zero expenditures in household budget surveys. The variability of tax rates within commodity groups could further distort the results. For instance a high spending household may encounter very low average tax rates whereas low spending households may encounter high tax rates for the same commodity groups. In those circumstances, an average of the two household tax rates would be an over estimate of the true tax rate for that population.

TABLE 7: SHARE OF TOTAL EXPENDITURE PER VAT-CATEGORY

Country	not taxed or exempted	reduced rate 1 4-6%	reduced rate 2 8-15%	standard rate 18-25%
share of expenditures (in %)				
BE	37.9	19.8	0.4	41.9
GR	16.4	0.5	36.7	46.5
HU	8.1	4.1	45.1	42.7
IR	42.0	-	21.8	36.2
UK	36.3	6.1	-	57.7
Exact VAT-rates (% of producer price)				
BE		6	12	21
GR		4	8	18
HU		5	15	25
IR			12.5	21
UK		5		18

Table 7 above shows there is a good deal of variety between countries in terms of the number of VAT rates applicable, their magnitude and the relative significance of each rate.

The results show that exemptions are greatest in the case of Ireland with Belgium and the United Kingdom displaying similar levels of expenditure being exempt from VAT. Greece and Hungary have much lower levels of expenditures exempt from VAT. The lower reduced rates between 4 and 6 per cent apply to all countries except Ireland. These rates are most common to expenditures in Belgium than any other country. In all countries they are the least relevant set of rates.

The higher reduced rates are particularly relevant in the case of Hungary and Greece. However Ireland uses this rate extensively whilst Belgium does not and the United Kingdom completely excludes it from their system. The standard rate applies to the greatest degree in the United Kingdom. However all countries rely heavily on the standard rate which varies from 18 per cent in the case of Greece and the United Kingdom to 25 per cent in the case of Hungary.

Table 8 shows the average indirect tax rates for all commodity groups. There are some interesting results. Indirect taxes applying to Food are much greater in Hungary than in the other four countries. The vast majority of food items are exempt from indirect taxes in both Ireland and the United Kingdom. Non alcoholic beverages form part of the food category and taxes apply to those items in all countries. There is some variation in the alcoholic beverages category. Belgium, Greece and Ireland have similar rates for alcohol. Hungary and the United Kingdom are greater in that regard.

Tobacco is the most taxed category in all countries. Clothing is taxed at the standard rate in most countries. However children's clothing is exempt in both Ireland and the United Kingdom. Some excise duties apply to home fuels and electricity. However VAT dominates taxation in this category. The existence of high excise duties for this category in Greece is partly responsible for the high average tax rate. Health taxation is low in all countries but is highest in Greece which relies more heavily on private healthcare.

The private transport category excludes durables such as motor vehicles and is therefore dominated by motor fuels for which excise duties are high in all countries. This is the second highest taxed commodity group. Public transport is exempt from indirect taxes in both Ireland and the United Kingdom. The standard VAT rate applies to most communication items in all countries. Education is generally exempt from indirect taxes in all countries. The United Kingdom has the highest tax on restaurants. Durables are taxed more in Belgium and Hungary than in the other three countries. The total indirect tax rates show that Hungary has the highest average tax rate followed by the United Kingdom, Greece, and Ireland with Belgium having the lowest average indirect tax rate. Treating excise duties and VAT separately makes a difference. The United Kingdom has the highest excise duty rate but Hungary is highest with regard to VAT.

TABLE 8: AVERAGE INDIRECT TAX RATES FOR THE COICOP AGGREGATION IN THE FIVE BUDGET SURVEYS

	Aggregate	BE	GR	HU	IR	UK
1	Food, non alcoholic beverages	6.4	7.9	15.5	3.9	2.1
2	Alcoholic beverages	40.9	24.8	65.3	29.9	65.9
3	Tobacco	207.5	278.6	300.9	317.0	522.3
4	Clothing and footwear	20.8	18.0	25.0	16.0	14.5
5	Home fuels and electricity	23.1	46.1	15.0	12.9	5.0
6	Rents	0.0	0.0	0.0	0.0	0.0
7	Household services	15.9	14.0	20.9	17.2	12.6
8	Health	2.9	4.1	5.5	1.1	0.0
9	Private transport	34.5	40.6	86.9	72.3	56.4
10	Public Transport	5.8	8.0	25.0	0.0	0.0
11	Communication	20.0	17.9	24.9	19.8	17.0
12	Recreation and culture	13.2	9.7	11.9	12.8	13.9
13	Education	1.9	0.3	0.0	1.7	0.0
14	Restaurants	11.9	16.8	14.0	12.9	18.0
15	Other goods and services	7.7	6.8	22.8	2.8	8.8
16	Durables	21.0	17.9	24.1	15.1	17.5
17	Home production		0.0	0	0	
	<b>Total indirect tax rate</b>	<b>12.3</b>	<b>14.2</b>	<b>22.8</b>	<b>14</b>	<b>16.1</b>
	total VAT-rate	10.6	11.8	18.7	10.8	11.6
	total Excise-rate	1.7	2.4	4.1	3.2	4.5

Note: tax rates in this table are tax liabilities divided by expenditures **minus taxes**, hence on a tax exclusive basis

TABLE 9: TOTAL INDIRECT TAX RATES BY DECILE OF DISPOSABLE INCOME IN THE FIVE BUDGET SURVEYS

Decile	BE		GR		HU		IR		UK	
	tax as % of prod. price	tax as % of income								
1	13.7	19.3	15.2	28.6	21.6	41.4	14.4	20.5	14.9	22.6
2	14.6	14.2	16.1	22.6	20.6	21.5	15.0	16.4	14.5	12.8
3	14.1	12.7	16.4	19.2	20.9	19.4	15.0	16.1	15.1	13.1
4	14.4	12.7	16.6	18.8	21.5	18.4	15.3	15.7	16.0	12.7
5	14.6	12.6	16.3	17.7	21.4	17.4	15.2	14.9	16.2	12.6
6	15.0	12.2	16.5	16.2	22.4	17.3	15.2	14.8	16.5	11.8
7	14.8	11.4	17.0	15.8	23.2	17.4	14.8	13.4	17.3	11.7
8	15.3	11.8	16.6	14.9	23.5	17.0	14.8	12.8	16.6	10.9
9	14.8	10.2	16.9	14.2	24.5	16.8	14.0	11.5	16.3	10.1
10	15.0	8.0	16.4	11.9	24.4	14.8	13.3	9.2	15.7	7.5
average	14.6	12.5	16.4	18	22.4	20.1	14.7	14.5	15.9	12.6
Kakwani index	-0.104		-0.106		-0.093		-0.104		-0.109	
Gini disp income	0.289		0.324		0.289		0.324		0.351	
conc. coeff taxes	0.185		0.217		0.196		0.219		0.241	

Notes: 1) deciles based on equivalent disposable income  
2) tax rates are on a tax inclusive basis: tax liability divided by disposable income

Table 9 shows the total indirect tax rate by decile of disposable income in the five budget surveys. In terms of percentage of producer price, most countries exhibit progressivity in that higher income groups tend to consume goods for which high indirect taxes apply. A possible exception is Ireland where the top two income deciles have tax rates below the average. In terms of percentage of disposable income, indirect taxes are regressive in all countries as indicated by the Kakwani Index. It is important to note that the computation of the Kakwani Index requires us to express tax rates as a percentage of the consumer rather than the producer price. The Kakwani Index results show that the United Kingdom has the most regressive system and Hungary the least regressive.

TABLE 10: VAT RATES BY DECILE OF DISPOSABLE INCOME IN THE FIVE BUDGET SURVEYS

Decile	BE		GR		HU		IR		UK	
	tax as % of prod. price	tax as % of income								
1	11.7	16.5	12.8	24.1	17.8	34.1	10.6	15.1	9.9	15.0
2	12.4	12.1	13.2	18.6	17.2	17.9	10.8	11.8	9.6	8.4
3	12.0	10.8	13.6	15.9	17.7	16.3	11	11.7	10.4	9.0
4	12.2	10.8	13.7	15.5	18.1	15.5	11.5	11.8	11.1	8.8
5	12.4	10.7	13.6	14.8	18.0	14.7	11.5	11.3	11.6	9.0
6	12.8	10.4	13.7	13.4	18.5	14.3	11.7	11.4	11.9	8.5
7	12.6	9.7	14	13	18.8	14.1	11.6	10.5	12.2	8.3
8	13.2	10.1	13.8	12.4	19.1	13.8	11.7	10.2	12.2	8.0
9	12.8	8.8	13.9	11.7	19.7	13.5	11.4	9.4	12.0	7.4
10	13.2	7.0	13.7	9.9	19.7	12.0	11	7.7	12.1	5.8
average	12.5	10.7	13.6	14.9	18.5	16.6	11.3	11.1	11.3	8.8
Kakwani index	-0.098		-0.106		-0.100		-0.082		-0.087	
Gini disp income	0.289		0.324		0.289		0.324		0.351	
conc. coeff taxes	0.191		0.218		0.188		0.241		0.263	

Notes: 1) deciles based on equivalent disposable income  
2) tax rates are on a tax inclusive basis: tax liability divided by disposable income

Tables 10 and 11 above show the distributional impact of VAT and excise duty. In terms of percentage of producer price, there appears to be progressivity in all countries. However in terms of percentage of income the results reveal strong regressivity. It is interesting that the UK system displays less regressivity with regard to VAT than to excise duties indicating that excise duties are responsible for the UK having the most regressive system which is confirmed by the results in table 7c. Ireland has a similar pattern to the UK in that excise duties are more regressive than VAT. Greece is the most regressive with regard to VAT. The regressivity of the Greek system varies little between excise duties and VAT. This is in stark contrast to the other four countries. Hungary is unusual in that it is the only country where the regressivity of VAT is greater than that for excise duties.

TABLE 11: EXCISE TAXRATES BY DECILE OF DISPOSABLE INCOME IN THE FIVE BUDGET SURVEYS

Decile	BE		GR		HU		IR		UK	
	tax as % of prod. price	tax as % of income								
1	2.0	2.8	2.4	4.5	3.8	7.3	3.8	5.5	5.0	7.6
2	2.2	2.1	2.8	4	3.4	3.6	4.2	4.5	5.0	4.4
3	2.1	1.9	2.8	3.3	3.3	3.0	4.1	4.4	4.7	4.1
4	2.2	1.9	2.9	3.3	3.4	2.9	3.8	3.9	4.9	3.9
5	2.2	1.9	2.7	3	3.3	2.7	3.7	3.6	4.6	3.6
6	2.2	1.8	2.9	2.8	3.8	3.0	3.4	3.3	4.7	3.3
7	2.2	1.7	3	2.8	4.4	3.3	3.2	2.9	5.1	3.4
8	2.2	1.7	2.8	2.6	4.4	3.2	3.1	2.6	4.4	2.9
9	2.0	1.4	3	2.5	4.8	3.3	2.6	2.1	4.3	2.7
10	1.8	1.0	2.7	1.9	4.6	2.8	2.2	1.6	3.5	1.7
Average	2.1	1.8	2.8	3.1	3.9	3.5	3.4	3.4	4.6	3.7
Kakwani index		-0.138		-0.108		-0.057		-0.183		-0.168
Gini disp income		0.289		0.324		0.289		0.324		0.351
conc. coeff taxes		0.150		0.216		0.232		0.14		0.183

Notes: 1) deciles based on equivalent disposable income

2) tax rates are on a tax inclusive basis: tax liability divided by disposable income

Table 12 shows the distributional impact in terms of expenditure deciles. There is a good deal of variety between the countries in that Belgium and Ireland appear to have regressive systems whereas the other three countries have progressive systems. This indicates that there is greater disparity in Greece and the UK between using income and expenditure deciles. The gini coefficient of non durable expenditure is greatest for the UK followed closely by Ireland and lowest for Hungary. Ireland and the UK have the highest shares for durable expenditure. The coefficient of all taxes is greatest for the United Kingdom and lowest for Belgium.

TABLE 12: TOTAL INDIRECT TAX RATES BY DECILE OF EXPENDITURES IN THE FIVE BUDGET SURVEYS

Decile <sup>*</sup>	BE	GR	HU	IR	UK
1	15.9	15.2	20.0	13	13.1
2	15.5	16.3	20.2	14.8	14.3
3	15.3	16.8	20.6	15.8	15.7
4	14.9	17	20.8	15.9	16.5
5	14.8	17.5	21.9	15.5	17.0
6	15.2	17	22.6	15.6	16.9
7	14.6	16.8	23.1	14.8	16.9
8	14.7	17	23.6	14.4	17.2
9	14.6	16.3	23.9	14.3	17.0
10	13.9	15.6	24.6	13.2	14.5
average	14.9	16.6	22.1	14.7	15.9
Kakwani index	-0.037	0.002	0.029	-0.014	0.005
Gini non dur exp	0.258	0.302	0.249	0.310	0.323
conc. coeff taxes	0.221	0.305	0.278	0.296	0.328

Notes: 1) deciles based on equivalent non durable expenditures

2) tax rates are on a tax inclusive basis: tax liability divided by disposable income

Table 13 shows some interesting results regarding the characteristics of the five populations in the budget surveys. The income statistics show the income of the expenditure quintiles in all five countries. The age table shows that on average poorer households are headed by older people. Belgium appears to be something of an exception in that respect. The average household size is greatest for Ireland in all quintiles. Belgium by contrast appears to have the smallest household size. The distributional trend is that poorer households tend to be of smaller size although that trend does not always apply to the top quintile. Car ownership appears to be highest in Belgium and Ireland and lowest in Hungary. This has important impacts on the relevance of motor fuel taxes. It appears that car ownership is positively related to income. The percentage of smokers is greatest in Greece and lowest in the United Kingdom. Poorer households are more likely to be smokers in all five countries. This trend appears highest in the United Kingdom. This perhaps explains the comparatively high regressivity of UK excise duties.

TABLE 13: CHARACTERISTICS OF INDIRECT TAX PAYERS IN THE FIVE BUDGET SURVEYS

Quintile	BE	GR	HU	IR	UK
income of this group relative to median income					
1	1.53	1.38	1.38	1.22	1.29
2	1.37	1.34	1.27	1.32	1.39
3	1.19	1.31	1.31	1.29	1.37
4	1.11	1.16	1.19	1.17	1.20
5	0.95	0.85	0.92	0.87	0.87
age of household head					
1	58.0	64.28	59.4	57.1	58.3
2	56.9	58.15	54.1	51.3	50.9
3	56.4	55.48	50.5	50.0	49.3
4	55.9	53.84	47.9	49.7	48.2
5	57.8	51.70	44.8	51.0	48.3
household size					
1	2.24	2.24	2.30	2.45	1.90
2	2.45	2.62	2.52	3.06	2.42
3	2.33	2.79	2.73	3.38	2.61
4	2.34	2.81	2.87	3.45	2.63
5	2.12	2.80	2.94	3.17	2.44
% of car owners					
1	68.4	43.1	20.7	58.7	45.4
2	77.4	60.1	35.9	77.2	71.1
3	82.5	72.5	48.3	80.5	78.6
4	86.0	75.2	56.5	82.8	79.7
5	89.5	77.2	61.9	83.5	75.4
% of smokers					
1	18.9	34.9	21.0	16.6	8.9
2	26.6	58.4	33.4	34.4	19.1
3	32.9	72.0	45.5	45.9	29.3
4	43.7	78.0	54.4	59.0	35.6
5	45.3	82.7	58.3	64.4	51.2

Tables 14-18 show the distribution of VAT between expenditure deciles and VAT rates. There are four VAT rates in Greece, Hungary and Belgium whereas only three exist in Ireland and the United Kingdom. Ireland is the only country without an indirect tax rate between zero and ten per cent. Such rates tend to apply to food items meaning that such rates are regressive by their very nature. The absence of such low rates in Ireland means that it has the largest amount of exempt expenditure with 42 per cent of expenditure being exempt. Belgium and the UK have slightly lower levels of exemptions whilst Greece and Hungary have comparatively little exempt expenditure. The standard rate tends to have a regressive impact in all countries and is most common in Greece and the United Kingdom.

TABLE 14: PERCENTAGE OF TOTAL EXPENDITURE PER VAT-CATEGORY, BELGIUM

Decile*	VAT 0%	VAT 6%	VAT 12%	VAT 21%
1	39.5	24.2	0.6	35.6
2	38.5	23.0	0.7	37.8
3	38.8	21.0	0.7	39.5
4	37.6	20.9	0.4	41.2
5	38.3	20.2	0.4	41.1
6	38.0	19.4	0.3	42.4
7	37.5	18.8	0.2	43.5
8	38.0	18.2	0.2	43.5
9	36.4	17.4	0.2	46.0
10	36.3	15.9	0.2	47.5
Total	37.9	19.8	0.4	41.9

\*deciles based on equivalent total non-durable expenditures

TABLE 15: PERCENTAGE OF TOTAL EXPENDITURE PER VAT-CATEGORY, HUNGARY

Decile*	VAT 0%	VAT 5%	VAT 15%	VAT 25%
1	10.5	3.2	50.3	36.0
2	9.8	4.7	50.5	35.0
3	8.5	4.9	50.3	36.3
4	7.5	4.6	48.8	39.1
5	7.9	4.9	47.7	39.5
6	7.2	4.6	45.9	42.3
7	7.4	3.8	43.0	45.8
8	7.2	3.8	41.5	47.4
9	6.7	3.3	38.9	51.1
10	7.7	3.2	34.1	55.1
Total	8.1	4.1	45.1	42.7

\*deciles based on equivalent total non-durable expenditures

TABLE 16: PERCENTAGE OF TOTAL EXPENDITURE PER VAT-CATEGORY, UK

Decile*	VAT 0%	VAT 5%	VAT 18%
1	42.9	8.8	48.3
2	44.6	8.9	46.5
3	41.3	7.3	51.4
4	38.8	6.3	54.9
5	35.9	5.8	58.3
6	34.0	5.3	60.8
7	31.9	5.1	63.0
8	31.0	4.4	64.5
9	30.9	4.2	64.9
10	29.7	4.0	66.3
Total	36.3	6.1	57.7

\*deciles based on equivalent total non-durable expenditures

TABLE 17: PERCENTAGE OF TOTAL EXPENDITURE PER VAT-CATEGORY, IRELAND

Decile *	VAT 0%	VAT 12.5%	VAT 21%
1	45.7	22.9	31.4
2	45.4	24.5	30.1
3	43.3	21.2	35.5
4	41.8	21.4	36.8
5	40.7	21.7	37.6
6	40.0	20.8	39.3
7	39.7	21.0	39.3
8	39.8	21.0	39.2
9	40.9	21.1	38.0
10	41.9	22.4	35.8
Total	42.0	21.8	36.2

\* deciles based on equivalent total non-durable expenditures

TABLE 18: PERCENTAGE OF TOTAL EXPENDITURE PER VAT-CATEGORY, GREECE

Decile *	VAT 0%	VAT 4%	VAT 8%	VAT 18%
1	14.2	0.3	48.7	36.8
2	15.7	0.4	43.7	40.2
3	15.0	0.3	42.5	42.1
4	16.4	0.4	38.9	44.4
5	17.3	0.5	37.3	45.0
6	17.2	0.7	34.8	47.4
7	17.1	0.6	33.7	48.7
8	16.6	0.6	32.1	50.8
9	17.1	0.7	29.1	53.1
10	17.2	0.7	25.9	56.2
Total	16.4	0.5	36.7	46.5

\* deciles based on equivalent total non-durable expenditures

## V. CONCLUSION

Consumption habits may vary substantially between different countries (table 3). However the redistributive impact of indirect taxation appears similar in all countries (table 9). The relative contribution of excise duties and VAT varies between countries. Excise duties appear to have a more regressive impact than VAT in both Ireland and the United Kingdom. Hungary appears to be something of an outlier in that their VAT system is more regressive than their excise duties (See tables 10 and 11). Hungary is also noteworthy for having the highest average tax rate of 22.8 per cent. This actually surpasses the highest rate of VAT in all other countries. Household characteristics are important. For example Greece has the highest rate of smokers and this increases the relevance of tobacco excise duties. Belgium has the highest rate of car ownership and this increases the relevance of motor fuel taxes.

We can conclude that different countries display regressive and progressive systems when we assess the impact in terms of percentage of total expenditure (table 12). However expressing tax liabilities as a percentage of disposable income reveals the very regressive nature of the system in all countries (table 9). The problems apparent from examination of the savings rates could pose question marks over the accuracy of the results (tables 4 and 5). The negative savings rates appear to be concentrated in the lower income deciles. Consumption smoothing may be responsible for some of this feature. However the presence of under-reported income concentrated disproportionately in the bottom income deciles could lead to an overestimation of the regressive impact of indirect taxes. This problem is greatest with regard to Greece and requires further examination.

The presence of zero expenditures in some commodity groups is worrying. For example roughly one third of Irish and UK households claim to have not purchased clothing during the survey period (table 6). For some countries the most recent available household budget data is somewhat older than that available for Greece and Hungary which both provide data from 2004/05. The data applying to UK, Ireland and Belgium are approximately four years older. The taxation systems used are of the same year as the expenditure surveys so that taxation systems may have changed somewhat in the intervening years. However it is unlikely that the principle features of the various systems have altered greatly in the meantime.

The Gini coefficient of disposable income varies between countries and may indicate varying levels of inequality aversion between countries. Such inequality aversion may well be a factor in determining the redistributive impact of indirect taxation. The United Kingdom appears to have the highest level of income inequality followed by Greece and Ireland with Belgium and Hungary displaying the lowest levels of income inequality. There does not appear therefore to be an easily identifiable relationship between inequality of

disposable incomes and inequality in the indirect taxation system. Exemptions and lower tax rates tend to favour poorer households in all five countries (Tables 14-18). However the highest rates appear to have a regressive impact that ultimately cancels out much of the progressive impact of exemptions. Again one must exercise caution in interpreting these results given that other features of tax-benefit systems are used to offset the very regressive impact of indirect taxation and this may well vary between countries.

**APPENDIX 1: AGGREGATION OF ITEMS IN HOUSEHOLD BUDGET SURVEY INTO AIM-AP AGGREGATES**

AIM-AP		NATIONAL ACC	DESCRIPTION	COICOP-HBS
Nr	Label			
0	NON CONSUMPTION VARIABLES			
1	FOOD & NON-ALCOHOLIC BEVERAGES	C1 FOOD	All types of food; The category includes only those meals away from home consumed at the work place (canteens) or on a regular basis and connected to work ; it does not include restaurants, etc..	HE 01.1.1 Bread and cereals HE 01.1.2 Meat HE 01.1.3 Fish HE 01.1.4 Milk, Cheese and eggs HE 01.1.5 Oils and fats HE 01.1.6 Fruit HE 01.1.7 Vegetables including potatoes and other tubers HE 01.1.8 Sugar, jam, honey, syrups, chocolate and confectionery HE 01.1.9 Food products n.e.c. (not elsewhere classified). HE 11.1.2.1 canteens
		C2 NON-ALCOHOLIC BEVERAGES	Mineral water, coffee, tea, fruit juice, etc..	HE 01.2.1 Coffee, tea and cocoa HE 01.2.2 Mineral waters, soft drinks and juices
2	ALCOHOLIC BEVERAGES	C3 ALCOHOLIC BEVERAGES	Wine, beer, spirits.	HE 02.1.1 Spirits HE 02.1.2 Wine HE 02.1.3 Beer

3	TOBACCO	C4 TOBACCO	Tobacco, cigarettes, cigars, etc.	HE 02.2 Tobacco HE 02.3 Narcotics
4	CLOTHING AND FOOTWEAR	C5 CLOTHING AND FOOTWEAR	All kinds of clothing and shoes of all household members. It includes also repairs and sport clothes.	HE 03.1 Clothing HE 03.2 Footwear
5	HOME FUELS & ELECTRICITY	C6 DOMESTIC FUEL	Oil, gas, coal, other	HE 04.5.2 Gas HE 04.5.3 Liquid fuels HE 04.5.4 Solid fuels HE 04.5.5 Hot water, steam and ice
		C7 ELECTRICITY		HE 04.5.1 Electricity
6	RENTS	C8.1 RENTS	Rents etc.	4.1 Actual Rents 4.2 Imputed Rents NB MORTGAGE INTEREST IS CONSIDERED SAVING
98	Included in DURABLES	C8.2 HOUSEHOLD GOODS	Durables	HE 05.1 Furniture, furnishings and decorations, carpets and other HE 05.1.1 Furniture and furnishing HE 05.1.2 Carpets and other floor coverings HE 05.2 Household textiles HE 05.3 Heating and cooking appliances, refrigerators, washing machines and similar major household appliances, including fittings and repairs HE 05.3.1.1 Refrigerators, freezers HE 05.3.1.2 Washing machines, drying machines, dish washing machines HE 05.3.1.3 Coolers HE 05.3.1.4 Heaters, air conditioners HE 05.3.1.5 cleaning equipment HE 05.3.1.6 sewing machines

				<p>HE 05.3.1.7 other major household appliances</p> <p>HE 05.3.2 small electric household appliances</p> <p>HE 05.4 Glassware, tableware and household utensils</p> <p>HE 05.5 Tools and equipment for house and garden</p> <p>HE 05.5.1 Major tools and equipment</p> <p>HE 05.5.2 Small tools and miscellaneous accessories</p>
7	HOUSEHOLD SERVICES	C8.3 HOUSEHOLD SERVICES	<p>Services and durable and non durable household goods: Tools, paint, timber, furniture, beds, electric/gas appliances (excluding tv, video rec., hifi, musical instruments): cookers, heaters, washing machine, fridge, dishwasher, other electric tools; pots and pans, kitchen equipment, repairs and maintenance services, cleaning services and cleaning materials, gloves, laundry, garden tools, etc.</p>	<p>HE 04.3 Regular maintenance and repair of dwelling:</p> <p>HE 04.3.1 Products for the regular maintenance and repair of dwelling</p> <p>HE 04.3.2 Services for the regular maintenance and repair of dwelling</p> <p>HE 04.4 Other services relating to the dwelling:</p> <p>HE 04.4.2 Refuse collection</p> <p>HE 04.4.3 Sewerage services</p> <p>HE 04.4.1 Water supply</p> <p>HE 04.4.4 Other services related to the dwelling n.e.c.</p> <p>HE 05.1.3 Repair of furniture, furnishings and floor coverings</p> <p>HE 05.3.3 repair of household Appliances</p> <p>HE 05.6 Goods and services for routine household maintenance</p> <p>HE 05.6.1 Non-durable household goods</p> <p>HE 05.6.2 Domestic services and care services</p>
8	HEALTH	C9 MEDICAL AND HEALTH CARE	<p>All medical expenses and fees: medicines, doctor fees, hospital charges, private health insurance, therapeutic equipments, spectacles, etc.</p>	<p>HE 06.1.1 Medical products, appliances and equipment</p> <p>HE 06.1.1.1 Pharmaceutical products</p> <p>HE 06.1.1.2 Other medical products</p>

				HE 06.1.2/3 Other medical products, therapeutic appliances and equipment HE 06.2.1 Medical services HE 06.2.2 Dental services HE 06.2.3 Paramedical services HE 06.3 Hospital services HE 12.5.3.1 insurance connected with health
98	Included in DURABLES	C9 MEDICAL AND HEALTH CARE C11.1 TRANSPORT DURABLES	Durables	HE 06.1.1.3 Therapeutic appliances and equipment HE 07.1.1 Motor cars HE 07.1.1.1 Purchase of new motor cars HE 07.1.1.2 Purchase of second hand motor cars HE 07.1.2 Motor cycles HE 07.1.3 Bicycles HE 07.1.4 Animal drawn vehicles
9	PRIVATE TRANSPORT	C10 PETROL, DIESEL AND OTHER MOTOR FUELS	MOTOR FUELS	HE 07.2.2 Fuels and lubricants
		C11.2 TRANSPORT	PERSONAL TRANSPORT	HE 07.2.1 spare parts and accessories HE 07.2.3 maintenance and repairs HE 07.2.4 other services in respect of personal transport equipment HE 12.5.4.1 insurance connected with transport
		C11.3 TRANSPORT (PRIVATE)	AIR & SEA TRANSPORT	HE 07.3.3 passenger transport by air HE 07.3.4 passenger transport by sea and inland waterway
10	PUBLIC	C11.2	Cars, motorcycles, bicycles, bus, train,	HE 07.3.1 passenger transport by railway

	TRANSPORT	TRANSPORT (Public)	air transport, taxi fares, accessories, parts, other vehicle costs, car insurance, car hire, parking, repairs, ...	HE 07.3.2 passenger transport by road HE 07.3.6 other purchased transport services HE 07.3.5 Combined passenger transport
11	COMMUNICATIO N	C12 COMMUNI- CATION	Telephone, mobile phone, postal service, etc.	HE 08.1.0 postal services HE 08.3.0 telephone, telegraph and telefax services
12	RECREATION AND CULTURE	C13 RECREATIONAL AND CULTURAL GOODS AND SERVICES	Radio, tv, hi-fi, video recorder, musical instruments, computer, photo, sport goods (not sport clothing), pets, pet food, participant and spectator sport, concerts, cinema, theatre, tv etc. repairs, tv and radio licence, toys, CDs, video cassettes, video rental, plants, seed, flowers, betting, stationery.	HE 09.1.4.1 recording media for pictures and sound HE 09.1.5.1 repair of audio-visual, photographic and data processing equipment and accessories HE 09.2.2.1 repair of other major durable for recreation and culture HE 09.3.1. games, toys, hobbies and small musical instruments HE 09.3.2 equipment for sport, camping and open-air recreation HE 09.3.3. flower and gardens HE 09.3.4./5 pets HE 09.4.1.1 sporting and recreational services HE 09.4.2.1 cinemas, theatres, concerts HE 09.4.2.2 museums, zoological gardens, etc. HE 09.4.2.3 television and radio taxes and hire of equipment HE 09.4.2.4 other services HE 09.5.4.1 stationery and drawing materials
		C14 BOOKS, NEWSPAPERS AND MAGAZINES	Books, newspapers, magazines.	HE 09.5.1.1 books HE 09.5.2.1 newspapers and periodicals HE 09.5.3.1 miscellaneous printed matter
98	Durables	C13 RECREATIONAL		HE 08.2.0 telephone and telefax equipment HE 09.2.1.1 major durables for outdoor recreation

		AND CULTURAL GOODS AND SERVICES		<p>HE 09.2.2.1 musical instruments</p> <p>HE 09.2.2.2 sports and leisure related equipments (not sport clothing)</p> <p>HE 09.1.1.1 equipment for the reception, recording and reproduction of sound</p> <p>HE 09.1.1.2 television sets, video cassette players and recorders</p> <p>HE 09.1.2.1 photographic and cinematographic equipment</p> <p>HE 09.1.2.2 optical instruments</p> <p>HE 09.1.3.1 data processing equipment</p>
13	EDUCATION	C15 EDUCATION	education, training, courses, tuition fees (private and public ed.).	<p>HE 10.1.0 pre-primary and primary education</p> <p>HE 10.2.0 secondary education</p> <p>HE 10.3.0 post-secondary, non-tertiary education</p> <p>HE 10.4.0 tertiary education</p> <p>HE 10.5.0 education not definable by level</p>
14	RESTAURANTS	C16 RESTAURANTS ETC.	Meals out, restaurant, cafe, hotel, holidays	<p>HE 09.6.1.1 package holidays</p> <p>HE 11.1.1.1 restaurants</p> <p>HE 11.1.1.2 cafés, bars and the like</p> <p>HE 11.2.1.1 accommodation services</p>
15	OTHER GOODS AND SERVICES	C17 OTHER GOODS AND SERVICES	Cosmetics, personal hygiene, toilet paper, soap, leather goods, jewellery, watches, hairdressing, beauty treatment, professional fees, money given to children and other contributions (charity, subscription to trade unions and other associations, etc.), bags and wallets, life and other insurance (except car and	<p>HE 12.1.1.1 hairdressing salons and personal grooming establishments</p> <p>HE 12.1.2.1 electrical appliances for personal care</p> <p>HE 12.1.2.2 other articles and products for personal care</p> <p>HE 12.1.3.1 personal care services n.e.c.</p> <p>HE 12.3.2.1 travel goods and other carriers</p> <p>HE 12.3.2.2 other personal effects</p>

			private health ins.), funeral expenses, bets and lottery all other expenses.	HE 12.4.1.1 social protection services HE 12.4.1.2 crèches, nurseries HE 12.5,1,1 life insurance HE 12.5.2. insurance connected with dwelling HE 12.5.5.1 other insurance HE 12.6.2.1 financial services n.e.c. HE 12.7.0.1 other services n.e.c. HE 09.4.3.1 games of chance
98	DURABLES			HE 12.3.1.1 jewelry, clocks and watches
99	HOME PRODUCTION			

Note: Linkage between the 17 categories and the Eurostat COICOP-HBS (Coicop = Classification of Individual Consumption by Purpose) classification (See Eurostat 1997, pag. 92)

**APPENDIX 2: THE STATA DO-FILE AGGRTAX.DO**

```
1 clear
2 set type double
3 set mem 200m
4 set matsize 10000
5 set more off
6 capture log close
7
8 log using "C:\My\documents\hbo\budget2001\tax rates baseline.log", replace
9
10 di c(current_time)
11
12 *****
13 * IN THIS BLOCK ALL PARAMETERS AND FILE PATHS ARE ASSEMBLED THAT NEED TO BE *
14 * CHANGED OR FILLED IN BY THE USER *
15 *****
16
17 * DEFINE THE NUMBER OF COICOP AGGREGATES HERE
18 local nagg=16
19
20 * PATH TO THE INPUT DATASET WITH TAX RATES ON INDIVIDUAL ITEMS
21 * The structure of this dataset should be:
22 *   var1= itemid   : string, 4 positions (0001 - maximum number of items)
23 *   var2= code    : expenditure code as in the national survey
24 *   var3= label   : label of the good or service
25 *   var4= coicop1 : the aggregation level based on coicop classification
26 *   var5= t       : VAT rate
27 *   var6= a       : Excise duty
28 *   var7= v       : Ad Valorem tax
29 *   var8= q       : consumer price
30 local taxrates="C:\My\documents\hbo\budget2001\taxcode_BE_2005.dta"
31
32 * PATH TO THE INPUT DATASET WITH DETAILED EXPENDITURE DATA PER HOUSEHOLD
33 * The structure of this dataset should be as follows
34 *   var1= hhid    : household identification
35 *   var2= weight  : population weighting variable
36 *   var3= e_1    : the first expenditure item
37 *   var4= e_2    : the second expenditure item
38 *   ...
39 *   varxxx=e_xxxx : the last expenditure item, e.g. var976=e_974
40 local expdata="C:\My\documents\hbo\budget2001\HBSdetail_BE_2001.dta"
41
42 * GIVE PATH OF THE OUTPUT DATASET where the tax rates and consumer prices on aggregates
43 * have to be saved for use in other programs
44 local aggregates="C:\My\documents\hbo\budget2001\aggregates prices and taxes.dta"
45
46 * PATH TO THE OUTPUT DATASET WHERE EXPENDITURES ON AGGREGATES AND TAXES FOR EACH HOUSEHOLD WILL BE STORED
47 local exp_and_baseline="C:\My\documents\hbo\budget2001\exp and tax baseline.dta"
48
49 * A Deflator in case the base year for the tax legislation is different from that of the survey
50 * especially for excise duties
```

```

51 * If the two years coincide `deflator'=1
52 local deflator=0.9249
53
54 * DEFINE A VALUE LABEL CONTAINING THE LABELS FOR THE DIFFERENT AGGREGATES
55 capture label drop coicoplables
56 label define coicoplables 1 "Food and non-alcoholic beverages"
57 label define coicoplables 2 "Alcoholic beverages", add
58 label define coicoplables 3 "Tobacco", add
59 label define coicoplables 4 "Clothing and footwear", add
60 label define coicoplables 5 "Home fuels and electricity", add
61 label define coicoplables 6 "Rents", add
62 label define coicoplables 7 "Household services", add
63 label define coicoplables 8 "Health", add
64 label define coicoplables 9 "Private transport", add
65 label define coicoplables 10 "Public transport", add
66 label define coicoplables 11 "Communication", add
67 label define coicoplables 12 "Recreation and culture", add
68 label define coicoplables 13 "Education", add
69 label define coicoplables 14 "Restaurants and hotels", add
70 label define coicoplables 15 "Other goods and services", add
71 label define coicoplables 98 "Durables", add
72 label define coicoplables 100 "Total", add
73
74 * GIVE PATH WHERE THE VALUE LABEL SHOULD BE STORED AS A DO FILE FOR LATER USE
75 * (if the latter is not done the value label gets lost in the process of the program)
76 local valueLabel="C:\my\documents\alternatieve financiering sz\do files\valueLabels.do"
77
78 label save coicoplables using `valueLabel', replace
79 *****
80 * Part 1: define the tax system *
81 *****
82 * retrieve the dataset with tax rates
83 use `taxrates'
84
85 * deflate excise duties to the appropriate level
86 qui replace a=a*`deflator'
87
88 * calculate producer price
89 gen p=((1-(1+t)*v)/(1+t))*q-a
90 label var p "producer price"
91 count if p<0
92
93 tempfile taxsystem
94
95 * calculate the new consumer prices after the reform (Ass: fixed producer prices)
96 gen q1=((1+t)*(p+a))/(1-(1+t)*v)
97 label var q1 "consumer price post reform"
98 keep itemid code coicopl p t a v q q1
99 sort itemid
100 save `taxsystem', replace

```

```
101
102 * make a vector containing the different item ID's (ranging from 0001 to maximum number of items)
103 mkmat itemid, matrix(codes)
104
105 * make a vector containing the COICOP aggregation levels for each item
106 mkmat coicopl, matrix(coicop)
107
108 * make a vector containing the producer prices for each item
109 mkmat p, matrix(p)
110
111 * make a vector containing the consumer prices for each item in the baseline
112 mkmat q, matrix(q)
113
114 * make a vector containing the consumer prices for each item in the post reform situation
115 * This will only be of use in a second run of the program for which we do not control and
116 * thus the post reform prices will also be calculated in the baseline situation, where they
117 * will be equal to the baseline prices
118 mkmat ql, matrix(ql)
119
120 * make a vector containing the VAT-rates for each item
121 mkmat t, matrix(t)
122
123 * make a vector containing the Excise duties for each item
124 mkmat a, matrix(a)
125
126 * make a vector containing the Ad-Valorem taxes for each item
127 mkmat v, matrix(v)
128
129 * the local `n_items' gives the total number of goods and services for which expenditure data is available
130 local n_items=rowsof(codes)
131
132 * Put the labels of the values of coicopl in a local variable to use it later
133 * Remark that this value label should be defined in the file with the tax rates
134 qui do "`value_label'"
135 forvalues i=1/`nagg' {
136     if `i'==`nagg' {
137         local i=98
138     }
139     local label`i': label coicopl_labels `i'
140 }
141
142 *****
143 * Part 2: calculation of tax revenues on all expenditure items for all households *
144 *****
145
146 * Read in the STATA-database with for each household the detailed list of expenditures
147 * contains `n_item' variables beginning with as name e_ followed by the code
148
149 use "`expdata'"
150
```

```

151 * Initialize taxes for all aggregates on zero
152 quietly {
153     forvalues i=1/\nagg' {
154         if `i'==\nagg' {
155             local i=98
156         }
157         gen exp`i'=0          /* expenditures on aggregate i */
158         gen T`i'_t=0         /* VAT and ad valorem */
159         gen T`i'_a=0         /* excise, but nominal values deflated to year of budget survey*/
160         label var exp`i'    "\label`i'"
161         label var T`i'_t    "\label`i'"
162         label var T`i'_a    "\label`i'"
163     }
164 }
165
166 quietly {
167     forv i=1/\n_items' {
168         capture drop e1
169
170         local k=coicop[`i',1]          /*contains the number of the aggregate where this item has to be classified
171         gen e1=e_`i'*(q1[`i',1]/q[`i',1]) /*assumption of constant quantities, hence new expenditures e1 (equation (5) in
172                                         workpackage 3.1)
173                                         In the baseline e1 will be equal to e_`i' because q1=q in baseline*/
174         local alpha = a[`i',1]/p[`i',1] /*alpha is the implicit proportional excise tax rate (equation (6) in workpacka
175         local denom = 1-(1+t[`i',1])*v[`i',1] /*denominator to be used in following formulas*/
176         local tau_t = (t[`i',1]*(1+\alpha'+v[`i',1])+v[`i',1])/\`denom' /*tau_t is an implicit VAT-rate (first term equation (10)
177                                         in workpackage 3.1)*/
178         local tau_a = \alpha'/\`denom' /*tau_a is an implicit excise tax rate (second term
179                                         equation (10) in workpackage 3.1)*/
180         local tau = \tau_t'+\tau_a' /*the total tax rate (equation (11) in workpackage 3.1)*/
181         replace exp`k'=exp`k'+e1 /* expenditure added to appropriate aggregate*/
182         replace T`k'_t=T`k'_t+(\tau_t'/(1+\tau'))*e1 /* vat payment on this expenditure*/
183         replace T`k'_a=T`k'_a+(\tau_a'/(1+\tau'))*e1 /* excise payment on this expenditure*/
184     }
185 }
186
187 * before we collapse into a sum over households, we save the expenditures on the aggregates
188 * drop all detailed expenditures, and tax rates
189
190 keep hhid weight exp* T*
191
192 save "\exp_and_baseline",replace
193
194 *****
195 * Part 3: calculation of implicit tax rates on the nagg aggregates *
196 *****
197 * the following collapse command produces ONE observation with the totals of all variables
198 * Note that the weights are noninteger, that is why we have to use pweight (fweight is only for integers)
199 * and aweight gives different results because of normalisation of the weights (see help on collapse)
200 * With this collapse we calculate: Sum_i x_i*weight_i

```

```
201 * we will save this observation in a temporary dataset (mother) and recall it
202 * several times to reload variables in memory
203 tempfile mothersums sumexp sumvat sumexc
204
205 collapse (sum) exp* T* [pw=weight] /* store the (weighted) sum of expenditures and tax payments on aggregates*/
206
207 save "`mothersums'" /*saved in a temporary file to be used in stages later on*/
208
209 * create the file with expenditures for the `nagg' aggregates
210
211 use "`mothersums'"
212 keep exp* /*only expenditures remain in file*/
213 xpose,clear /*make the `nagg' aggregates the observations now*/
214 rename v1 exp
215 label var exp "exp (€mn)"
216 egen coicop1=fill(1/`nagg') /*add category of aggregate to allow a merge later*/
217 replace coicop1=98 in `nagg'
218 label var coicop1 "COICOP aggregate level 1"
219 sort coicop1
220 save "`sumexp'"
221
222 * create the file with VAT taxes for the `nagg' aggregates
223
224 use "`mothersums'"
225 keep T*_t /*only vat taxes remain in file*/
226 xpose,clear /*make the `nagg' aggregates the observations now*/
227 rename v1 vat
228 label var vat "vat"
229 egen coicop1=fill(1/`nagg') /*add category of aggregate to allow a merge later*/
230 replace coicop1=98 in `nagg'
231 label var coicop1 "COICOP aggregate level 1"
232 sort coicop1
233 save "`sumvat'"
234
235 * create the file with Excise taxes for the `nagg' aggregates
236
237 use "`mothersums'"
238 keep T*_a /*only excise taxes remain in file*/
239 xpose,clear /*make the `nagg' aggregates the observations now*/
240 rename v1 exc
241 label var exc "excise"
242 egen coicop1=fill(1/`nagg') /*add category of aggregate to allow a merge later*/
243 replace coicop1=98 in `nagg'
244 label var coicop1 "COICOP aggregate level 1"
245 sort coicop1
246 save "`sumexc'"
247
248 * merge the three datasets: expenditures, VAT payments, Excise payments
249 use "`sumexp'"
250 merge coicop1 using "`sumvat'", sort
```

```
251 drop _merge
252 merge coicopl using "`sumexc'", sort
253 drop _merge
254
255 gen tax=vat+exc
256 label var tax`reform' "Total indirect tax paid"
257
258 * add observation `nagg'+1 with totals, this is observation _N
259 expand 2 in 1 /*duplicates the first observation, which is appended at the end of the file*/
260 local new=_N /*observation number for the new observation*/
261 /*replace coicopl=`nagg'+1 in `new' */
262 replace coicopl=100 in `new' /*gets the coicopl classification of `nagg'+1*/
263
264 replace exp=0 in `new'
265 replace tax=0 in `new'
266 replace vat=0 in `new'
267 replace exc=0 in `new'
268 egen totexp=sum(exp) /* summation over the `nagg' aggregates (which are observations)*/
269 egen tottax=sum(tax)
270 egen totvat=sum(vat)
271 egen totexc=sum(exc)
272
273 * put these totals in the new observation
274 replace exp=totexp in `new'
275 replace tax=tottax in `new'
276 replace vat=totvat in `new'
277 replace exc=totexc in `new'
278
279 * Express the totals in Million €
280 foreach name of varlist exp* tax* vat* exc* {
281     replace `name'=`name'/1e+06
282 }
283
284 * Preparing for output tables:
285
286
287 * average tax rates and BUDGET shares by category defined in coicopl
288 * NOTE: these averages are obtained by dividing the taxes paid on this item by the
289 * total expenditures before taxes.
290 * Same for budgetshares: exp on aggregate divided by total expenditures
291 * The last row displays the tax rates on total expenditures
292
293 gen tau=100*tax/(exp-tax) /*equation (18) in workpackage 3.1, expressed in percentages*/
294 gen tau_t=100*vat/(exp-tax) /*first term equation (19) in workpackage 3.1, expressed in percentages*/
295 gen tau_a=100*exc/(exp-tax) /*second term equation (19) in workpackage 3.1, expressed in percentages*/
296 gen w=(exp/exp[_N])*100 /*budget share of each aggregate; the last observation contains the total expenditures*/
297 gen q=1+tau/100 /*consumer price for normalised producer price=100*/
298 label var tau "indirect tax rate (%)"
299 label var tau_t "VAT rate (%)"
300 label var tau_a "Excise tax rate (%)"
```

```
301 label var w "Budget Share (%)"
302 label var q "Consumer Price"
303 do "`value_label'"
304 label values coicop1 coicopl_labels
305 format w tau tau_t tau_a %5.1f
306 format q %5.3f
307 format exp %7.0f
308
309 tabstat2 exp w q tau_t tau_a tau, by(coicop1) nototal format labelwidth(32) title(Expenditures (million €), /*
310 */budget shares (%), normalized consumer prices and tax rates (%) on `nagg' aggregates) nolabel
311
312 * save the tax rate information in a dataset (only the nagg aggregates, not the total)
313 keep coicop1 tau tau_t tau_a q
314 *drop if coicop1>`nagg'
315 drop if coicop1>99
316 save "`aggregates'",replace
317 di c(current_time)
318 capture log close
319
```