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Panos TSAKLOGLOU  
Athens University of Economics and Business and IMOP  
and  
Theodore MITRAKOS  
Athens University of Economics and Business and Bank of Greece

**ON THE DISTRIBUTIONAL IMPACT OF EXCISE DUTIES:**

**EVIDENCE FROM GREECE**

Abstract

The distributional impact of excise duties in Greece is analysed using Household Budget Survey micro-data. Unlike claims routinely made in the public discourse, the findings of the paper do not support the claim that these duties are strongly regressive. The Lorenz curve of the distribution of equivalent consumption expenditure and the concentration curve of equivalent excise duties intersect, leading to ambiguous results. In fact, most of the indices used in the paper suggest that the overall distributional impact of excise duties is mildly progressive. Of the four excise duties examined in detail, those on Alcoholic Drinks and, particularly, Transportation Fuels are found to be progressive, while those on Heating Fuels and, especially, Tobacco Products are shown to be regressive.

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Address for correspondence:  
Dr Panos Tsakloglou,  
Department of International and European Economic Studies,  
Athens University of Economics and Business,  
76 Patission Street,  
Athens 10434  
GREECE

e-mail: panos@aueb.gr

## 1. Introduction

During the last two decades the share of tax revenues in GDP grew rapidly in Greece. It now stands close to the EU average. However, the composition of these revenues differs considerably from the corresponding composition of most EU member-states. Indirect taxes account for a substantially higher share of total government receipts in Greece than in any other EU country. Among the indirect taxes, excise duties play a very important role; certainly more important than in most EU member-states. The distributional impact of indirect taxation in Greece has never been studied thoroughly. Few unsystematic references to the distributional impact of the VAT or the impact of a number of specific taxes can be found in the literature, but the distributional impact of excise duties has never been examined in detail. In spite of this, arguments claiming that the distributional impacts of indirect taxes, in general, and excise duties, in particular, are regressive are routinely heard in the public discourse.

The aim of the present paper is to investigate the distributional impact of excise duties in Greece using the micro-data of the 1993/94 Household Budget Survey (HBS - the most recent available). Section 2 discusses briefly the structure of taxation in Greece, while section 3 deals with methodological issues. Section 4 contains the main empirical results and section 5 provides the conclusions.

## 2. The structure of taxation and the role of excise duties in Greece: A brief overview

As noted above, the share of taxes in GDP has risen steadily in Greece in recent decades [OECD (1988), Georgakopoulos (1992)]. The combined share of direct and indirect taxes in GDP is close to 30%, which is not substantially lower than the EU average. Despite an increase in the share of direct taxes in total taxes in the 1990s, they account for around one third of total tax revenues, while the remaining is due to indirect taxes. Such a structure of tax revenues with so much weight on indirect taxes is not encountered in the tax system of any other EU member-state. Regarding direct taxes, the lion's share (a little over four fifths of the corresponding revenues) is due to income taxes. VAT accounts for a little less than half of the total revenues from indirect taxes, excise duties account for almost one third and other taxes for the remaining fifth [NSSG (various years)]. For example, in the year that almost coincides with the HBS used in the paper (1994), of the 3,711 billion drachmas collected through indirect taxation, VAT contributed 1,718 billion (46.3%), excise duties 1,271 billion (34.2%) and other taxes 722 billion (19.5%) [Ministry of Finance (1995)].<sup>1</sup>

In 1994, excise duties were as high as 7.1% of GDP. This is one of the highest proportions in the EU [Georgakopoulos (1992)]. There are four main commodity

Table 1. The structure of excise duties revenues in Greece (1994)

Commodity Group	Excise duties revenues (millions of drachmas)	Proportion of total excise duties revenues (%)
Alcoholic Drinks	41,528	3.27
Tobacco Products	334,637	26.32
Fuels	722,842	56.86
Vehicles	165,018	12.99
Other	7,251	0.56
TOTAL	1,271,276	100.00

Source: Ministry of Finance (1995)

groups that are subject to excise duties in Greece: Alcoholic Drinks, Tobacco Products, Fuels (Heating and Transportation) and Vehicles. Table 1, reports the contribution of each of these groups to the aggregate excise duties revenues. Almost 57% of these revenues are due to excise duties imposed on Fuels and another 26% to excise duties on Tobacco Products. Excise duties on Vehicles, Alcoholic Drinks and Other Commodities (mainly bananas) play a far less important role.<sup>2</sup>

Excise duties on these commodities are calculated in a variety of ways, taking into account not only producer prices but various other characteristics of the product under consideration such as, the alcoholic content of the drinks, the length of the cigarettes, the use of the fuels, the size of the engine of the vehicles, etc. [Georgakopoulos (1992), Alogoskoufis (1996)]. Alogoskoufis (1996) calculates that in the case of Beer excise duties account for 9% of the final (consumer) price of the commodity, while in the case of other high grade Alcoholic Drinks subject to excise duties this percentage rises to 15% (wine is not subject to excise duties). According to the same authors, excise duties account for 57.5% of the final prices of Cigarettes and Tobacco for Pipes and Rolled Cigarettes and for 26.0% of the consumer price of Cigars and Cigarillos. The corresponding proportions for Central Heating Fuels and Gas (for heating and cooking purposes) are 16.5% and 6.5%, respectively, whereas in the case of Transportation Fuels it is 60.0%.<sup>3</sup> Finally, these rates vary enormously in the case of Vehicles, depending on the type and the size of the engine of the vehicle. In comparison with the rest of the EU member-states, the above rates in the cases of Alcoholic Drinks and Transportation Fuels are relatively lower in Greece, in the cases of Heating Fuels and Vehicles higher and in the case of Tobacco Products in the middle of the range [Georgakopoulos (1992), Alogoskoufis (1996)].

With respect to the overall distributional impact of taxation in Greece, no systematic study has been made recent years. Earlier studies using grouped published data from HBSs [Karayiorgas (1973, 1977)] or Tax Returns [Germidis and Negreponi-Delivanis (1975)] of the 1960s and 1970s concluded, under heroic assumptions, that the overall impact of taxation in Greece was regressive, although some of their results were disputed by Provopoulos (1979). More specifically, Germidis and Negreponi-Delivanis (1975) claim that even though direct taxation was mildly progressive, indirect taxation was strongly regressive and counterbalanced the effects of direct taxation. Loizides (1986, 1988) and Papapanagos (1994) use data from tax returns, focus exclusively on the impact of direct taxation and conclude that the impact of direct taxation in Greece is progressive. However, their results should be interpreted with caution since they leave out of their analysis the poorest segments of the population that do not fill tax returns and, further, ignore completely the impact of tax evasion. Regarding the distributional impact of Value Added Taxation, Sapounas (1987) using *ex ante* analysis under alternative scenaria anticipated that the distributional impact of the - then, about to be introduced - VAT was likely to be strongly progressive, while in a series of papers using grouped data Georgakopoulos (1990, 1991, 1992) suggests that the introduction of VAT in the mid-1980s resulted in a slightly more progressive distribution of the tax burden by income classes. Finally, as noted earlier, no study has examined the distributional impact of excise duties in detail.

### 3. Methodological issues

The data used in the paper are the micro-data of the most recent HBS which was carried out by the National Statistical Service of Greece (NSSG) between September 1993 and October 1994. The survey covers all the private (non-institutional) households of the country and its sampling fraction is 2/1000 (around 6,700 households). Its main purpose is the collection of information for the construction of the weights used in the Consumer Price Index and it contains detailed information about consumption expenditures (actual and imputed), incomes and socio-economic characteristics of the households.

For the purposes of the paper, the (unobservable) welfare level of a household is approximated by its level of consumption expenditure. This choice was dictated by two factors. The first factor is theoretical. Standard micro-economic theory suggests that economic agents derive utility from the consumption of goods and services and, since the marginal utility of consumption is assumed to be positive but diminishing, they save and dissave in different phases of their life-cycles in an attempt to smooth out their consumption. Hence, current consumption can be considered a better indicator of the long-term welfare level of economic agents than current income and the use of consumption expenditure data in the framework of the present study can help in side-

stepping problems arising from comparisons over different phases of the life-cycle. The second factor is more practical since, according to the NSSG, the consumption expenditure data of the HBS are considered as more reliable than the corresponding income data.

The concept of consumption expenditure used here includes, apart from the value of purchased goods and services, consumption of own production, consumption of income in kind and imputed rent for owner-occupied accommodation evaluated at market prices. Several adjustments were made to the data before they were used for the estimation of the distributional impact of excise duties. A few households were removed from the sample on reliability grounds and the sample was re-weighted in order to reflect more accurately the entire population using weights derived from the 1994 Labour Force Survey. Further, all consumption expenditure figures were expressed in constant mid-1994 prices in order to remove the impact of inflation (9.8% during the period of the survey). Finally, the value of cars purchased during the period of the survey was subtracted from the concept of consumption expenditure and replaced by the value of imputed car services, estimated using hedonic regression techniques, for all the households which owned cars.

The unit of analysis is the household and the distributions used are distributions of equivalent consumption expenditure per household, so that the impact of economies of scale in consumption and differences in needs between children and adults are taken into account. The equivalence scales used are the so called "modified OECD scales" which have been used extensively in distributional studies by the Statistical Service of the European Union (Eurostat). These scales assign a weight of one to the household head, a weight of 0.5 to each of the remaining adults and a weight of 0.3 to each child (person aged up to 13) in the household. In comparison with other sets of equivalence scales used in empirical distributional studies, these scales are in the middle of the range regarding the economies of scales they imply [(Buhmann *et al.* (1988)]. Division of the total expenditure of each household with its equivalence scale yields its equivalent consumption expenditure, which is used as an indicator of the household's welfare level.

HBSs are, probably, the best sources of information for distributional studies in Greece and, certainly, the best available data sets for the purposes of the present paper. They are, nevertheless, far from ideal. This is due to a number of factors. Firstly, unlike the VAT, a considerable proportion of some excise duties is not paid directly by the consumers. Apart from final consumer goods, excise duties are also imposed on commodities that are intermediate resources used for the production of final goods. Naturally, in the end they are passed to the consumers of the corresponding final goods and services, through higher prices. However, using the information of the HBS, it is not possible to calculate their distributional impact.

Secondly, as noted above, excise duties on vehicles vary enormously depending on the size of the engine of the vehicle. However, the only pieces of information about vehicles in the HBSs are the number of vehicles owned by each household in the sample as well as the amount spent for the purchase of vehicles during the 12 months preceding the interview of the household. The latter constitute only a small fraction of the total number of households owning vehicles in the sample. Evidently, under these circumstances it is not possible to calculate the distributional impact of excise duties on vehicles using the data of the HBS. For this reason, excise duties on vehicles are left out of the present analysis. Thirdly, comparison of the HBS estimates with the relevant estimates of the Private Consumption Expenditure Table of the National Accounts, reveals some differences between the corresponding figures for some of the commodities subject to excise duties. To some extent, these discrepancies should be attributed to differences in the concepts (as well as the sample) used in the HBSs and the National Accounts and do not necessarily imply that the HBS estimates are less reliable than the corresponding estimates of the National Accounts. Moreover, even if it is assumed that the National Accounts estimates are more reliable than the estimates of the HBSs, any adjustment of the figures of the HBSs would be arbitrary and open to many criticisms. Therefore, it was decided to avoid any adjustments of the corresponding data. Fourthly, because the information collection period for each household participating in the HBS is relatively short (two weeks), the frequency of zero expenditures on some commodity groups may be considered as relatively high. This is not necessarily the case in most of the commodities included in our analysis. However, in the case of Alcoholic Drinks a slightly different problem is encountered. In the HBS, expenditures on Alcoholic Drinks consumed out of home (in restaurants, bars, cafes, etc.) are not recorded in the commodity group "Alcoholic Drinks", but in the commodity group "Food and Drinks out of Home". Therefore, it is not possible to evaluate the distributional impact of the corresponding excise duties and our analysis is restricted to the evaluation of the excise duties imposed on Alcoholic Drinks consumed at home.

The general approach employed in the paper is the following. The actual (non-imputed) expenditures of each household on Alcoholic Drinks (separately for Beer and High Spirit Drinks), Tobacco Products (separately for Cigarettes, Cigars and Cigarillos and Tobacco for Pipes and Rolled Cigarettes), Heating Fuels (separately for Central Heating Fuels and Gas<sup>4</sup>) and Transportation Fuels<sup>5</sup> are calculated. Naturally, imputed expenditures are not subject to excise duties. Then, for each of the above expenditures the component attributed to the excise duties is calculated, using the rates reported in section 2.

In the first stage of the analysis, estimates of inequality for the distribution of equivalent consumption expenditure per household before and after the imposition of

excise duties are derived. Comparisons of inequality before and after the imposition of excise duties are made using the following indices of inequality: Gini ( $G$ ), Atkinson ( $A$ , for  $e=0.5$  and  $e=2$ ), Theil ( $T$ ) and the mean logarithmic deviation ( $N$ ). Their formulae are given below:

$$G = \frac{\sum_{i=1}^n \sum_{j=1}^n |y_i - y_j|}{2n^2 \mu} \quad \text{for } i, j=1, 2, 3, \dots, n \quad (1)$$

$$A = 1 - \frac{1}{\mu} \left[ \frac{1}{n} \sum_{i=1}^n y_i^{1-e} \right]^{\frac{1}{1-e}} \quad \text{for } e \neq 1 \quad (2)$$

$$T = \frac{1}{n} \sum_{i=1}^n \frac{y_i}{\mu} \ln \left( \frac{y_i}{\mu} \right) \quad (3)$$

$$N = \frac{1}{n} \sum_{i=1}^n \ln \left( \frac{\mu}{y_i} \right) \quad (4)$$

where  $y_i$  is the equivalent consumption expenditure of household  $i$  ( $i, j = 1, 2, 3, \dots, n$ ),  $n$  is the size and  $\mu$  the mean equivalent expenditure of the population. These indices satisfy the basic axioms of inequality measurement (symmetry, mean-independence, population-independence and the Dalton-Pigou principle of transfers) and are sensitive to different types of transfers [Cowell (1995)]. In comparison with most indices used in empirical studies,  $A$  (for  $e=2$ ) and  $N$  are relatively more sensitive to transfers close to the bottom of the distribution,  $T$  and  $A$  (for  $e=0.5$ ) more sensitive to transfers close to the top of the distribution and  $G$  to transfers close to the middle of the distribution. Hence, the combined use of these indices satisfies a wide range of tastes regarding the responsiveness of an index to different types of transfers. Further, decile shares of equivalent consumption expenditure before and after the imposition of the excise duties as well as Lorenz curves and concentration curves are also employed at this stage.

In the second step of the analysis, an attempt is made to examine the contribution of the various excise duties to aggregate inequality using a covariance method for decomposing the Gini coefficient by factor components.<sup>6</sup> One of the advantages of this method is that it can be used for the calculation of the elasticity of the Gini coefficient with respect to excise duties, thus providing useful information for the examination of the distributional impact of tax reforms. Following Pyatt *et al.* (1980), once the households in the sample are ranked in ascending order according to their equivalent expenditures, the Gini index of the distribution of equivalent consumption expenditure can be written as:

$$G = \left( \frac{2}{n\mu} \right) \text{cov}(y, r) \quad (5),$$

where  $y$  and  $r$  are, respectively, the vector of total equivalent consumption expenditure per household and the vector of ranks.. Likewise, the Gini coefficient for the distribution of the  $k$  th ( $k = 1, 2, \dots, K$ ) consumption expenditure component,  $G_k$ , can be expressed as:

$$G_k = \left( \frac{2}{n\mu_k} \right) \text{cov}(y_k, r_k) \quad (6),$$

where  $y_k$  represents the vector of (equivalent) expenditures for consumption expenditure component  $k$ , while  $\mu_k$  denotes its mean value and  $r_k$  its vector of ranks. Since total consumption expenditure is the sum of particular expenditures, the covariance between total expenditure and its respective rank can be expressed as the sum of the covariances between each expenditure component and the rank of total expenditure. Then, (5) and (6) can then be used in order to express the overall Gini as a function of the Gini coefficient of each expenditure component:

$$G = \sum_{k=1}^K \frac{\mu_k}{\mu} R_k G_k \quad (7),$$

where  $R_k$  is the relative correlation coefficient for the expenditure component  $k$  which is defined as the ratio of the covariance between this consumption expenditure component and the rank of total consumption expenditure to the covariance between the consumption expenditure component and its own rank; that is:

$$R_k = \frac{\text{cov}(y_k, r)}{\text{cov}(y_k, r_k)} \quad (8).$$

The larger the relative correlation coefficient of a particular consumption expenditure component,  $R_k$ , the larger its share in total consumption expenditure,  $\mu_k/\mu$ , and the more unequal its distribution,  $G_k$ , the more decisive the influence of this component on the determination of aggregate inequality.<sup>7</sup> Replacing (6) and (8) in (7) and dividing by  $G$  we derive:

$$\sum_{k=1}^K w_k g_k = 1 \quad (9),$$

where  $w_k = \mu_k/\mu$  is the share of component  $k$  in total expenditure and  $g_k = R_k(G_k/G)$  is the relative concentration coefficient of component  $k$  in aggregate inequality. Hence,  $w_k g_k$  is the factor inequality weight of component  $k$  in aggregate inequality and an increase

in expenditure component  $k$  will cause an increase or decline in aggregate inequality if  $g_k$  is greater or less than one.

Further, using (8) it is possible to calculate the elasticity of the Gini coefficient with respect to a proportional change in the expenditures of all households for item  $k$

$$\begin{aligned} e_k &= \frac{dG}{d\mu_k} \frac{\mu_k}{G} = \left[ \frac{\partial G}{\partial \mu_k} + \frac{\partial G}{\partial \mu} \frac{d\mu}{d\mu_k} \right] \frac{\mu_k}{G} \\ &= \frac{1}{\mu} [R_k G_k - G] \frac{\mu_k}{G} = w_k g_k - w_k \end{aligned} \quad (10).$$

Thus, the sum of such elasticities for all consumption expenditure components is always equal to zero, since an equiproportionate increase of all consumption expenditure components will leave aggregate inequality unaffected (consequence of the mean-independence property of the inequality indices). Naturally, in the context of this paper, taxing a commodity whose elasticity is positive (negative) will result in a decline (increase) in aggregate inequality.

As noted earlier, when compared with other widely used inequality indices, the Gini index appears to be relatively more sensitive to transfers close to the middle of the distribution. However,  $G$  belongs to the following parametric family of indices [generalised Gini indices, see Yitzhaki (1983)]:

$$G(u) = -\frac{u}{\mu} \text{cov} \left[ y, \left( 1 - \frac{r}{n} \right)^{u-1} \right] \quad (11),$$

where  $u > 1$  is an inequality aversion parameter.<sup>8</sup> The higher the value of  $u$  the more sensitive the index becomes to transfers close to the bottom end of the distribution, while when  $u$  approaches infinity the index approaches the Rawlsian criterion for ranking distributions. It is easy to show that when  $u=2$  the index becomes the conventional Gini index shown in (5) and, following the same steps, (11) can be written as:

$$G(u) = \sum_{k=1}^K \frac{\mu_k}{\mu} R_k(u) G_k(u) \quad (12),$$

which allows the decomposition of the extended Gini index for different values of  $u$ . (12) is used below for the purposes of the decomposition of aggregate inequality when the value of  $u$  is set, successively, at 1.5, 2, 3 and 4; thus, allowing for the examination of the distributional impact of excise duties under different assumptions regarding the responsiveness of the index to different types of transfers.

#### 4. Empirical results

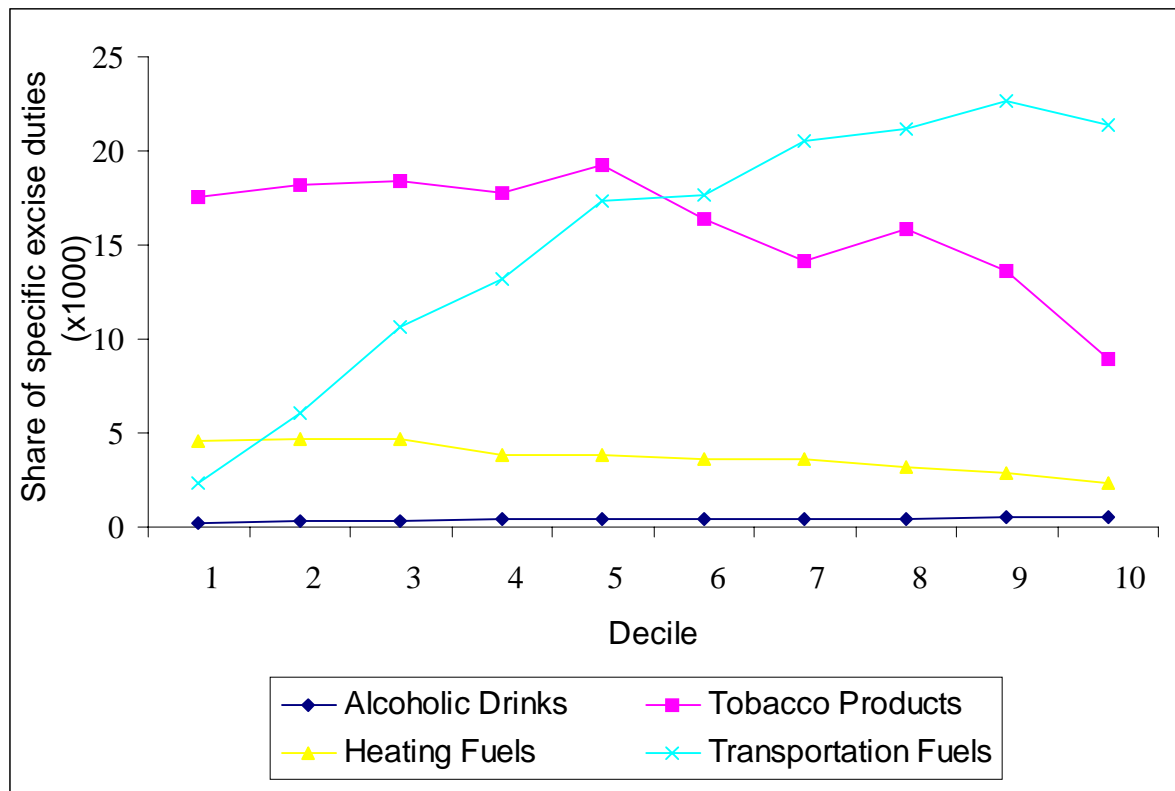
The empirical investigation starts with Table 2. For the purposes of this table, the households of the sample were ranked in ascending order according to their equivalent consumption expenditure and, then, grouped into deciles from the poorest (bottom) to the richest (top). Column (1) depicts the mean equivalent consumption expenditure of each decile. The content of the next three columns is the same for each of the four commodity groups subject to excise duties (Alcoholic Drinks, Tobacco Products, Heating Fuels and Transportation Fuels). Columns (2), (5), (8) and (11) depict the mean equivalent consumption expenditures on each of these groups - consumption expenditure on the commodity group divided by the number of equivalent adults in the household - per decile. Division of the figures in columns (2), (5), (8) and (11) by the corresponding figures in column (1) yields the budget shares for the corresponding commodities. These shares, in turn, provide a rough idea about the income elasticity of demand of these commodities; luxury if the budget share rises as we move to higher deciles, necessity if it declines.<sup>9</sup>

None of the four commodities can be considered as “inferior” since, with very few exceptions, spending on them does not decline when household expenditure rises. However, although the mean equivalent consumption expenditure for each of these commodities rises as we move to higher deciles, the budget shares do not follow a similar pattern. The budget share for Alcoholic Drinks is almost constantly rising when moving to higher deciles, the budget share for Tobacco Products is initially relatively flat and then declines sharply, the budget share for Heating Fuels is monotonically decreasing, whereas the budget share for Transportation Fuels rises steadily up to the ninth decile and then declines slightly. This evidence provides an approximate idea about the likely nature of the redistributive impact of excise duties on the corresponding groups of commodities. Since Alcoholic Drinks and Transportation Fuels are luxuries, it is likely that taxing them will result in a more equal distribution. The opposite is likely to happen when the distributional impact of excise duties on necessities, such as Tobacco Products and Heating Fuels, is considered.

Table 2. Private expenditure on Alcoholic Drinks, Tobacco Products, Heating Fuels and Transportation Fuels subject to excise duties  
Households ranked by decile of equivalent consumption expenditure

Decile	Mean equival. expendit. (total) (1)	Alcoholic Drinks subject to excise duties			Tobacco Products subject to excise duties			Heating Fuels subject to excise duties			Transportation Fuels subject to excise duties		
		Mean equival. expendit. (2)	Mean equival. excise duties (3)	(3)/(1) *1000 (4)	Mean equival. expendit. (5)	Mean equival. excise duties (6)	(6)/(1) *1000 (7)	Mean equival. expendit. (8)	Mean equival. excise duties (9)	(9)/(1) *1000 (10)	Mean equival. expendit. (11)	Mean equival. excise duties (12)	(12)/(1) *1000 (13)
1 (bot.)	57574	112	14	0.238	1758	1011	17.554	1989	264	4.583	229	137	2.385
2	85849	239	29	0.335	2711	1559	18.157	2750	400	4.657	861	517	6.017
3	106653	273	34	0.315	3407	1959	18.369	3268	495	4.644	1887	1132	10.616
4	126346	403	48	0.384	3896	2240	17.729	3203	487	3.852	2777	1666	13.187
5	145427	496	58	0.400	4873	2802	19.265	3604	557	3.830	4209	2525	17.365
6	167054	649	78	0.465	4754	2734	16.365	3910	610	3.649	4924	2954	17.684
7	192517	757	91	0.472	4732	2721	14.133	4426	699	3.632	6586	3952	20.527
8	225564	842	103	0.455	6221	3577	15.860	4489	708	3.139	7962	4777	21.179
9	275187	1136	142	0.515	6518	3748	13.618	4910	788	2.864	10381	6229	22.635
10 (top)	423755	1746	222	0.524	6592	3788	8.940	6223	1001	2.363	15065	9039	21.330

Graph 1. Share of specific excise duties in total consumption expenditure per decile



Columns (3), (6), (9) and (12) of Table 2 report the mean equivalent excise duties paid by each decile for each of the four commodity groups. As could be anticipated, with very few exceptions, the amount of excise duties paid for each commodity rises in each successive decile. However, in the cases of Alcoholic Drinks and Transportation Fuels these increases are substantially steeper than in the cases of Tobacco Products and Heating Fuels. For example, the equivalent excise duties paid by the households of the top decile for Tobacco Products and Heating Fuels are, respectively, 3.75 and 3.79 times higher than the equivalent excise duties paid by the households of the bottom decile. The corresponding ratios for Alcoholic Drinks and Transportation Fuels are 15.86 and 65.98, respectively. Evidently, the distributional impact of excise duties is likely to vary substantially across commodities.

Columns (4), (7), (10) and (13) of Table 2 report the share of the excise duties for each commodity group in the total consumption expenditure of the corresponding deciles. These shares are also depicted in Graph 1. They confirm that the proportion of the total expenditure of the poorer households going to excise duties for Tobacco Products and Heating Fuels is higher than the corresponding proportion of better-off households. Exactly the opposite is the case with respect to Alcoholic Drinks and Transportation Fuels. For example, the proportions of total consumption expenditure of the bottom decile that go to excise duties for Tobacco Products and Heating Fuels

Table 3. Aggregate private equivalent consumption expenditure on items subject to excise duties.

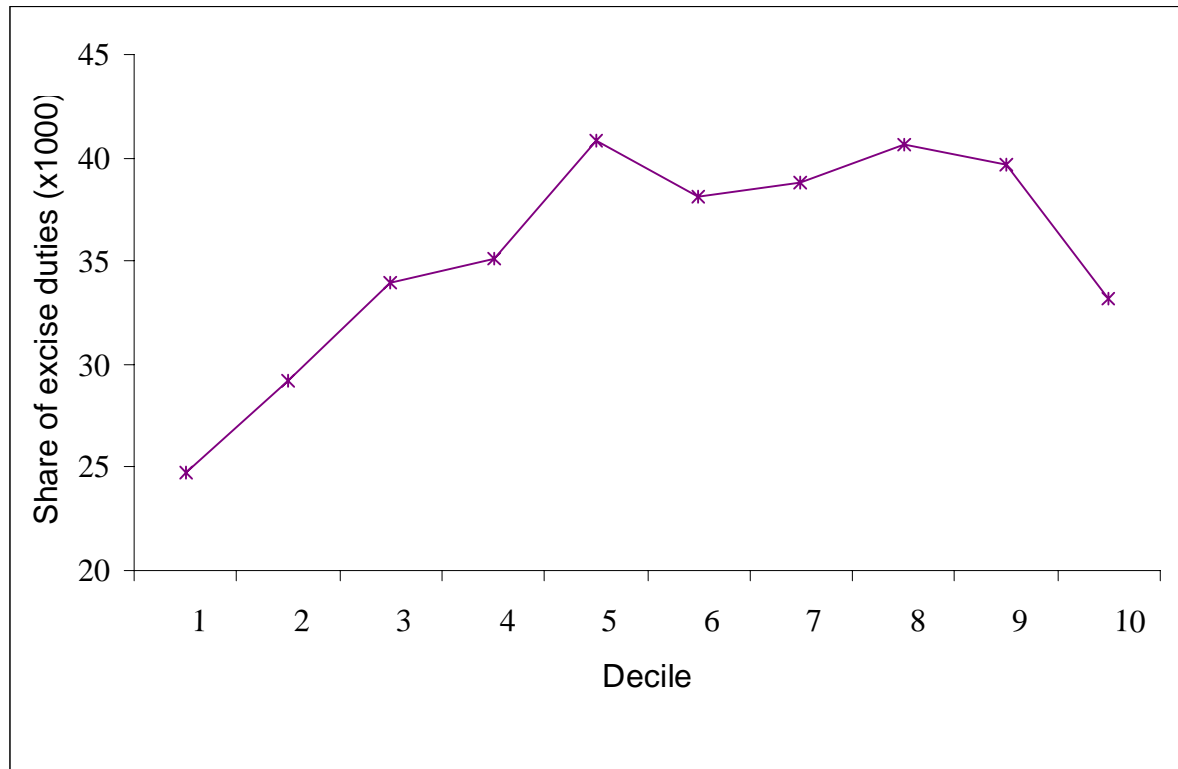
Households ranked by decile of equivalent consumption expenditure

Decile	Mean equivalent expenditure (total) (1)	Goods subject to excise duties (excluding means of transportation)		
		Mean equivalent expenditure (2)	Mean equivalent excise duties (3)	(3)/(1) *1000 (4)
1 (bottom)	57574	4087	1426	24.760
2	85849	6561	2504	29.166
3	106653	8835	3620	33.943
4	126346	10279	4441	35.151
5	145427	13182	5942	40.860
6	167054	14237	6375	38.164
7	192517	16502	7463	38.765
8	225564	19514	9165	40.633
9	275187	22944	10906	39.632
10 (top)	423755	29625	14050	33.157

are, respectively, 1.96 and 1.94 times higher than the corresponding proportions of the top decile. On the contrary, the corresponding ratios for Alcoholic Drinks and Transportation Fuels are 0.45 and 0.11, respectively.

The aggregate impact of excise duties is examined in Table 3. This table is similar to Table 2 but, instead of examining each commodity separately, its last three columns report the mean equivalent consumption expenditure on the four commodity groups taken together, the mean equivalent excise duties corresponding to them and the proportion of excise duties in the total consumption expenditure of each decile. Graph 2 depicts the share of excise duties in total consumption expenditure per decile. Both the mean equivalent expenditure on commodities subject to excise duties and the mean equivalent excise duties rise as we move to a higher decile. However, the share of excise duties in total expenditure follows approximately an inverted U-shaped pattern. This share takes its lowest value in the bottom decile, 2.48%, rises continuously until the fifth decile where it takes its highest value,

Graph 2. Share of excise duties (excluding duties on vehicles) in total consumption expenditure per decile



4.09%, and then gradually but non-monotonically declines until it reaches 3.32% in the top decile. On this evidence, it is difficult to speculate about the overall distributional impact of excise duties.

This brings us to Table 4 which contains some of the most important results of the paper. The upper part of the first column of the table reports the share of each decile in the distribution of equivalent consumption expenditure. The lower part of the same column reports estimates of inequality indices for the distribution of equivalent consumption expenditure per household. The next four columns report the same attributes when the amount of excise duties paid by each household for each of the four commodity groups under examination is subtracted from the concept of consumption expenditure.<sup>10</sup> The last column refers to the distribution of equivalent consumption expenditure net of all excise duties. The figures in parentheses below the estimates of the inequality indices in columns (2)-(6) are the percentage differences of these estimates from the corresponding estimates reported in column (1).

These distributions should be interpreted in the following way. The HBS records the overall expenditure of all households including the excise duties, but the households do not derive utility from the excise duties they pay (at least directly). The money-

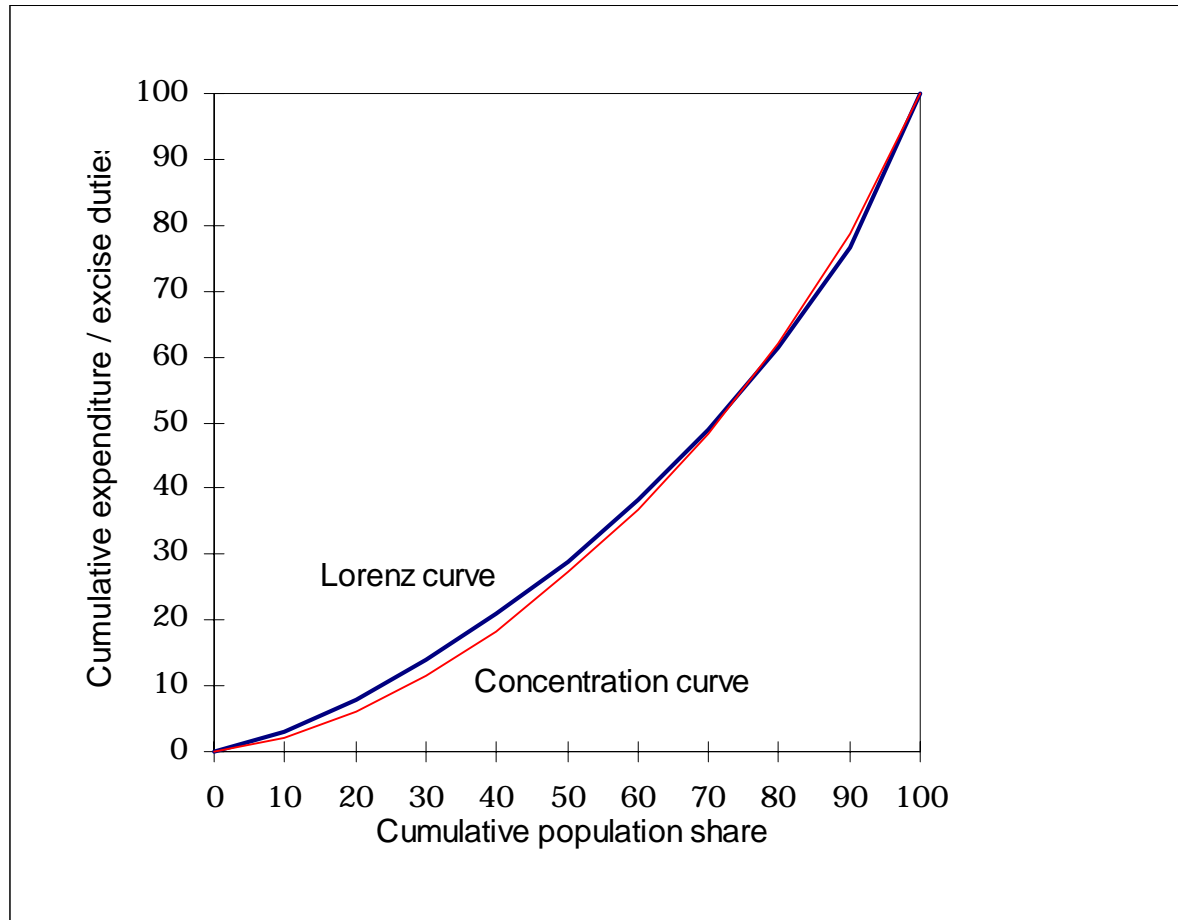
Table 4. Budget shares and inequality indices for equivalent consumption expenditure and equivalent consumption expenditure net of excise duties

	Equivalent consumption expenditure	Equivalent consumption expenditure net of excise duties on alcoholic drinks	Equivalent consumption expenditure net of excise duties on tobacco products	Equivalent consumption expenditure net of excise duties on heating fuels	Equivalent consumption expenditure net of excise duties on transportation fuels	Equivalent consumption expenditure net of excise duties (excl. means of transportation)
	(1)	(2)	(3)	(4)	(5)	(6)
Decile	Budget Shares					
1 (bottom)	3.188	3.179	3.173	3.185	3.234	3.214
2	4.749	4.766	4.733	4.745	4.816	4.788
3	5.910	5.904	5.882	5.900	5.949	5.915
4	6.999	6.999	6.972	6.986	7.026	6.990
5	8.049	8.061	8.016	8.064	8.055	8.028
6	9.258	9.250	9.225	9.250	9.249	9.231
7	10.659	10.654	10.675	10.656	10.647	10.643
8	12.488	12.495	12.469	12.489	12.447	12.421
9	15.253	15.236	15.281	15.253	15.194	15.214
10 (top)	23.447	23.455	23.575	23.472	23.384	23.556
	Inequality Indices					
Gini ( <i>G</i> )	0.3068	0.3068 (0.00%)	0.3087 (0.62%)	0.3072 (0.13%)	0.3044 (-0.78%)	0.3067 (-0.03%)
Atkinson ( <i>A</i> , $e=0.5$ )	0.0756	0.0756 (0.00%)	0.0765 (1.19%)	0.0758 (0.26%)	0.0745 (-1.46%)	0.0756 (0.00%)
Atkinson ( <i>A</i> , $e=2$ )	0.2751	0.2751 (0.00%)	0.2774 (0.84%)	0.2757 (0.22%)	0.2704 (-1.71%)	0.2732 (-0.69%)
Theil ( <i>T</i> )	0.1571	0.1571 (0.00%)	0.1592 (1.34%)	0.1575 (0.25%)	0.1550 (-1.34%)	0.1575 (0.25%)
Mean log deviation ( <i>N</i> )	0.1579	0.1579 (0.00%)	0.1598 (1.20%)	0.1583 (0.25%)	0.1552 (-1.71%)	0.1574 (-0.32%)

metric level of their welfare is determined by the level of their consumption expenditure net of excise duties. Therefore, the distribution of economic welfare is approximated by the distribution of consumption expenditure net of excise duties, whereas the distribution of consumption expenditure including the excise duties represents the level of welfare that would have existed if the excise duties were abolished. Therefore, in order to assess the distributional impact of the imposition of excise duties we should compare the level of inequality in the distribution of welfare as it is now (columns (2)-(6)) with the level of inequality that would have existed if there were no excise duties (column (1)). Comparison of columns (2), (3), (4) and (5) with column (1) provides the distributional impact of excise duties on Alcoholic Drinks, Tobacco Products, Heating Fuels and Transportation Fuels, while comparison of columns (1) and (6) provides an evaluation of the overall distributional impact of the excise duties. If the estimates of the inequality indices reported in columns (2)-(6) are higher (lower) than the estimates reported in column (1), it can be concluded that the distributional impact of the corresponding excise duties are regressive (progressive).

The estimates of column (2) indicate that the distributional impact of excise duties on Alcoholic Drinks is negligible. This could have been anticipated, taking into account the low values of the equivalent excise duties on Alcoholic Drinks reported in Graph 1. In the lower part of column (2), inequality indices hardly move as a result of these excise duties, although it is fair to say that all the indices record a decline in inequality albeit an extremely mild one (the changes are recorded in the fifth or sixth digit of the indices).<sup>11</sup> Unlike the distributional impact of excise duties on Alcoholic Drinks, the distributional impact of excise duties on Tobacco Products reported in column (3) appears to be significant and very regressive. The evidence of the upper panel of Table 4 suggests that, as a result of these duties, the expenditure shares of the six bottom deciles and the eighth decile decline. As a consequence, all the indices in the lower panel of Table 4 record a significant increase in inequality. Inequality appears to rise between 0.62% in the case of the least sensitive index (*G*) and 1.34% in the case of the index that is most sensitive to changes at the top of the distribution (*T*). Similar, but less pronounced, results are derived when the distributional impact of excise duties on Heating Fuels is examined in column (4). The shares of all the seven bottom deciles but the fifth decline as a consequence of these duties and all the indices of inequality apart from *G* rise by around 0.25%. The strongest results of Table 4 are reported in the case of Transportation Fuels in column (5). *Ceteris paribus*, the imposition of excise duties on Transportation Fuels increases the shares of the five bottom deciles and decreases the shares of the top five deciles (sometimes, substantially so). As in the previous columns, *G* records the smallest decline in

Graph 3. Lorenz curve for the distribution of equivalent consumption expenditure and concentration curve of equivalent excise duties



inequality, -0.78%, whereas the rest of the indices record declines between -1.34% and -1.71%.

The overall distributional impact of the excise duties under examination is presented in the last column of Table 4 as well as in Graph 3. The latter depicts the Lorenz curve of the distribution of equivalent consumption expenditure and the concentration curve of the equivalent excise duties paid by the corresponding deciles. Some very interesting results become evident. As a result of the excise duties, the expenditure shares of the three bottom deciles rise. But so does the share of the top decile, too. This results in an intersection of the Lorenz curve and the corresponding concentration curve in Graph 3.<sup>12</sup> As a consequence, some of the inequality indices record higher levels of inequality in the distribution of consumption expenditure net of excise duties, while others record lower levels of inequality. It is interesting to examine the behaviour of the various indices.  $T$ , which is relatively more sensitive to changes at the top end of the distribution records an increase in inequality - consequence of the fact that the share of the top decile rose steeply. On the contrary, the indices that are relatively more sensitive to changes at the bottom end of the distribution ( $N$ ,  $A$  for  $e=2$ ) record a decline in inequality - consequence of the fact that the share of the three bottom

deciles (and, particularly, the lowest) rose. The remaining indices which are relatively more sensitive to changes around the middle of the distribution ( $G, A$  for  $e=0.5$ ) hardly move.

Table 5 reports the results of decomposition analysis. The first column reports the shares of the excise duties under examination in the total consumption expenditure of the population, while the next four columns report the contributions of these duties to aggregate inequality (factor inequality weights),  $w_k g_k$ , when the value of the inequality aversion parameter,  $u$ , rises from 1.5 to 4. The last four columns report the elasticity of the extended Gini index,  $G(u)$ , with respect to a change in the excise duties. The results of Table 5 appear to be fully consistent with the results of the previous tables.

According to the first column of the table, the excise duties under examination account for 3.65% of the total consumption expenditure of the population. The lion's share is due to excise duties imposed on Transportation Fuels (1.82%) and Tobacco Products (1.45%), while excise duties on Heating Fuels (0.33%) and Alcoholic Drinks (0.05%) play a less significant role. The next four columns suggest that the progressivity of these duties (contribution to aggregate inequality) depends on the value of the inequality aversion parameter,  $u$ . For all values of the inequality aversion parameter reported in the table the contribution of all the excise duties taken together to aggregate inequality (factor inequality weight) is higher than their budget share.<sup>13</sup> Since, in the framework of the present analysis, taxes are treated as "negative" consumption, these figures imply that as aversion to inequality rises, the excise duties appear to be increasingly progressive (more unequally distributed than consumption expenditure). The estimates reported in the last four columns should also be interpreted in a similar way. Higher elasticities imply that, at the margin, an increase in excise duties will result in a larger decline in aggregate inequality and vice versa. For example, *ceteris paribus*, when  $u$  is set at 2 (conventional Gini index), an 1% increase in the total excise duties under consideration will result in a decline in inequality by 0.0019%, whereas if  $u$  is set at 4 the corresponding decline should be 0.0045%.

With respect to the specific excise duties, the estimates of the last four lines of Table 5 confirm the findings of the previous tables. Excise duties on Tobacco Products and Heating Fuels play a regressive role, whereas, those on Transportation Fuels appear to be progressive and those on Alcoholic Drinks progressive but not very important. However, it is interesting to note that as the extended Gini index becomes more sensitive to transfers close to the bottom of the distribution, the progressivity of

Table 5. Inequality decomposition and excise duties: Greece 1994

Excise Duties	Share of Excise Duties in Total Expenditure $w_k$ (%)	Factor inequality weight $w_k g_k$ (%)				Elasticity of $G(u)$ with respect to a change in excise duties $e_k$			
		Inequality aversion parameter ( $u$ )				Inequality aversion parameter ( $u$ )			
		1.5	2	3	4	1.5	2	3	4
Total Excise Duties	3.65	3.66	3.84	4.02	4.10	0.0001	0.0019	0.0037	0.0045
Alcoholic Drinks	0.05	0.06	0.06	0.06	0.06	0.0001	0.0001	0.0001	0.0001
Tobacco Products	1.45	0.81	0.91	1.03	1.10	-0.0063	-0.0053	-0.0042	-0.0035
Heating Fuels	0.33	0.19	0.20	0.22	0.23	-0.0014	-0.0013	-0.0011	-0.0011
Transportation Fuels	1.82	2.59	2.66	2.71	2.72	0.0077	0.0084	0.0089	0.0089

excise duties on Transportation Fuels rises, while the regressivity of excise duties on Tobacco Products and, to a lesser extent, Heating Fuels, declines.

An application of this type of decomposition analysis can be provided using data from a recent tax reform in Greece. In October 1998 the Greek government reduced excise duties on Transportation Fuels by 7.21% and on Heating Fuels by 28.57%. Our analysis demonstrates that the first of these reductions is likely to be regressive since it will increase disproportionately the spending power of the richest households, while the second will have the opposite impact. However, by how much will they influence aggregate inequality? The evidence of the last columns of Table 5 suggests that in the case of the conventional Gini index ( $u=2$ ), the reduction in the excise duties on Transportation Fuels will increase the index by 0.061%, whereas the reduction in the excise duties on Heating Fuels will reduce the index by 0.037%; that is the overall impact will be regressive. If the index chosen is more sensitive to transfers close to the bottom of the distribution (for example, if  $u=4$ ) the overall effect is more clearly regressive since the progressive effect of the reduction in the excise duties on Heating Fuels (0.031%) is clearly counterbalanced by the regressive effect of the reduction in the excise duties on Transportation Fuels (0.064%).<sup>14</sup>

## 5. Conclusions

The findings of the paper cast serious doubts on the assertion frequently made in the Greek public discourse that the distributional impact of excise duties is strongly regressive. The results suggest that the overall distributional impact of the excise duties examined in the paper is not unambiguous. Their burden is disproportionately borne by the middle income classes, whereas the contributions of the three poorest deciles as well as the richest decile to the aggregate excise duties burden are lower than their shares in aggregate consumption expenditure. As a consequence of the imposition of excise duties, the indices of inequality that are relatively more sensitive to changes at the bottom end of the distribution record mild declines in aggregate inequality, while those that are relatively more sensitive to changes at the top end of the distribution record a very modest increase.

Regarding excise duties on particular commodities, the excise duties on Alcoholic Drinks consumed at home were found to be progressive but quantitative not very significant, while, on the contrary, the distributional impact of excise duties on Tobacco Products was found to be both quantitative significant and very regressive. Regressive is also the distributional impact of excise duties on Heating Fuels. The most progressive and quantitative important of the excise duties examined were found to be those imposed on Transportation Fuels used by private vehicles.

As noted earlier, a number of excise duties were left out of our analysis. Therefore, to some extent, the picture provided by our results may be “partial”. What is the likely impact of the remaining excise duties? An answer to this question can be provided by examining the likely income elasticities of demand of the commodities not covered or covered insufficiently in our analysis. The main group of excise duties that was left completely out of our analysis are those imposed on vehicles. Since the income elasticity of demand for private vehicles in Greece is very high [Mergos and Donatos (1989)]<sup>15</sup> and the structure of excise duties on such vehicles is progressive (proportionally higher duties are applied to more expensive cars with more powerful engines), these duties are likely to be borne mainly by the better-off households and their distributional impact is likely to be very progressive. On the contrary, since public transportation services have a low income elasticity of demand, excise duties imposed on vehicles used for public transportation as well as the excise duties imposed on the fuels used by these vehicles are likely to have a negative distributional impact. Regarding the excise duties imposed on Alcoholic Drinks there are two problems. The first has to do with the deliberate under-reporting of expenditures on these items by the respondents to the HBS and the second with the fact that alcoholic drinks consumed in restaurants, bars, etc. were not included in our analysis. With respect to the first problem, we do not have any grounds to claim that the under-reporting is in any way related to the welfare level (equivalent consumption expenditure) of the under-reporting households. Therefore, it can be argued that the results reported in the paper are valid, but had all the relevant expenditures been recorded properly, the distributional impact of excise duties on Alcoholic Drinks consumed at home would appear to be stronger. With respect to the second problem, since eating and drinking out of home are likely to be activities with high income elasticity of demand, the corresponding excise duties are also likely to have a progressive distributional impact. Regarding the two regressive excise duties examined in detail in the paper - on Tobacco Products and Heating Fuels - our results seem to be very robust. It is likely that some deliberate under-reporting by the respondents of the HBS exists in the case of Tobacco Products (although substantially smaller than in the case of Alcoholic Drinks). Hence, most probably, had the consumption expenditure figures been reported correctly, the distributional impact of excise duties on Tobacco Products could appear to be even more regressive. Finally, in the case of excise duties imposed on intermediate goods, it is difficult to speculate about the nature of their distributional impact. Therefore, if the rationale described above on a commodity-by-commodity case is correct, then, almost certainly, the main conclusions of our study would hardly change had we had the information to evaluate the distributional impact of the excise duties left out of our analysis.<sup>16</sup>

Indirect taxes are imposed for a variety of reasons and in many cases, their distributional impact is not among the prime considerations of the governments that impose them. However, in recent years, with the advent of direct tax cuts, the share of indirect taxes in total tax revenues has risen in most developed countries. Under these circumstances, the *ex ante* analysis of the likely distributional effects of indirect tax reforms assumes greater importance. The present paper outlined and applied a methodology that is both easily replicable and applicable to a number of related areas (for example, for the examination of the distributional impact of changes in VAT rates).

FOOTNOTES

1. In 1994, 1US\$=242.6 drachmas [IMF (1996, p. 387)].
2. Until the early 1990s, excise duties on Vehicles were substantially higher and were contributing almost 40% of all the excise duties revenues or around 3.5% of GDP [Georgakopoulos (1992)].
3. The proportion varies slightly between leaded and unleaded petrol and is substantially lower for diesel.
4. The latter also includes liquefied gas used mainly for cooking which is subject to the same excise duties as gas used for heating.
5. No information on the type of transportation fuel used by the households (leaded petrol, unleaded petrol or diesel) is provided in the HBS. However, the evidence of the Ministry of Finance (1995) implies that the overwhelming majority of private cars in 1994 were using leaded petrol. Therefore, the corresponding rate (60% of the consumer price) has been used throughout our analysis.
6. This method has been used in a number of studies for the examination of the structure of income inequality [see, for example, Fields (1979), Lerman and Yitzhaki (1985), Garner (1993)], Podder (1993), Adams (1994), Jenkins (1995), Achdut (1996), Sotomayor (1996), Gustafsson and Shi (1997) and Aaberge (1997)], while Yitzhaki and Thrisk (1990) and Yitzhaki and Slemrod (1991) outline how it can be exploited for the study of tax progressivity.
7. Note that a negative  $R_k$  implies that the expenditure for this particular component is negatively correlated with the rank of total expenditure and, therefore, this component contributes to aggregate equality rather than inequality.
8. Note that  $r/n$  is the vector of the cumulative distribution of the total population or, alternatively, the rank vector normalised to be between zero and one.
9. Strictly speaking, this is not correct because, firstly, the consumption expenditure figures for the four groups do not take into account imputed consumption expenditures and, secondly, the savings of the households are ignored.
10. In comparison with the distribution of the first column, in each of the rest of the columns of Table 3 there is both a decline in the mean of the distribution and a re-ranking of the households.
11. This progressivity becomes apparent when comparing the Lorenz curve of the distribution of equivalent consumption expenditure with the concentration curve of the equivalent excise duties on Alcoholic Drinks. The latter lies outside the former and, therefore, the distributional impact of excise duties on Alcoholic Drinks is unambiguously progressive. Graphs are available from the authors on request.
12. As a consequence, the Lorenz curves of the distributions of equivalent consumption expenditure and equivalent consumption expenditure net of excise duties also intersect. However, due to the small absolute magnitude of the changes in decile shares, when put in a common graph the two Lorenz curves appear as almost overlapping and, thus, these graphs are not shown here (but they are available from the authors on request).
13. Nevertheless, using sensitivity analysis it can be shown that the opposite is true for  $u < 1.3$ .
14. It should be stressed that these estimates are provided primarily for expositional purposes, since they assume that changes in the excise duties do not affect the consumption patterns of the households (*ceteris paribus*). Such an assumption can be considered as rather

unrealistic, particularly if the changes are large in absolute terms and the corresponding commodities have a high price elasticity of demand.

15. This is also implied by the estimates of Table 2 regarding the share of Transportation Fuels in consumption expenditure per decile.

16. The conclusions could be different if (equivalent) income was used as a welfare indicator instead of (equivalent) consumption expenditure and there was significant concentration of savings at the top end of the distribution. Experimentation with our data shows in such a case, the classification of the particular excise duties with respect to their progressivity is not affected, but the overall progressivity of excise duties declines substantially.