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INDIRECT TAXATION IN GREECE: EVALUATION AND POSSIBLE REFORM

Abstract

The paper assesses the distributional and efficiency/disincentive aspects of the Greek indirect tax system, which provides 60% of total tax revenue. The marginal welfare costs of broad commodity groups were computed to identify welfare-improving directions of reform. The disincentive effects were estimated from marginal indirect tax rates using Household Expenditure Survey data. The indirect tax structure is shown to be unnecessarily complicated and inefficient, without achieving any redistributive goals. The UK indirect tax structure was shown to be simpler, more equitable and more efficient to implement and administer when simulated on Greek consumers.

JEL Classification: H21, H23, H31.

Keywords: indirect tax reform, inequality, tax efficiency, disincentive effects, tax simulations.

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Indirect taxation in Greece: evaluation and possible reform

Georgia Kaplanoglou and David Newbery

1. Introduction

Greece is unusual among EU countries in the large share of indirect taxes in total tax revenue (60% compared to an average of around 40% for the OECD countries or the EU-15, OECD 1999), and the considerable variation in individual indirect tax rates.[1] This variability in tax rates results from the large number of different taxes levied often on the same good,[2] and to a large extent survives despite joining the European Union and adopting the EU system of Value Added Taxes (VAT). The EU VAT system initiated by the Sixth Council Directive 77/388/EEC of 17 May 1977 and its various amendments[3] was intended both to harmonise taxes within and across countries, and gives limited discretion to member countries in the number of different rates and the extent to which they can be varied. Perhaps more surprising, both the heavy emphasis on indirect taxes and their variability have survived substantial tax reforms that have raised Greece's tax share in GDP from 24% to 37.4% from 1980 to 1999 (Ministry of Finance and Economy, 2001), though the share of indirect taxes in total revenue has fallen from 70% to 60% over that period. The introduction of VAT in the late 1980s simplified indirect taxes somewhat, and since then there have been further but modest simplifications. Greece is now contemplating a major reform of its entire tax system, and thus needs to consider whether these particular features of the current tax system are the result of historic accident, political expediency, or a considered view of the social objectives of the Greek people that should be defended and retained.

The balance between indirect and direct taxation is not the direct concern of this paper, and will depend on the efficacy of direct and indirect tax collection (Newbery, 1992; 1997), the costs of tax collection (Slemrod, 1990), the extent to which indirect taxes are considered an efficient way of taxing tourists (compared, say, to hotel taxes and airport charges), and the extent to which indirect taxes are less visible than direct taxes, and hence less objectionable to swing voters (in the middle classes). This paper addresses the second feature of the indirect tax system, and the extent to which the high degree of variability in tax rates can be defended on social welfare grounds. Not only is this timely, given the current interest in major tax reform in Greece, but, despite the overwhelming importance of indirect taxes in total Greek revenue, there are surprisingly few systematic up-to-date studies available. The few papers on the Greek indirect tax system are either fragmentary (Grevenitis and Sapounas, 1988; Georgakopoulos, 1989), or outdated (Karageorgas, 1973; Provopoulos, 1979).

There is one caveat that should be borne clearly in mind when examining any part of a tax system, and certainly in the present paper. The component taxes within a properly designed tax system can only be assessed within the context of the whole system, which includes the expenditure side of the budget. If tax compliance and administration costs allow a reasonably effective system of direct taxation, then indirect taxes can be left to make minor improvements to distributional and efficiency goals (as well as correcting for market failures, such as the social and/or environmental damage caused by consuming certain goods). A well-designed system of social expenditure (on health, education, and welfare) and transfers (to the poor, as child support, etc.) is a better method of addressing distributional concerns than most taxes. It follows that uniform tax rates combined with such well-designed expenditures can be part of an efficient yet egalitarian tax and expenditure *system*. Criticising indirect taxes because they are not adequately progressive or redistributive would therefore be unreasonable without first

[1] For a comparative study of consumption taxes in OECD countries, see OECD (1999).
[2] See Table A1 for the tax rates by commodity group and the variability within groups.
[3] For a comprehensive overview of the Sixth directive and its amendments, see the relevant internet site of the European Union, http://europa.eu.int/scadplus/leg/en/lvb/l31006.htm.

demonstrating that such distributional goals could not better be achieved either with other parts of the tax system or through changes to the expenditure side of the budget.

To see how important this is for the reform of indirect taxation, section 2 derives formulae for the marginal social cost of raising revenue from particular indirect taxes. If these are not equal across goods, then the same revenue can be raised at lower social cost by raising taxes on the good with the lower marginal social cost and lowering the tax on one with a higher social marginal cost. The marginal social cost depends both on distributional considerations, and the product of tax rates and various own and cross-price elasticities of aggregate demand. If the only possible reform consists of revenue-neutral adjustments of indirect tax rates, then this approach (of *marginal tax reform analysis*) has some merit, though it is not without its own problems, as we shall see. If distributional considerations are not too important, then taxing inelastically demanded goods more heavily than elastically demanded goods appears defensible (but conversely if distributional considerations are very important, and are reflected sufficiently in different consumption patterns of the rich and poor).

In order to estimate these elasticities, moderately strong restrictions have to be placed on the form of consumer demands, and these, together with a wider choice of tax instruments, can largely predetermine the outcome. Thus weak separability between goods and leisure in the utility function combined with Engel curves which are linear and have the same intercept, the ability to tax all goods, and the ability to redistribute tax revenue in the form of lump-sum grants, implies that indirect taxes should be made uniform (Atkinson, 1977; Deaton, 1979 and 1981). Even in the case where the intercepts of the Engel curves vary across households on the basis of observable household characteristics, uniformity of indirect taxation is still optimal provided that the government can apply an optimal system of family grants (Deaton and Stern, 1986). If non-linear income taxes can also be optimally set, then all we need for the optimality of uniform indirect taxes is weak separability of goods and labour and individuals differing only in the wage rate (Atkinson and Stiglitz, 1976; Deaton, 1981; Stern, 1987).[4] Uniform commodity taxes then deliver the consumption bundle to workers at least cost (by creating minimum relative price distortion), encouraging them to work harder by confining distortions to the supply of labour (effort).

The case for non-uniform commodity taxation then rests on the extra leverage such differentiation gives over labour supply - there is then a case for heavier taxes on goods that are complementary to leisure (golf clubs?), and lighter taxes on goods complementary to work (commuting?). As it is both hard to think of such taxes that do not create unreasonable extra distortionary costs, and whose elasticities can be estimated sufficiently reliably, there is an arguable presumption for uniformity of indirect Value Added Taxes (VAT). There are additional advantages of uniform VAT in terms of lower administrative and collection costs.

It is therefore likely to be difficult for Greece to defend its very non-uniform indirect tax structure. One possible defence is that there are very few other instruments that can be used to improve the overall tax and expenditure structure. For example, it is clearly perceived to be difficult to achieve all the desired redistribution from personal income taxes (which collect remarkably little revenue from some segments of the population that are clearly relatively well off, such as the professional classes and the self-employed). We observe that Greece has finally balanced its budget and met the Maastricht criteria exclusively through substantial increases in the share of GDP taken in taxes, so that the expenditure side of the budget is also severely constrained.

If this is accepted, then we can ask whether indirect taxes offer any serious prospect of relaxing these constraints, and contributing anything to distributional equity without compromising either revenue or efficiency (i.e. the total amount of after-tax income available).

[4] If indirect taxes are to be set at positive levels, then one also needs the ability to tax all goods, though if some goods cannot be taxed, then it would be optimal to have uniform zero indirect taxes, ignoring for the moment the other reasons for positive taxes (tourists, minimising tax compliance costs, etc.)

If not, then the current variability of taxes reflects a failure, despite repeated opportunities, to further simplify indirect taxes and make them more uniform (which should help compliance, reduce collection costs and move towards the preferred EU pattern of taxation).

This paper builds on the findings of a recent paper assessing the distributional effects of the Greek indirect tax system (Kaplanoglou, 2000). It extends that paper by examining efficiency as well as distributional aspects of the current tax system, and by inquiring how the present system can be improved. This is done in three ways. The standard theory of marginal tax reform (Feldstein, 1972; Ahmad and Stern, 1984; Stern, 1987) can, given sufficient information about aggregate demand elasticities, indicate which indirect taxes should be reduced and which increased (assuming, as noted above, no other taxes can be changed). The paper applies this approach to see whether the current dispersion in tax rates can be defended either on efficiency or distributional grounds. We find little support for the current pattern of tax variability even within the strong assumptions needed to justify marginal tax reform analysis.

The marginal tax reform approach has the attraction of combining both efficiency and distributional considerations in a theoretically consistent framework (the same utilitarian framework that underlies welfare economics more generally and social cost-benefit analysis in particular). It can be embedded in a more comprehensive study of the whole tax and expenditure system (although we shall not follow this here), but it has a number of limitations, in addition to those noted above. The most serious, and the one that bedevils all arguments for differential indirect tax rates, is that it relies on good estimates of own and cross-price elasticities (Deaton, 1987). There are various responses that can be made to this short-coming, of which the most pragmatic is to argue that any case for non-uniformity must either be based on reasonably strong evidence that the demand structure justifies it, or that distributional considerations are so important that they are likely to dominate the demand-side effects (which, as noted above, is hard to do if revenue-neutral lump-sum redistributions can be made). The practical effect of this problem is that we can only examine the indirect tax structure at a fairly high level of aggregation, which is likely to conceal some important detail.

The other limitation is that marginal tax reform analysis only indicates which taxes could be raised or lowered to improve matters, not by how much, nor even which ones would deliver the best result.[5] That in itself might not be an overwhelming objection if the main purpose is to see whether there is any defence for the present departures from uniform taxation, and we are able to draw some conclusions from this part of the analysis. Here again the high level of aggregation is a limitation, bringing out the importance of excises and other considerations in setting these excise tax rates.

The second way in which this paper explores options for reform is to examine the redistributive and efficiency impact of the whole indirect tax system by seeing whether the marginal indirect tax rate as a whole varies across the income (or expenditure) distribution in a logical and defensible way, following the approach of Newbery and Révész (2000). We find that once we correct for household type, there is essentially no variation in the marginal tax rate across the income distribution, and hence the individual variability in indirect tax rates is at best only redistributing income *between* different household types at each income level, and has no advantage over a more uniform set of indirect tax rates for taxing the rich more heavily than the poor. This provides strong evidence that the guiding principle of uniformity of VAT rates within a complete tax and benefit system holds even within the more restrictive exercise conducted here.

This leads to the third way in which we criticise the current structure of indirect taxes, by examining the impact of a revenue-neutral tax reform of the entire system. Section 4 investigates

[5] It is tempting to argue that the most socially costly tax rate should be lowered and the least socially costly tax should be increased, but if we do not know by how much, and if there are fixed costs to making any changes, then their overall net contribution to social welfare may be lower than changing other taxes.

the distributional and efficiency effects of simulating the indirect tax system of the United Kingdom on Greek consumers. This simulation exercise is interesting both in its own right as a thought experiment and as an attempt to use as a benchmark a tax system which is already in operation in a developed country and seems to be politically sustainable. Furthermore, it can be shown that the UK indirect tax structure can largely be rationalised in terms of optimal commodity taxation principles (Kaplanoglou, 1999). The advantages in terms of reasonableness and political relevance of using existing tax systems as comparison benchmarks have been recently recognised in the literature; see Gale (1997) and Keen (1997), who discuss the implications of aspects of British tax policy for the US. However, this is the first attempt to put this idea in operation within a microsimulation analytical framework.

2. Marginal tax reform analysis

Optimal tax theory starts with a description of the economy and the objectives of the government, and characterises the optimal level of each of the tax instruments considered available, given the information that it is reasonable to assume is available to the government. Solving for the set of optimal taxes requires the ability to predict how the economy behaves not just in its present equilibrium but at all other possible equilibria, in order to identify the optimum. Marginal tax reform analysis also requires an adequate description of the economy and government objectives (summarised in a social welfare function), but considers the more modest and informationally less demanding task of identifying the direction in which taxes can be changed to improve matters, judged by the social welfare function. That requires only local information about economic responses to tax changes, in contrast to the global information required for determining optimal taxes. A convenient summary of both optimal tax theory and the theory of marginal tax reform is supplied by Stern (1987), and applied to the present case below.

2.1. The theory of marginal tax reform

Suppose that the government ranks distributional outcomes according to a Utilitarian or Benthamite social welfare function $W(V^1,...,V^h,...,V^H)$, where agent h enjoys utility $V^h = V^h(y^h+g, \mathbf{q})$ that depends on net income y^h, plus any transfers, g, and the vector of consumer prices, $\mathbf{q} = \mathbf{p} + \mathbf{t}$, where $\mathbf{p}$ is the vector of producer prices and $\mathbf{t}$ is the vector of indirect taxes.[6] All we need to assume about the description of the economy is that the producer prices do not vary with indirect taxes (defended below). Consider the impact on social welfare of a change in consumer price q_i, caused by a change in the tax, t_i:

$$\frac{\partial W}{\partial q_i} = \sum_h \frac{\partial W}{\partial V^h} \cdot \frac{\partial V^h}{\partial q_i} = - \sum_h \beta^h x_i^h , \qquad (1)$$

where

$$\beta^h \equiv \frac{\partial W}{\partial V^h} \cdot \frac{\partial V^h}{\partial g} \qquad (2)$$

[6] The force of utilitarianism is that it is *individualistic*, that is, it respects individual wellbeing as measured by the individual utility function, and it is *consequentialist*, in confining attention to outcomes, rather than processes or rights (though these can be included by restrictions on either information or policy variables). When it comes to numerical quantification, individuals are weighted by the OECD equivalence scale. An *agent* is then defined as one equivalent adult, who is assumed to receive the equivalent share of total household expenditure.

is the social marginal utility of transferring 1 Euro to agent h, x^h_i is consumption of good i by agent h, and the last equality in equation (1) makes use of Roy's identity. The impact of the tax change will thus depend on both the level of consumption and its distribution amongst the population. It is convenient to isolate these two effects by defining d_i, Feldstein's (1972) *distributional characteristic* of good i:

$$d_i \equiv \frac{\sum_h \beta^h x_i^h}{\overline{\beta} X_i}, \quad X_i \equiv \sum_h x_i^h, \qquad \overline{\beta} \equiv \frac{1}{H}\sum_h \beta^h, \tag{3}$$

where X_i is aggregate consumption of i, $\overline{\beta}$ is the average over the H agents of β^h, so that d_i is a measure of how concentrated the consumption of good i is on the socially deserving (those with high social marginal values of consumption, β^h). The social welfare impact of a price change is then

$$\frac{\partial W}{\partial q_i} = -\overline{\beta}\, d_i X_i. \tag{4}$$

The standard approach to determining desirable directions of tax reform is to compute the marginal social cost of raising one Euro of revenue by increasing the indirect tax on the ith good. On the standard assumption that the tax is 100% shifted forward to the final price (this is the force of assuming that producer prices do not vary with taxes),[7] the impact on social welfare is $\partial W/\partial t_i$, while the extra revenue collected is $\partial R/\partial t_i$, where $R = \Sigma t_i X_i$ is total tax revenue. The extra revenue collected is then

$$\frac{\partial R}{\partial t_i} = X_i + \sum_k t_k \frac{\partial X_k}{\partial t_i} = X_i\left(1 + \sum_k \frac{q_k X_k}{q_i X_i}.\frac{t_k}{q_k}.\frac{q_i \partial X_k}{X_k \partial q_i}\right) = X_i\left(1 + \sum_k \frac{\omega_k \tau_k \varepsilon_{ki}}{\omega_i}\right), \tag{5}$$

where ω_i is the budget share of good i, $q_i X_i / \Sigma q_i X_i$, $\tau_i = t_i/q_i$ is the ratio of the indirect tax to the tax-inclusive price, and ε_{ki} is the cross price elasticity of good k with respect to the price of good i (or the tax t_i).

In order to collect one more Euro of tax, the tax rate will have to be increased by $1/\partial R/\partial t_i$, so the marginal social *cost* of raising a Euro of tax is

$$\lambda_i = \frac{-\partial W/\partial t_i}{\partial R/\partial t_i} = \frac{d_i X_i}{X_i(1 + \sum_k \frac{\omega_k \tau_k \varepsilon_{ki}}{\omega_i})}. \tag{6}$$

This expression is rather inelegant, and its inverse can be more readily examined. Define the *marginal social tax productivity* of tax i as the extra revenue collected for a unit increase in social pain, $-\partial W/\partial t_i$, θ_i:

$$\theta_i \equiv -\frac{\partial R/\partial t_i}{\partial W/\partial t_i} = \frac{1}{\lambda_i} = f_i\left(1 + \sum_k \tau_k \frac{\omega_k \varepsilon_{ki}}{\omega_i}\right) = f_i\left(1 + \tau_i \varepsilon_{ii} + \sum_{k \neq i} \tau_k \frac{\omega_k \varepsilon_{ki}}{\omega_i}\right), \tag{7}$$

[7] This assumption can be defended theoretically for a competitive constant returns economy, or for an imperfectly competitive economy (Lockwood, 1988; Stern, 1987), and empirically in the case of Greece (Karageorgas, 1973; Karageorgas and Pakos, 1988).

where $f_i = 1/d_i$ is the inverse of the distributional characteristic of good i, and may be termed the *tax appeal* of good i, the extent to which it is well targeted on the consumption of the better off.

Equation (7) can now be interpreted. The marginal social productivity of taxing good i increases with the tax appeal of the good, is reduced the higher is the product of the tax rate on the good with the (absolute) value of the own price elasticity, ε_{ii}, and is further influenced by other taxes and cross-price elasticities, ε_{ki}. High own price elasticities signal that the distortionary cost of raising revenue by tax increases as the tax rate rises, but this may be counterbalanced by the equity considerations represented by the good's tax appeal, f_i.

Unfortunately, the direction of reform depends to a considerable extent on the values of the elasticities, ε_{ki}, that are hard to estimate. Deaton (1987) argues that their values are often largely predetermined by the choice of demand system in any econometric estimation. For example, the Linear Expenditure System (LES) has zero (uncompensated) cross-price elasticities, so that (7) then reduces to

$$\theta_i = f_i\left(1 + \tau_i \varepsilon_{ii}\right). \qquad (7a)$$

If we ignore distributional considerations, this is the familiar Ramsey rule that argues that indirect taxes should be inversely proportional to the (absolute) value of the price elasticity. Goods that are *price* inelastic should be more heavily taxed.

If instead of assuming additive separability (of which the LES is a special case), we assume *indirect additivity* (Houthakker, 1960: Deaton, 1987), then (7) reduces to

$$\theta_i = f_i\left(A - \tau_i(\varepsilon_i - \xi)\right),\ A \equiv 1 - (1+\xi)\bar{\tau} + \sum_j \omega_j \varepsilon_j \tau_j, \qquad (7b)$$

and where $\varepsilon_i > \xi$ is the expenditure elasticity of good i, and ξ is a parameter to be estimated. In this case, ignoring distributional considerations, indirect taxes should be inversely proportional to the adjusted expenditure elasticity, ($\varepsilon_i - \xi$), and *income* inelastic goods should be more heavily taxed. There is a close relation between these two formula, as Deaton and Muellbauer (1980a, p139) point out, for additivity implies Pigou's Law, namely that price elasticities are likely to be roughly proportional to income elasticities in the case of additivity (and a reasonable degree of commodity disaggregation). It also reminds us that goods that on efficiency grounds are attractive for higher indirect taxes (low price or income elasticities of demand) are likely to be unattractive on distributional grounds (low income elasticities, i.e. necessities consumed by the poor). These two opposing factors are captured by f_i and the various elasticities, as in (7a) and (7b).

The conflict between equity and efficiency can be demonstrated for the special case of constant expenditure elasticities ε_i, and a log-normal distribution of expenditure (which is a reasonable approximation to the actual expenditure distribution in the case of most countries). The *tax appeal* of good i can be written as $E\beta Ex_i/\{E[\beta x_i]\}$, where Ex_i is the expected or average value of x_i over the whole population. If the log of expenditure is normally distributed with a mean μ and variance σ , then

$$x_i^h = a_i(c^h)^{\varepsilon_i},\quad \beta^h = (c^h)^{-\nu},\quad Ec^{\alpha} = \exp(\alpha\mu + \tfrac{1}{2}\alpha^2\sigma^2).$$

where the last equality comes from the properties of the lognormal distribution (see e.g. Newbery and Stiglitz, 1981, p89). It follows that

$$f_i = \frac{E\,c^{-\nu}\,E\,a_i c^{\varepsilon_i}}{E\,c^{-\nu}\,a_i c^{\varepsilon_i}} = \exp(\varepsilon_i \nu \sigma^2),$$

and the values of f_i are a simple function of, and will be correlated with, the expenditure elasticities. A high value of ε_i will give a high value of f_i but from (7b) on efficiency grounds should have a low tax.

2.2. *Estimation*

In order to apply this theoretical framework to the Greek case, we have to combine information from different sources. Household expenditure data are readily available from cross-section microdata of the 1987/8 Household Expenditure Survey (HES). The sample consists of 6,489 households, is representative of the population[8] and provides information on household expenditure on 293 categories of goods and services. The indirect tax rates ($\tau_i = t_i/q_i$) were computed on the basis of taxes on final goods. This was particularly time-consuming, given the complicated structure of indirect taxation, which involves a large number of taxes levied on different commodities at various rates, sometimes in a cascaded manner.[9]

Demand derivatives and elasticities can be obtained from estimates of aggregate demand systems. Since there is effectively no price variation in the HES data, we draw on two recent time series estimates of complete demand systems for Greece.[10] The first, by Andrikopoulos *et al* (1992), contains an estimation of the Almost Ideal Demand System (AIDS) for Greece for thirteen commodity groups based on National Accounts time series data for the period 1958-1986. The second study was conducted by Alogoskoufis *et al* (1996) and involves again an estimation of the AIDS for Greece for nine commodity groups using annual time series data for the period 1970-1990.

The AIDS is considered a sufficiently flexible demand system, allowing second-order flexible functional forms for the preference representation functions and, thus, provides consistent estimates of price and income elasticities. It has the additional advantage of not entirely pre-determining the direction of tax reform, as would the simpler Linear Expenditure System (Deaton, 1987). In both studies, to conform with the constraints implied by classical demand theory, the adding-up condition, homogeneity and Slutsky symmetry restrictions have been imposed on the share equations. The results of the two studies, although based on the same demand specification, are not directly comparable, since they refer to different time periods, the commodity classifications are not identical and they reflect different estimation methods –see Table A2 in the Appendix.

The marginal social tax productivities, θ_i, are calculated for both sets of elasticity estimates from the two studies, in order to test for the sensitivity of results to the different demand derivative estimates. The number of commodity groups handled in this framework is therefore restricted to the level of commodity aggregation of these two studies. We require that the price elasticities satisfy the budget constraint for the 1987/8 HES data. Thus, the elasticities matrices of the two studies have been adjusted so that they satisfy the 1987/8 HES vector of shares of consumer expenditure. This is done as in Ahmad and Stern (1984), where

[8] In fact, various dimensions of the representativity of the HES sample have been checked against macro-variables from other sources and results are very satisfactory, thus guaranteeing the quality of the results, see Kaplanoglou (1999).

[9] For a detailed description of the calculation of tax rates see Kaplanoglou (1999).

[10] This approach is common in such studies: see for example the original article by Ahmad and Stern (1984), Madden (1989) and Decoster and Schokkaert (1989).

adjusted elasticities, ε^* are chosen by minimising the distance, S, between the original and the adjusted elasticity matrices, where $S \equiv \varepsilon^* - \varepsilon$ and we minimise:

$$Min|S| = \sqrt{\sum_{ij}(\varepsilon_{ij}^* - \varepsilon_{ij})^2} \qquad \text{s.t.} \qquad \sum_i \overline{w_i}\varepsilon_{ij}^* = -\overline{w_j} \tag{8}$$

where $\overline{w}$ is the vector of the HES shares of consumer expenditure.

Finally, we need a method to calculate the welfare weights β^h that allows us to experiment with differing value judgements about the importance of distributional considerations. The simplest and most easily parameterised approach is given by the iso-elastic utility function defined over real consumption per equivalent adult, c^h: $u^h = (c^h)^{1-\nu}/(1-\nu)$, $(\nu \neq 1)$, $u^h = \log c^h$, $(\nu = 1)$, where ν is Atkinson's (1970) coefficient of inequality aversion. Then for an additive (utilitarian) social welfare function, $W = \Sigma u^h$, $\beta^h = (c^h)^{-\nu}$. The higher is the value of ν, the more concerned the government is with inequality. Thus, if $\nu = 1$, transferring one Euro to someone at double the living standard of another has a social value of only one-half that of the reference person. A value of zero indicates no inequality aversion, in which case β^h would be the same for all households, while at the other extreme, a value of 5 approaches the Rawlsian "maxi-min" principle in which only the impact on the poorest counts (for if $\nu = 5$, a marginal unit of income to the poorest is worth $2^5 = 32$ times the value of a unit to someone with twice that income).

Table 1 presents the θ_i s, as well as their components as presented in equation (7), of different commodity groups and the corresponding ranks, for five different degrees of inequality aversion (ν=0, 0.5, 1, 2 or 5). The interpretation of ranking followed here is that a commodity group with a lower rank (say 12) is preferred to a commodity ranked higher (say 1) as candidate of additional taxation – i.e. low ranks mean lower taxes. In the same table we present the *tax appeal* values f_i (the inverse of the distributional characteristics, d_i) of the commodity groups and the corresponding ranks for different values of the inequality aversion parameter. Again commodity groups with high tax appeal are potential candidates for higher tax rates. If we do not care about equity ($\nu = 0$), they are equal to one. The f_is for the other levels of inequality aversion indicate directions of reform for a government that is willing to trade off efficiency for equity.

From Table 1 is apparent that the existing tax structure is not optimal for any of the levels of ν chosen, since θ_i s differ across commodities. Desirable directions of tax reform are moderately sensitive to the coefficient of inequality aversion. If government cares little or nothing about redistribution (ν = 0 to 0.5), one would propose raising taxes on communication, health, education, and possibly furniture and food, and decreasing taxes on recreation (including durables related to entertainment such as TV sets, hi-fi stereo systems), transport, alcohol and housing using the elasticities by Andrikopoulos *et al* (1992). The results are not very different using the elasticities from Alogoskoyfis *et al* (1996), taking into account the difference in the number of commodity groups. For the latter set of elasticities, for example, taxes on communication, furniture and possibly food are to be raised, while taxes on alcohol, tobacco, housing and transport should be lowered.

The introduction of inequality concerns allows the working of the marginal reform framework to be demonstrated. One can notice that distributionally sensitive commodities, for example food, communication and heating move from moderately high ranks (indicating that taxes should perhaps be raised) for zero or low values of inequality aversion to lower ranks (lower taxes). On the other hand, the table indicates that commodity groups like transport, clothing and alcohol that have low ranks on efficiency considerations ($\nu = 0$), become more attractive candidates for additional taxation when the government strongly cares about redistribution. Some goods, such as tobacco and housing (which have low ranks), and education (high rank), hardly change their position regardless of how averse to

inequality the government is. Furthermore, the general tendencies do not seem to demonstrate strong sensitivity to the set of elasticities used, taking into account the differences in commodity groups, and in this respect can be considered robust.

As the level of inequality aversion increases, the ranking of the θ_i's tends to approximate the ranking of tax appeal, see Table 1. Closer inspection of the table, however, suggests that in general the rankings of the θ_i s are dominated by the efficiency element. The introduction of distributional considerations at low levels of ν does not significantly affect the ranking of the θ_i's and it is only at high values of ν that significant changes in the ranking occur. This result supports the finding by Decoster and Schokkaert (1989), who demonstrate a similar result for Belgium. The authors conclude that this is an indication that consumption patterns are not sufficiently differentiated to ascribe an important redistributive role to indirect taxes, a problem theoretically analysed in Sah (1983). Part of the problem is the high degree of aggregation forced by the need to estimate cross-price elasticities, as this tends to obscure variations in consumption patterns (and also variations in tax rates within the commodity groups). However, the conclusion that the indirect tax system is not particularly well-suited for redistribution is well taken, and was argued above. Equity considerations are better addressed using direct taxes and even more by the expenditure side of the budget.

The marginal tax results presented in Table 1 should be further qualified before they can be used to guide policy. Before listing the theoretical limitations of the approach, it is worth applying some elementary common sense to the prescriptions that appear to emerge from the analysis. Thus tobacco, which on efficiency and equity grounds would appear to require lower taxation, is heavily taxed in most countries to discourage use of an addictive and harmful product.[11] In the case of alcohol, which is quite heavily taxed (compared to the average tax rate, though not compared to other EU countries), and on efficiency grounds appears to warrant a tax reduction, is also taxed to discourage consumption, though here the externalities are more obvious (road accidents, battered wives and children, etc.). Similarly, taxing education may appear similarly attractive, but ignores merit good case of beneficial externalities (to children, in reduced crime, etc.) Transport fuels are frequently heavily taxed as a *user charge* for the public road system, and the pure tax element is considerably smaller than shown in the table. Replacing the nominal tax rate with the amount above the user charge element would greatly weaken the argument for lowering that tax. Similarly, the apparently low tax on food which on efficiency grounds is a reason for some increase, ignores the heavy implicit tax on consumers caused by the Common Agricultural Policy. What this suggests is that a simpler indirect tax system would distinguish between corrective or user charge excises (on alcohol, tobacco, fuel), and a small number of VAT rates to deal with other goods (the lower or zero rate being retained for food, education and other goods which are deemed for various reasons to require lower taxes).

At the more theoretical level, we have already noted that marginal analysis does not allow any conclusions on the desirable magnitude of the changes proposed in the rate structure. Furthermore, the assumption of fixed incomes implicitly imposes weak separability between goods and leisure, which we noted argues for uniform taxation. When combined with the ability to impose an optimal non-linear income tax, the optimal indirect tax system is one of uniform taxes, so that the whole marginal reform analysis becomes unnecessary. Marginal indirect tax reform analysis then requires not only the non-optimality of the income tax structure, but also strong limits to redistributing tax revenue through lump-sum transfers.

[11] The argument that it should be taxed to pay for the subsidised medical treatment that smokers may need ignores the larger saving in publicly funded pension payments caused by their premature death.

Table 1. **Efficiency and equity parameters for varying values of inequality aversion.**

Good	budget share (1)	Rank efficiency (2)	θ_i (for ν=0) (3)=1+(4)+(5)	t_i*e_{ii} (4)	sum of $(t_k*w_k*e_{ki}/w_i)$ for $i \neq k$ (5)	f_i^*: tax appeal for various inequality aversion (ν) (rank in italics) (6)								θ_i^* for various inequality aversion (ν) (rank in italics) (7)=(3)*(6)							
						ν = 0.5		1		2		5		ν = 0.5		1		2		5	
Andrikopoulos et al (1992)																					
Recreation/Entertainment	3.6%	1	0.352	-0.299	-0.349	1.05	*10*	1.10	*9*	1.18	*9*	1.48	*11*	0.44	*1*	0.46	*1*	0.50	*1*	0.63	*7*
Alcohol	0.7%	2	0.429	-0.061	-0.510	1.03	*8*	1.05	*7*	1.05	*6*	0.90	*7*	0.53	*2*	0.54	*2*	0.54	*3*	0.47	*5*
Transport	10.3%	3	0.574	-0.216	-0.210	1.06	*11*	1.12	*11*	1.27	*11*	1.45	*10*	0.73	*5*	0.77	*6*	0.87	*8*	1.01	*9*
Housing	5.9%	4	0.616	-0.034	-0.350	0.94	*4*	0.88	*4*	0.74	*4*	0.42	*4*	0.70	*3*	0.65	*3*	0.55	*5*	0.31	*2*
Tobacco	2.6%	5	0.669	-0.222	-0.110	0.91	*2*	0.82	*2*	0.66	*2*	0.39	*2*	0.73	*4*	0.66	*4*	0.53	*2*	0.31	*3*
Heating/Lighting	4.3%	6	0.755	-0.012	-0.232	0.90	*1*	0.80	*1*	0.60	*1*	0.16	*1*	0.81	*6*	0.72	*5*	0.54	*4*	0.15	*1*
Clothing	14.3%	7	0.866	-0.159	0.025	1.05	*9*	1.10	*10*	1.21	*10*	1.97	*12*	1.09	*9*	1.14	*9*	1.26	*9*	2.07	*12*
Other goods and services	7.4%	8	0.872	-0.055	-0.072	1.08	*13*	1.15	*13*	1.32	*13*	2.02	*13*	1.12	*10*	1.20	*10*	1.37	*11*	2.13	*13*
Food	29.9%	9	0.897	-0.005	-0.098	0.94	*3*	0.87	*3*	0.74	*3*	0.40	*3*	1.01	*7*	0.94	*7*	0.80	*6*	0.43	*4*
Communication	1.4%	10	0.923	-0.053	-0.024	0.95	*5*	0.90	*5*	0.78	*5*	0.56	*5*	1.05	*8*	0.99	*8*	0.87	*7*	0.62	*6*
Furniture	9.1%	11	1.014	-0.011	0.025	1.03	*7*	1.05	*6*	1.08	*7*	0.70	*6*	1.24	*11*	1.27	*11*	1.32	*10*	0.86	*8*
Health	7.3%	12	1.070	-0.079	0.148	1.08	*12*	1.15	*12*	1.28	*12*	1.20	*8*	1.38	*13*	1.47	*13*	1.64	*13*	1.55	*10*
Education	3.1%	13	1.111	-0.010	0.121	1.03	*6*	1.05	*8*	1.12	*8*	1.23	*9*	1.36	*12*	1.40	*12*	1.49	*12*	1.66	*11*
Weighted average	100.0%		0.836	-0.078	-0.086	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	
Alogoskouifs et al (1996)																					
Alcohol	0.7%	1	0.363	-0.269	-0.368	1.03	*7*	1.05	*7*	1.05	*6*	0.93	*7*	0.46	*1*	0.47	*1*	0.46	*2*	0.41	*4*
Tobacco	2.6%	2	0.556	-0.317	-0.128	0.91	*2*	0.82	*2*	0.66	*2*	0.39	*2*	0.61	*2*	0.56	*2*	0.45	*1*	0.27	*2*
Transport	10.3%	3	0.690	-0.239	-0.071	1.06	*8*	1.12	*9*	1.27	*9*	1.49	*8*	0.89	*5*	0.94	*7*	1.07	*7*	1.24	*8*
Housing	5.9%	4	0.767	-0.017	-0.216	0.94	*4*	0.88	*4*	0.75	*4*	0.43	*4*	0.88	*4*	0.82	*4*	0.69	*4*	0.40	*3*
Heating/Lighting	4.3%	5	0.769	-0.102	-0.129	0.90	*1*	0.80	*1*	0.60	*1*	0.17	*1*	0.84	*3*	0.75	*3*	0.56	*3*	0.16	*1*
Food	29.9%	6	0.827	-0.011	-0.162	0.94	*3*	0.87	*3*	0.75	*3*	0.41	*3*	0.94	*6*	0.88	*5*	0.75	*5*	0.41	*5*
Communication	1.4%	7	0.840	-0.068	-0.092	0.95	*5*	0.90	*5*	0.78	*5*	0.57	*5*	0.98	*7*	0.92	*6*	0.80	*6*	0.58	*6*
Other goods and services	35.9%	8	0.860	-0.048	-0.092	1.06	*9*	1.12	*8*	1.23	*8*	1.68	*9*	1.11	*8*	1.17	*8*	1.29	*9*	1.75	*9*
Furniture	9.1%	9	0.942	-0.079	0.021	1.03	*6*	1.05	*6*	1.09	*7*	0.72	*6*	1.18	*9*	1.21	*9*	1.24	*8*	0.82	*7*
Weighted average	100.0%		0.819	-0.069	-0.112	1.00		1.00		1.00		1.00		1.00		1.00		1.00		1.00	

Note: ranked by efficiency. lowest score merits lower tax. * Divided by the weighted average of the respective column.

3. Disincentive effects of indirect taxation

The inefficiency of a tax depends on its *marginal* rate (and on various elasticities), as this determines its disincentive effect. That concept is familiar in the case of personal income taxes, but applies just as much to indirect taxes as a whole. Here the appropriate concept is the marginal indirect tax rate, defined as the extra indirect tax paid on additional goods purchased when income (or expenditure) increases by one unit. If this marginal rate is constant over the income or expenditure distribution, then there is no distributional case for departures from uniformity. In this section we explore the cross-sectional characteristics of the marginal indirect tax rate.

3.1 Two models of marginal indirect tax rates

The marginal indirect tax rate is the weighted sum of indirect taxes on different goods, weighted by the *marginal* expenditure shares of the goods (for an application see Newbery and Révész, 2000). The marginal expenditure shares can be estimated given some estimable form of individual preferences (for example, the linear expenditure system or the AIDS). This is readily done by estimating the marginal indirect tax rates as a direct function of expenditure, given a suitable functional specification. Two alternative formulations of the relationship are adopted, one corresponding to the Linear Expenditure System, or LES (Stone, 1954) and the other to the AIDS (Deaton and Muellbauer, 1980b). More precisely, according to the LES, Engel curves take the form:

$$q_i x_i^h = \gamma_i + \alpha_i (y^h - y_0^h) \tag{9}$$

where, using the same notation as before, $q_i x_i^h$ is equivalent expenditure on good i, y^h is income (or total expenditure) of household h (again by equivalent adult), $y^h{}_0$ is subsistence expenditure, and $\Sigma\alpha_i = 1$. The formula for total tax collected from household h is:

$$T^h = \sum_i \tau_i q_i x_i^h \tag{10}$$

where T^h is total taxes paid by household h (per equivalent adult) and τ_i is the tax rate on good i (as a fraction of the tax inclusive price). Substituting (9) into (10):

$$T^h = \sum_i \tau_i \gamma_i + \sum_i \tau_i \alpha_i y^h \ . \tag{11}$$

Differentiating (11) with respect to expenditure, y^h, gives the marginal indirect tax rate, $B^h = \Sigma \tau_i \alpha_i$, a constant that does not vary with the level of expenditure.

Where prices do not vary, the Almost Ideal Demand System gives the non-linear Working-Leser Engel curve, developed by Working (1943) and Leser (1963). It takes the following functional form:

$$w_i^h = \frac{q_i x_i^h}{y^h} = \alpha_i + \delta_i \log y^h \Leftrightarrow q_i x_i^h = \alpha_i y^h + \delta_i y^h \log y^h \tag{12}$$

where w_i^h is again the share of expenditure by household h on good i, y^h is defined as before, and $\Sigma\alpha_i = 1$, $\Sigma\delta_i = 0$. The Working-Leser Engel curve gives rise to a different functional form of the tax equation, as follows:

$$T^h = \sum_i \tau_i q_i x_i^h = \sum_i \tau_i (\alpha_i y^h + \delta_i y^h \log y^h) = y^h \sum_i \tau_i \alpha_i + y^h \log y^h \sum_i \delta_i \tau_i \tag{13}$$

Differentiating (13) with respect to expenditure, y^h, gives the marginal indirect tax rate as $T^h/y^h + \Sigma\delta_i\tau_i$, so that the value of $\Sigma\delta_i\tau_i$ describe departures from the average.[12]

Marginal indirect tax rates were estimated on the basis of equations (11) and (13) across the expenditure distribution, in a first stage not controlling, and in a second stage controlling, for demographics.[13] More precisely, in the first stage the household expenditure distribution was split in quintiles of equivalent non-durable expenditure and equations (11) and (13) were estimated for each group. Demographics were not controlled for, as the principal aim at this stage was to calculate the marginal indirect tax rates faced on average by the Greek consumers of the given demographic and other status characteristics on the basis of their position in the expenditure distribution alone.

In the second stage, equations (11) and (13) were also estimated across the total household sample controlling for demographic and other status characteristics. The latter were allowed to influence the intercept of the tax equation, but not its slope.[14] The estimated equations appear in Table A3 in Appendix A and allow the calculation of marginal indirect tax rates across the expenditure distribution holding demographic composition and other socio-economic characteristics constant. In the present context, marginal indirect tax rates were calculated on the basis of the estimated equations for the average values of non-durable equivalent expenditure for each quintile for two "representative" household types,[15] i.e. a married couple with two children living in Athens in own accommodation, where the head belongs to the 26-50 age group, is an employee in the private sector and has high school education (household type A) and a childless couple living in own accommodation in Athens, the head is a pensioner over 65 years old and has basic or no education (household type B). Finally it should be noted that the Working-Leser model produces a more realistic picture of the relation between paid taxes and expenditure, since it captures non-linearities in this relation. The LES, by forcing a linear relationship between taxes and expenditure, in general produces higher and less reliable estimates of marginal tax rates than the Working-Leser model.

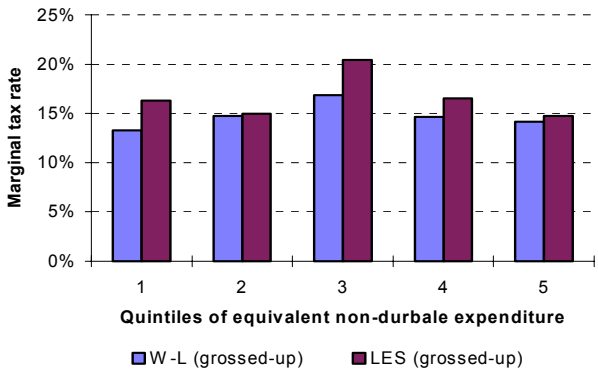


Figure 1. **Marginal indirect tax rates – all households**

[12] It should be noted that in all estimated equations y^h corresponds as before to non-durable items. The parameters were scaled up to reflect the share of non-durable expenditure in total expenditure.

[13] All estimated regressions were tested for the presence of multicollinearity, hetero-skedasticity and the existence of outliers. Unless otherwise stated, the estimated equations passed the tests of multicollinearity and the existence of outliers. Heteroskedasticity-consistent estimators were obtained using White's method - see MacKinnon and White (1985).

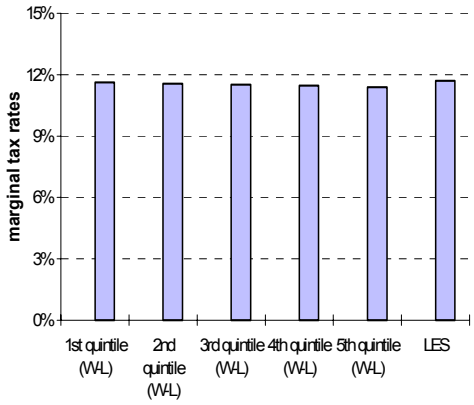
[14] The reason was the severe multicollinearity introduced in the Working-Leser type model of equation (13) through the introduction of interaction terms between the logarithm of expenditure and the socio-economic dummies. This, however, is not a very important compromise, since the marginal indirect tax rates are allowed to vary across socio-economic groups through the average indirect tax rate component.

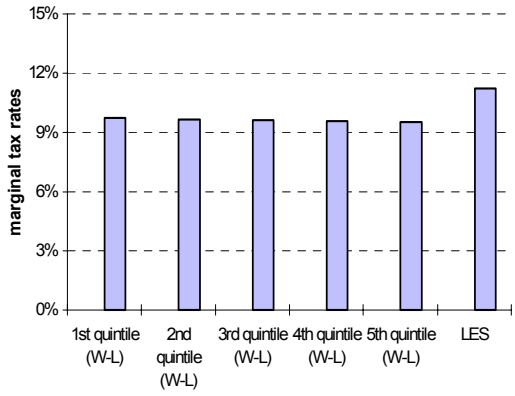
[15] One can in principle estimate marginal tax rates for any combination of the demographic and other status dummies.

Figure-1 shows the variation in marginal tax rates across quintiles of non-durable expenditure for the total sample. As explained before, separate regressions were run for each quintile so that the figures presented refer to the actual marginal indirect tax rates faced by the Greek consumers in each quintile given their socio-economic structure. This variation is non-negligible and statistically significant, in terms of the deviations from the values of the middle quintile.

If, however, the socio-demographic structure is controlled for, marginal indirect tax rates become surprisingly uniform. Most of the variation in average and marginal indirect tax rates seems to be captured by demographic and socio-economic characteristics, rather than the expenditure level itself - note in Table A3 that the estimated expenditure coefficient is positive and significant, but very small in magnitude for the LES, and negative and not statistically significant for the W-L model. This is verified in Figures 2a-b, which present the marginal indirect tax rates for the two "representative" household types described above.

***Figure 2a*. Marginal indirect tax rates – households type A** ***Figure 2b*. households type B**





The main conclusion is that when the demographic and other status characteristics of the households are controlled for, the marginal indirect tax rates are fairly constant across the expenditure distribution, i.e. the actual tax system creates the same marginal indirect tax rates that a uniform indirect tax system would create, but nevertheless is much more distortionary since it comprises of many different taxes charged at varying rates (see appendix table A1). Therefore, the present indirect tax system, judged on purely efficiency grounds, is distortionary in an unnecessary way and from this perspective we can strongly argue for moves towards uniformity.[16]

4. Simulating the UK indirect tax system on Greek consumers: evaluation of an alternative tax structure

4.1. The simulation methodology

The UK indirect tax structure is substantially simpler than the Greek one. It involves a standard VAT rate applicable to most expenditure items, a lower rate (mainly for domestic energy), with certain goods zero-rated (for example food) or exempt, coupled with special excises on certain goods, notably tobacco, alcohol, petrol and diesel. What the replacement of the Greek indirect tax system by this system would broadly imply is the elimination of VAT on most food items, children's clothing, medicines, books, newspapers and transport, which are currently taxed at the low VAT rate, with the notable exception of domestic energy

[16] Note that uniformity of tax rates would result in a similar overall patterns of marginal tax rates, but would involve gainers and losers, especially among different demographic groups.

and heating oil, which attract high tax rates, rather than the reduced UK rate.[17] Goods currently subject to excises (cars, petrol, alcohol and tobacco) would attract new rates of duty. Car purchase taxes would dramatically fall and their variability according to engine power would not be retained and neither would the variability of transport dues. Excises on petrol would marginally increase and there would also be an increase in the tax rate of tobacco. At the same time, the marginal increase of the standard VAT rate to around 19% or 22% depending on the assumption about behavioural responses, would increase the tax rate on a broad range of commodities (for example furniture and clothing) taxed under the standard VAT rate in both systems.

We assume, as before, that producer prices are constant and indirect tax changes are fully reflected on consumer prices. In the absence of own- and cross-price elasticities estimated for a sufficiently detailed level of commodity disaggregation, two extremes of behavioural response to the resulting change in the retail price of commodities can be modelled. One scenario assumes that the purchased quantity of a commodity remains constant and corresponds to zero own-price elasticity. Final expenditure changes and hence the household budget constraint might be violated (if treated as a static given, though not necessarily in an intertemporal context), so this sort of analysis better describes the short-run impact of the policy change. The alternative scenario assumes constant expenditure for each good, which implies that the quantity bought changes and corresponds to an own-price elasticity of -1.[18] In both cases no cross-price effects are modelled. The use of extreme assumptions about household behaviour is particularly appropriate, since it provides some kind of 'confidence interval' for the results.

We need to identify tax payments at a commodity level associated with the Greek and the UK tax regime. Following the notation of section 2, assume that before the tax change, indirect tax payments at a commodity level (tx) and the tax rate as a percentage of the consumer price (t/q or τ) are given (dropping subscripts) by:

$$tx = qx - px\,, \qquad \text{and} \qquad \tau = \frac{t}{q} = \frac{tx}{qx} = \frac{qx - px}{qx}\,. \tag{14}$$

As explained in section 2, we have information on household expenditure data for around 6,500 households and 293 commodities (qx) and we have also calculated the tax rates (τ). Indirect tax payments can be derived from (14) as $tx = qx\tau$.

Under the UK tax regime, indirect tax payments at a commodity level depend on the assumption about the behavioural responses of households. Under the constant quantity scenario, x and p are constant, so that (14) becomes:

$$\tau' = \frac{t'}{q'} = \frac{t'x}{q'x} = \frac{q'x - px}{q'x}\,, \tag{15}$$

where τ' is the tax rate of the commodity under the UK tax regime, t' is the amount of tax per unit of the commodity under the UK tax regime, q' is the new consumer price, p is the unchanged producer price, x is the constant purchased quantity of the goods, px is the unchanged pre-tax expenditure on the commodity under the UK tax regime and $q'x$ is the new total expenditure on the commodity after the tax change. After simple algebraic manipulations, we derive the following formula for the calculation of the new amount of tax paid, $t'x$,:

[17] To simplify, we only consider a two-rate VAT, and assign goods in the lower (5%) rate to the zero rate band.
[18] This scenario is also followed in other studies, e.g. Redmond (1995), where indirect tax changes for the UK are simulated.

$$t'x = \tau' \frac{qx(1-\tau)}{1-\tau'} . \tag{16}$$

In the constant expenditure scenario, matters are simpler and the new amount of tax paid is (where notation as before):

$$t'x' = (qx)\tau' . \tag{17}$$

Note that the standard UK VAT rate has been scaled up so that the tax reform is an equal-yield one and has no impact on total government revenue. This results in an upward adjustment of the VAT rate to 22.3% in the constant expenditure scenario and 19.2% in the constant quantity scenario.

4.2. Distributional effects

The result of replacing the Greek by the UK indirect tax system for the tax shares of different commodity groups is presented in Table 2.

Table 2. **Implications of the tax reform for the structure of indirect tax revenue.**

	Greek system		UK system (constant expenditure)		UK system (constant quantity)	
	Average tax rate	Tax shares (%)	Average tax rate	Tax shares (%)	Average tax rate	Tax shares (%)
Food	6.0%	11.9	5.0%	9.9	5.0%	9.8
Alcohol	33.6%	1.5	53.2%	2.4	50.1%	3.0
Tobacco	67.6%	11.8	78.9%	13.8	75.9%	17.9
Clothing/Footwear	13.8%	13.3	14.6%	14.1	13.4%	12.7
Housing	10.8%	6.3	8.9%	5.2	9.4%	5.1
Central Heating	44.0%	4.4	0.0%	0.0	0.0%	0.0
Household.goods	13.5%	8.2	18.2%	11.0	16.1%	10.0
Medical	1.0%	0.3	0.0%	0.0	0.0%	0.0
Personal Care	12.1%	1.7	18.2%	2.6	16.1%	2.4
Education	0.5%	0.1	1.6%	0.2	1.6%	0.2
Recreation	15.6%	5.2	14.3%	4.7	12.6%	4.1
Transport	44.0%	30.3	36.9%	26.1	40.3%	23.2
Communication	13.5%	1.2	17.9%	1.6	15.8%	1.5
Other	7.6%	3.8	16.7%	8.4	18.2%	10.1
TOTAL	14.9%	100	14.9%	100	15.1%	100

As expected, revenues from food, housing, heating fuel and transport have substantially declined. This fall is counterbalanced by an increase in revenues from alcohol, tobacco, household durables and 'other goods'.

The replacement of the Greek indirect tax system with the UK one is positively judged on equity grounds, since the distribution of tax gains and losses across deciles of the population is progressive regardless of the assumptions on behavioural responses, see Figure 3.[19] In this figure, much information is concealed, since within each decile certain households gain or lose different amounts.

[19] The household welfare indicator, used to rank households, is deflated equivalent pre-reform expenditure on non-durables, see section 2.2.

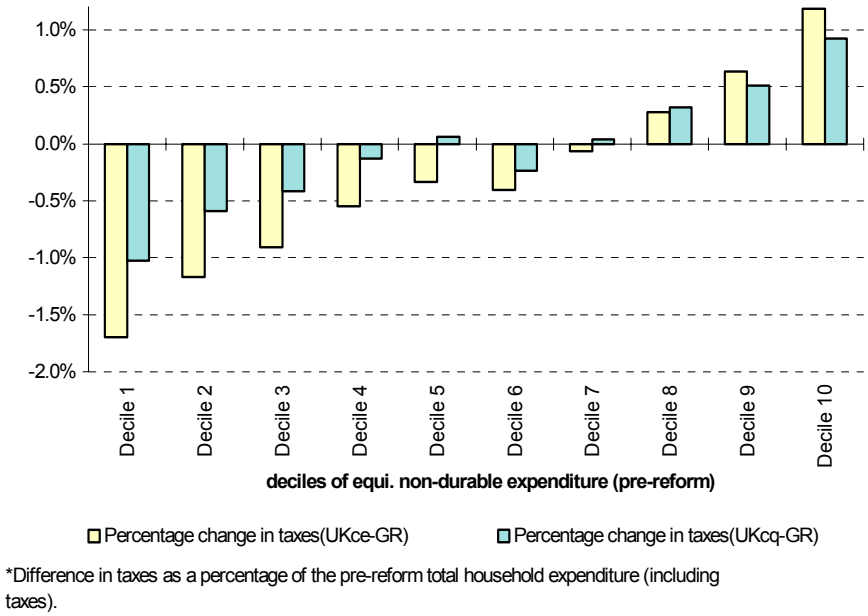


Figure 3. **Percentage change in taxes paid* under the UK tax system by expenditure deciles**

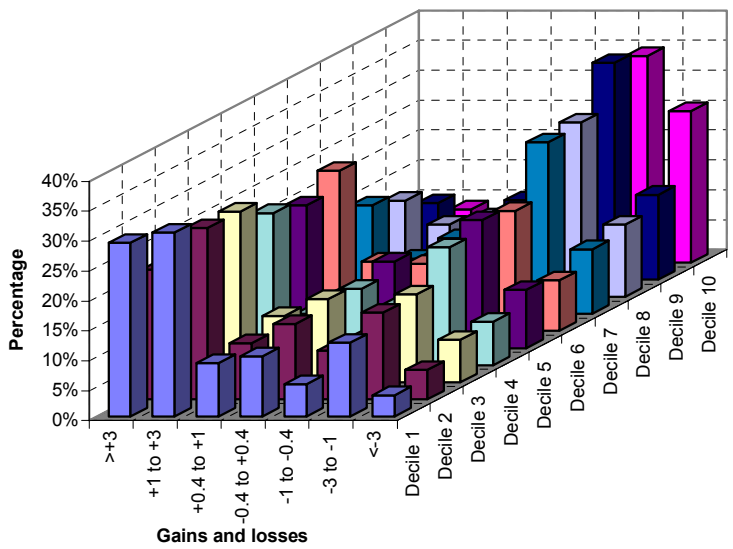


Figure 4. **Proportions of each decile gaining/loosing certain amounts, in percentages of total initial expenditure (constant expenditure assumption)**

The mixed pattern of gainers and losers is displayed graphically in Figure 4,[20] which shows the proportions of each decile losing or gaining certain amounts as a percentage of their total pre-reform expenditure. The bars near the front represent poorer deciles with the top deciles against the back wall. Bars on the left show large gainers, those on the right show large losers. From Figure 4 is apparent that losers are concentrated to the top deciles, with small proportions of large losers in the bottom deciles, while there are some exceptions to the norm in each decile of expenditure. If we seek to explain the progressive pattern of tax gains and losses, the zero-rating of food, medicines, domestic energy and domestic fuel, and the

[20] For reasons of space constraints, results are displayed only for the constant expenditure scenario, but are qualitatively the same for the constant quantity case.

increase in the tax rate on eating out, household durables and personal care, have a considerable progressive effect, which is not matched by the regressive effect of the increase of the tax rate on tobacco and the large decrease in the tax rate of cars and their use.

The equity impact of replacing the Greek tax system with the UK on the whole expenditure distribution can also be explored by comparing the Lorenz curves under the two tax regimes. Figure 5 shows the two curves and their difference is measured on the right axis. The Lorenz curve of the after-UK tax expenditure lies closer to the 45˚ line of equality and actually dominates the curve of after-Greek tax expenditure, indicating clearly that the UK indirect tax system results in a more equitable after-tax distribution than the Greek one.

Finally the improvement in the targeting of the indirect tax system towards the 'socially deserving' is confirmed in Table 3, which shows the correlation coefficients between the tax rates of commodities and their distributional characteristics using as weights the budget shares of commodities. We use various values of the inequality aversion parameter in order to capture different possible government preferences on inequality. A negative value of the correlation coefficient would be desirable in the sense that distributionally sensitive commodities bear relatively lower taxes. These values are negative but not statistically significant under the Greek tax system, but become larger in magnitude and statistically

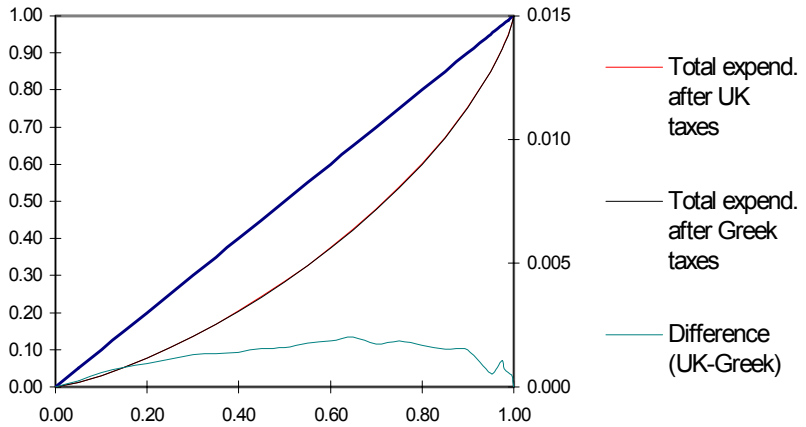


Figure 5. **Lorenz curves of expenditure distributions under Greek and UK**

Table 3. **Correlation coefficients between distributional characteristics and tax rates: comparison of the UK and the Greek indirect tax system.**

Values of the Pearson correlation coefficient between tax rates and distributional characteristics for*:	$v = 0.5$	$v = 1$	$v = 2$	$v = 5$
Greek tax system	-0.052 (0.377)	-0.065 (0.272)	-0.087 (0.139)	-0.101 (0.085)
UK tax system (constant expenditure)	**-0.165** (0.005)	**-0.174** (0.003)	**-0.188** (0.001)	**-0.167** (0.000)
UK tax system (constant quantity)	**-0.121** (0.003)	**-0.129** (0.003)	**-0.145** (0.001)	**-0.157** (0.001)

*Commodities have been weighted by their budget share.
Significance probability that the statistic is 0 in parenthesis. Significant statistics at the 5% in bold.

significant under the UK tax simulation experiment, suggesting that on the whole the UK tax system treats distributionally sensitive commodities more favourably than the Greek one.

4.3 Marginal indirect tax rates under the UK tax reform: disincentive effects

The UK tax simulation experiment can be judged on purely efficiency grounds by estimating the indirect taxes paid at the margin along the expenditure distribution. The methodology for calculating marginal indirect tax rates has already been described in section 3. Results are presented for the 'constant expenditure' scenario, but are qualitatively the same for the alternative scenario of 'constant quantity'

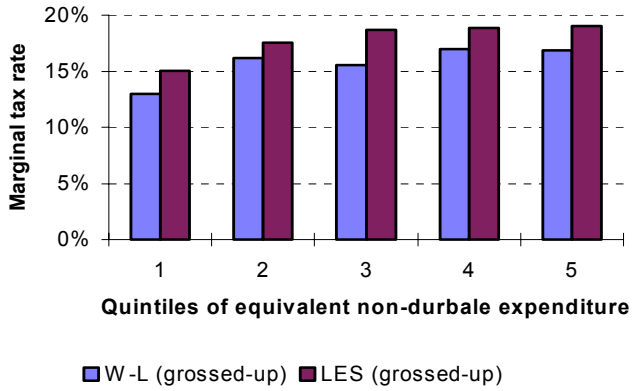


Figure 6. **Marginal indirect tax rates in UK tax simulation experiment – all households**

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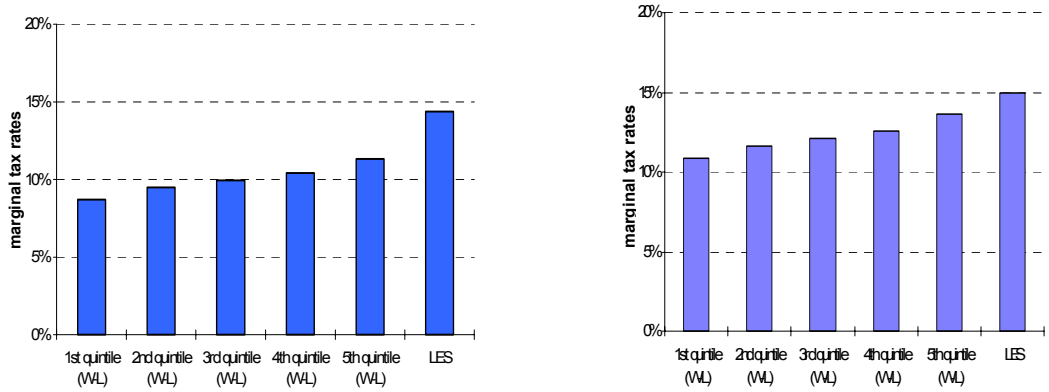
Figure 6 shows that marginal indirect tax rates are rather variable across household quintiles of expenditure when the demographic structure is not controlled for. However, controlling for demographic and other status characteristics presents a quite different picture. For the Greek tax system, marginal tax rates were approximately uniform across the expenditure distribution for the two representative household types described in section 3.

Households type A **Households type B**



Figures 7a-b. **Marginal indirect tax rates in UK tax simulation experiment**

This provided a direct argument for simplifying the indirect tax structure. For the UK tax structure, the estimation of the proportion of taxes paid at the margin for the same household types shows a clear increasing pattern, see Figures 7a and b. The same result is reinforced by

the econometric analysis of Table A4. Whether this pattern is optimal can hardly be established given current theoretical knowledge and data, and as we have seen, marginal tax analysis is of little help in answering this question.

4.4 Lessons from the UK tax simulation experiment

The UK simulation experiment shows how a country's rather successful experience on certain policy problems can be useful for another country. Although the UK tax structure disposes several features which supposedly enhance the progressivity of the tax system albeit at the expense of adding to its complexity, it results in an unambiguously more equitable after-tax distribution, while the relative gains of such tax reform accrue in larger proportions to poorer households. Furthermore, efficiency arguments based on marginal indirect tax rate analysis no longer point to a simplification of the indirect tax structure, as was the case with the Greek indirect tax system.

However, microsimulation analysis should be viewed only as part of the social calculation required to assess what is desirable or in fact can be achieved in practice. Certain further aspects of a tax reform should be considered. The closed and static nature of microsimulation analysis does not allow the study of general equilibrium effects, for example the effects resulting from changing employment opportunities in the different sectors of the economy, frontier trade, macro-economic effects and so on. In the case of the UK tax simulation experiment, these effects are hard to predict especially because the changes entailed are far from small. The most prominent example is the enormous increase in wine taxation, which would severely affect consumption patterns and the behaviour of the large number of wine producers, for example in terms of providing incentives for illegal activities, tax evasion and smuggling.

Another aspect of the tax reform so far ignored is its impact on the costs of the administration and compliance mechanisms. The administrative (publicly carried) and compliance (privately carried) costs of taxation are an important dimension of the quality of a tax system (Slemrod, 1990). An indirect tax structure which is complicated and in a state of flux, like the Greek one, is much more costly to administer, since information is processed slowly, audits are infrequent, resulting in lax tax enforcement and low compliance.[21] Thus, a reduction in the number and rates of taxes, as would be the case in the potential scenario of replacing the Greek indirect tax structure with the UK one, would be welcome since it would normally minimise administrative complexity and hence minimise both administrative costs for the revenue authorities and compliance costs for traders.

On the other hand, in order to keep total revenue from indirect taxes unchanged, the standard VAT rate was adjusted to considerably higher than present levels. Higher VAT rates would create stronger incentives for tax evasion and would potentially call for higher spending on tax administration and enforcement mechanisms. On the other hand, keeping the UK standard VAT rate (17.5%) would result in a decrease in total revenue collected by about 10-12%, depending on behavioural responses. Increased international tax competition of more mobile tax bases renders the shifting of taxation towards certain other sources, e.g. capital, problematic. On the other hand, a decrease in tax revenue would not be sustainable for Greece at least at present, when revenue collection is crucial under increased pressures for restricting the public deficit, in line with the Maastricht criteria and the Stability and Growth Pact. This does not diminish the role of the British tax experience for Greece, it just needs to be clarified that Greece could potentially benefit most by replicating the much simpler and more transparent UK indirect tax structure, if it also replicated other desirable parts of the UK

[21] For empirical evidence on the negative relationship between the number of VAT rates and VAT compliance in OECD countries see Agha and Haughton (1996). For an excellent account of the relation between tax reform and tax administration in Greece, see Rapanos (1997).

tax and expenditure system, that is a more substantial redistributive role for the expenditure side of the budget, increased efficiency in the collection of direct taxes and, thus, a lower reliance on indirect taxation for redistribution and especially revenue collection.

5. Concluding remarks

The indirect tax system in Greece has been the historical outcome of the efforts of governments to use it both as the main revenue-raising device and as a tool for redistribution. This has created a tax structure which is unnecessarily complicated and inefficient without achieving any noticeably beneficial redistribution. Marginal tax reform analysis revealed that the efficiency element dominates the ranking of commodity groups unless government's aversion to inequality approaches Rawlsian values, although we also found that it was hard to identify efficiency improving reforms from the data available, if reforms are to be confined to changes in indirect taxes alone. That at least suggests that consumption patterns are not sufficiently differentiated to support any important redistributive role for indirect taxation. Further analysis showed that marginal indirect tax rates are essentially constant across the income distribution once differences in demographic characteristics are controlled for, a result that is robust to the choice of demand system. That again suggests that there is little distributional cost and possibly considerable administrative benefit perspective in moving to a much simpler tax structure, while making taxes uniform reduces their overall disincentive effect.

This analysis of indirect taxation assumes that other tax instruments cannot be changed – an assumption that is most favourable for defending differential indirect tax rates. If the reform can be broadened to include other tax and transfer instruments, then the case for a simple and more uniform indirect tax structure is greatly strengthened. Various authors (Atkinson and Stiglitz, 1976; Deaton, 1981; Deaton and Stern, 1986) provide conditions under which uniform VAT on commodities is optimal, specifically the ability to tax income optimally, and weak separability between goods and leisure. In any case, the non-separability of labour is not strong enough to substantially affect commodity tax rates and as Deaton (1987) points out "a considerable part of the efficiency case for uniform indirect taxes is the lack of any empirically convincing evidence that differential taxes could encourage more effort and less leisure". Given the difficulty of rejecting this maintained hypothesis in distributionally relevant ways (Blundell and Walker, 1982; Browning and Meghir, 1991; Madden, 1995, 1997), it is clearly difficult to defend non-uniformity on either efficiency or equity grounds.

It also seems reasonable to suppose that income taxes are better suited to redistribution (combined with the expenditure side of the budget) than indirect taxes, even in Greece. The main limitation of income taxation is evasion, whose extent and precise pattern are still a matter of dispute. However, unless one accepts that present extensive tax evasion is an exogenous political constraint, rationalising and implementing an effective income tax structure should be possible, given the evidence from other EU countries, and is surely desirable.

Even if there remain doubts about whether the conditions for optimal uniform indirect taxes are met, any welfare costs of moving to a simple indirect tax structure have to be balanced against the administrative gains of doing so. Even if it were possible to precisely calculate optimal tax rates for every distinguishable commodity (on which we have cast grave doubts), the actual implementation of a finely differentiated tax structure would most probably create high administrative and collection costs to the tax authorities and compliance costs for the tax payers, as well as attracting inefficient rent-seeking activities of producer groups. Judging from available evidence for other European countries (Ebrahimi and Heady, 1988; Sandford *et al*, 1989; Rapanos, 1997; Davies and Kay, 1985), there are reasons to

suspect that the administrative gains of moving to a simpler commodity tax structure in Greece would most likely exceed any efficiency losses. It therefore seems that theory and the available evidence point towards a simplification of the present indirect tax structure.[22]

The UK indirect tax structure in general conforms with the above principles and its simulation on Greek consumers has revealed a realistic alternative tax structure, which is simpler, more equitable and more efficient to implement and administer. It is interesting to note that the most meaningful recommendations for restructuring the Greek indirect tax system are dependent on the proper functioning of other parts of the tax/transfer system. The same conclusion was reached in the UK tax simulation experiment. This is hardly surprising if one is willing to accept that any equity and efficiency considerations of the government have to be accommodated using a range of instruments. The answer to the role that indirect taxation should play will depend on how effectively the other instruments are used. Thus, taking one example, the suggestion for significantly simplifying the indirect tax structure in Greece would further benefit from rationalising and enforcing income taxation, combined with a more active role for the transfer system. In this respect, a more far reaching tax and transfer reform should have high priority for policy makers in Greece.

[22] Complete uniformity might be undesirable, given other distortions such as the CAP, while additional excise taxes can be justified for commodities as explained in the paper.

References

Agha, A. and Haughton, J. (1996). "Designing VAT Systems: Some Efficiency Considerations", *The Review of Economics and Statistics* 78(2), pp. 303-8.

Ahmad, E. and Stern, N. (1984). "The Theory of Reform and Indian Indirect Taxes", *Journal of Public Economics* 25(3), pp. 259-98.

Ahmad, E. and Stern, N. (1987). "Alternative Sources of Government Revenue: Illustrations from India, 1979-80", in D.M.Newbery and N.Stern (eds.) *The Theory of Taxation for Developing Countries*. New York, Oxford University Press.

Alogoskoufis, G., Misoulis, N. and Karavitis, N. (1996). "Excise Taxes and their Effects", Institute for Economic Policy Research, Athens (mimeo) (in Greek).

Andrikopoulos, A.A., Brox, J.A. and Georgakopoulos, T.A. (1992). "A Short-run Assessment of the Effects of the VAT on Consumption Patterns: the Greek Experience", Working Paper no. 92-03, Athens University of Economics and Business.

Atkinson, A.B. (1970). "On the Measurement of Inequality", *Journal of Economic Theory* 2(3), pp. 244-63.

Atkinson, A.B. (1977). "Optimal Taxation and the Direct versus Indirect Tax Controversy", *Canadian Journal of Economics* 10(4), pp. 590-606.

Atkinson, A.B. and Stiglitz, J.E. (1976). "The Design of Tax Structure: Direct versus Indirect Taxation", *Journal of Public Economics* 6(1-2), pp. 55-75.

Blundell, R.W. and Walker, I. (1982). "Modelling the Joint Determination of Household Labour Supplies and Commodity Demands", *The Economic Journal* 92, pp. 351-64.

Browning, M. and Meghir, C. (1991). "The Effects of Male and Female Labor Supply of Commodity Demands", *Econometrica* 59(4), pp. 925-51.

Davies, E.H. and Kay, J.A. (1985). "Extending the VAT Base: Problems and Possibilities", *Fiscal Studies* 6(1), pp. 1-16.

Deaton, A. (1979). "Optimally Uniform Commodity Taxes", *Economics Le*tters 2(4), pp. 357-61.

Deaton, A. (1981). "Optimal Taxes and the Structure of Preferences", *Econometrica* 49(5), pp. 1245-60.

Deaton, A. (1987). "Econometric Issues for Tax Design in Developing Countries" in D.M.Newbery and N.Stern (eds.) *The Theory of Taxation for Developing Countries*. New York, Oxford University Press.

Deaton, A. and Muellbauer, J. (1980a). *Economics and Consumer Behaviour*, Cambridge University Press, Cambridge.

Deaton, A. and Muellbauer, J. (1980b). "An Almost Ideal Demand System*", American Economic Review* 70(3), pp. 312-26.

Deaton, A. and Stern, N. (1986). "Optimally Uniform Commodity Taxes, Taste Differences and Lump-sum Grants", *Economics Letters* 20, pp. 263-6.

Decoster, A. and Schokkaert, F. (1989). "Equity and Efficiency of a Reform of Belgian Indirect Taxes", *Recherches Economiques de Louvain* 55(2), pp. 155-76.

Diamond, P.A. and Mirrlees, J.A. (1971a). "Optimal Taxation and Public production: Part I - Production feficiency", *American Economic Review* 61(1), pp. 8-27.

Diamond, P.A. and Mirrlees, J.A. (1971b). "Optimal Taxation and Public Production: Part II - Tax Rules", *American Economic Review* 61(3), pp. 261-78.

Ebrahimi, A. and Heady, C. (1988). "Tax Design and Household Composition", *The Economic Journal*, Conference Papers 98(390), pp. 83-96.

European Commission (2000). Public Finances in EMU – 2000, *European Economy*, Reports and Studies 3, European Community, Belgium.

Feldstein, M.S. (1972). "Distributional Equity and the Optimal Structure of Public Prices", *American Economic Review* 62(1), pp. 32-6.

Gale, W. (1997). "What Can America Learn from the British Tax System?", *Fiscal Studies* 18(4), pp. 341-369.

Georgakopoulos, T.A. (1989). "The Indirect Tax System: Structure, Effects and Changes", in G.Provopoulos (eds.) *Priorities of fiscal policy*, Special Studies no. 18, Institute for Economic and Industrial Research, Athens (in Greek).

Grevenitis, P. and Sapounas, G. (1988). *Taxation in Greece: Comparative Incidence on Socio-Economic Groups*, Studies on the Agricultural Economy 32, Athens (in Greek).

Houthakker, H.S. (1960). "Additive Preferences", *Econometrica* 28(2), pp. 244-56.

Kaplanoglou, G. (1999). "Distributional and Efficiency Aspects of the Greek Indirect Tax System: a Microsimulation Analysis", University of Cambridge, unpublished PhD thesis.

Kaplanoglou, G. (2000). "A Microsimulation Analysis of the Distribution of the Indirect Tax Burden among Greek Households", in L.Mitton, H.Sutherland and M.Weeks (eds.) *Microsimulation Modelling for Policy Analysis: Challenges and Innovations*. UK, Cambridge University Press.

Karageorgas, D. (1973). "The Distribution of Tax Burden by Income Groups in Greece", *The Economic Journal* 83(330), pp. 436-48.

Karageorgas, D. and Pakos, T.B. (1988). “The Distribution of the Tax Burden in Greece: 1982”, in Institute for Regional Development PASKE (eds.) *In honour of Saki Karageorga*. Athens.
Keen, M.J. (1997). “Peculiar Institutions: a British Perspective on Tax Policy in the United States”, *Fiscal Studies* 18(4), pp. 341-369.
Leser, C.E.V. (1963). “Forms of Engel Functions”, *Econometrica* 31(4), pp. 694-703.
Lockwood, B. (1988). “Tax Incidence, Market Power and Bargaining Structure”, Birbeck College, London (mimeo).
MacKinnon, J.G. and White, H. (1985). “Some Heteroskedasticity-Consistent Matrix Estimators with Improved Finite Sample Properties”, *Journal of Econometrics* 29(3), pp. 305-25.
Madden, D. (1989). “Indirect Tax Reform in Ireland”, *Economic and Social Review* 21, pp. 27-47.
Madden, D. (1995). “Labour Supply, Commodity Demand and Marginal Tax Reform”, *Economic Journal* 105, pp. 485-97.
Madden, D. (1997). “Conditional Demands and Marginal Tax Reform”, Oxford Bulletin of Economics and Statistics 59(2), pp. 237-255.
Ministry of Finance and Economy (2001). *Main National Account Aggregates of the Greek Economy, 1960-1999 (ESA 95)*, Athens.
Mirrlees, J.A. (1971). “An Exploration in the Theory of Optimal Income Taxation”, *Review of Economic Studies* 38, pp. 175-208.
National Statistical Service of Greece (1994). Data: Family Expenditure Survey 1987/88, Athens.
Newbery, D.M. (1993). "Tax and Expenditure Policies in Hungary", *The Economics of Transition* 1(2), pp. 245-72.
Newbery, D.M. (1995a). *Reforming Road Taxation*, Group Public Policy, The Automobile Association, UK.
Newbery, D.M. (1995b). “The Distributional Impact of Price Changes in Hungary and the UK”, *The Economic Journal* 105(431), pp. 847-63.
Newbery, D.M. (1997). "Optimal Tax Rates and Tax Design during Systemic Reform", *Journal of Public Economics* 63(2), pp. 177-206.
Newbery, D.M. and Révész, T. (2000). “The Evolution of the Tax Structure of a Reforming Transitional Economy: Hungary 1988-98”, *International Tax and Public Finance* 7(2), 209-240.
Newbery, D.M. and Stiglitz, J.E. (1981). *The Theory of Commodity Price Stabilisation: a Study in the Economics of Risk*, Oxford University Press, Oxford.
Organisation for Economic Co-operation and Development (1999). *Consumption Tax Trends,* Paris.
Organisation for Economic Co-operation and Development (1999 and 2000). *Revenue Statistics of OECD Member Countries,* Paris.
Provopoulos, G.A. (1979), “The Distribution of Fiscal Burdens and Benefits by Income Groups in Greece”, *Greek Economic Review* 1(1), pp. 77-99.
Rapanos, V. (1997). “Tax Reform and Tax Administration”, in G.Provopoulos and V.Rapanos (eds.) *Functions of the Public Sector: Problems and Prospects*. Foundation for Economic and Industrial Research, Athens (in Greek).
Redmond, G. (1995). “POLIMOD: the Calculation of VAT and Excise Duties on Household Expenditure”, Research Note no. 11, The Microsimulation Unit, Department of Applied Economics, University of Cambridge.
Sah, R.K. (1983). “How Much Redistribution is Possible Through Commodity Taxes?”, *Journal of Public Economics* 20(1), pp. 89-101.
Sandford, C., Godwin, M. and Hardwick, P. (1989). *Administrative and Compliance Costs of Taxation*, Fiscal Publications, Bath.
Slemrod, J. (1990). “Optimal Taxation and Optimal Tax Systems”, *Journal of Economic Perspectives* 4(1), pp. 157-78.
Stern, N. (1987). “The Theory of Optimal Commodity and Income Taxation: an Introduction”, in D.M.Newbery and N.Stern (eds.) *The Theory of Taxation for Developing Countries*. New York, Oxford University Press.
Stone, J.R.N. (1954). “Linear Expenditure Systems and Demand Analysis: an Application to the Pattern of British Demand”, *The Economic Journal* 64(255), pp. 511-27.
Working, H. (1943). “Statistical Laws of Family Expenditure”, *Journal of the American Statistical Association* 38(221), pp. 43-56.

Appendix A Basic data for tax calculations

***Table A1*. Basic data on taxes for groups of commodities**.

Good	Tax rate	Budget share	Variance of tax rates within group*	CV %		Tax rate	Budget share	Variance of tax rates within group*	CV %
Andrik. et al (1992)					Alog. et al (1996)				
Food	6.0%	29.9%	0.060%	41%	Food	6.0%	29.9%	0.060%	41%
Alcohol	33.6%	0.67%	5.730%	71%	Alcohol	33.6%	0.7%	5.730%	71%
Tobacco	67.6%	2.62%	0.000%	0%	Tobacco	67.6%	2.6%	0.000%	0%
Housing	9.9%	5.90%	5.170%	229%	Housing	9.9%	5.9%	5.170%	229%
Heating	23.6%	4.32%	2.280%	64%	Heating	23.6%	4.3%	2.280%	64%
Furniture	13.5%	9.06%	0.220%	35%	Furniture	13.5%	9.1%	0.220%	35%
Transport	44.0%	10.29%	6.770%	59%	Transport	44.0%	10.3%	6.770%	59%
Communication	13.5%	1.35%	0.030%	13%	Communication	13.5%	1.4%	0.030%	13%
Clothing	13.8%	14.35%	0.010%	7%					
Health	4.3%	7.29%	0.320%	133%					
Recreation	20.0%	3.64%	3.060%	88%					
Education	1.7%	3.14%	0.040%	117%					
Other	7.6%	7.45%	1.130%	140%	Other	10.1%	35.9%	0.410%	63%
wted av.	15.0%					15.0%			

* Defined as the sum of the squared deviations of the taxes from the group average weighted by the budget share of the commodities within each group.

***Table A2*. Expenditure and price elasticities of broad commodity groups for Greece.**

Commodity group	Expenditure elasticities		Adjusted uncompensated price elasticities	
	Andrikop.*et al* (1992)	Alogosk. *et al* (1996)	Andrikop.*et al* (1992)	Alogosk. *et al* (1996)
Food	0.686	0.537	-0.087	-0.182
Alcoholic Beverages	0.808	1.034	-0.182	-0.801
Tobacco	1.117	0.904	-0.328	-0.468
Housing	0.908	0.948	-0.344	-0.175
Heating & Lighting	1.063	1.024	-0.053	-0.430
Furniture	1.104	1.752	-0.084	-0.586
Transportation	1.535	1.757	-0.490	-0.543
Communication	1.802	1.407	-0.391	-0.499
Clothing	1.138	*0.976*	-1.148	*-0.475*
Health	1.232	*0.976*	-1.841	*-0.475*
Recreation & Entertainment	1.622	*0.976*	-1.493	*-0.475*
Education	0.920	*0.976*	-0.594	*-0.475*
Other goods and services	1.336	*0.976*	-0.732	*-0.475*

Source: Andrikopoulos *et al* (1992). and Alogoskoufis *et al* (1996) and own calculations

Table A3. Calculation of marginal indirect tax rates -LES versus Working Leser models

	Linear Expenditure System		*Working-Leser Model*	
Dependent Variable: EQTAX[1] (for LES) **Dependent Variable: TBURDEN[2] (for W-L)**	***t*-ratios in parentheses** (significant coefficients in bold letters)			
Intercept	2,73	(0,00)	**0.1056**	**(9.01)**
Expenditure level:				
ln(Non-dur expenditure per equiv.adult)	**0.1039**	**(23.13)**	-0.0012	(1.20)
Age of head of household (ref. hous[3]: 51<age<65)				
Less than 25 years old	**3605**	**(2.77)**	**0.0230**	**(6.07)**
Between 26 and 50 years old	**803**	**(3.49)**	**0.0071**	**(4.81)**
Over 65 years old	**-933**	**(4.03)**	**-0.0078**	**(4.76)**
Household composition:				
Two adults in the household (ref. hous: one adult)	**1518**	**(3.14)**	**0.0167**	**(6.82)**
Three or more adults in the household	**2080**	**(3.43)**	**0.0264**	**(8.69)**
One adult female in househ. (ref.hous.: no female)	- 829	(1.07)	**-0.0099**	**(2.86)**
Two adult females in the household	-1421	(1.64)	**-0.0150**	**(3.63)**
Three or more adult females in the household	**-1958**	**(2.17)**	**-0.0189**	**(3.82)**
Dummy for head female (ref. hous.: male head)	405	(0.84)	0.0009	(0.39)
One child in the household (ref.hous.:no children)	**-658**	**(2.81)**	**-0.0022**	**(4.76)**
Two children in the household	**-806**	**(3.14)**	**-0.0043**	**(3.47)**
Three or more children present in the household	**-983**	**(2.41)**	**-0.0059**	**(2.70)**
One retired person (ref. hous.: no retired people)	-265	(1.09)	**-0.0044**	**(2.37)**
Two or more retired persons	-367	(1.30)	**-0.0085**	**(3.36)**
Degree of Urbanisation: (ref. hous.: urban area)				
Rural area	**-665**	**(4.01)**	**-0.0092**	**(6.44)**
Semi-urban area	**-469**	**(2.37)**	**-0.0039**	**(2.25)**
Regional Location: (ref.hous.: E.Sterea and Islands)				
Peloponese and West Sterea	-322	(1.63)	**-0.0057**	**(3.24)**
Macedonia	394	(1.69)	**0.0057**	**(4.33)**
Crete	**-734**	**(3.78)**	**-0.0100**	**(4.22)**
Thessalia	392	(1.06)	**0.0053**	**(2.58)**
Islands of East Aegeon	611	(1.48)	0.0037	(1.40)
Thraki	575	(1.61)	0.0052	(1.88)
Ipiros	52	(0.18)	0.0029	(1.13)
Head's occupation: (ref.hous.:empl. in public sector)				
Student	**-3675**	**(2.48)**	**-0.0165**	**(3.01)**
Employee in the private sector	315	(1.08)	**0.0040**	**(2.50)**
Employer (own business with employees)	756	(1.14)	-0.0008	(0.31)
Self-employed (without employees)	-15	(0.06)	-0.0021	(1.32)
Unemployed	2211	(1.44)	0.0091	(1.42)
Pensioner	387	(1.14)	0.0029	(1.23)
Level of education of head: (ref.hous.:no/basic ed.)				
High-school education (middle educ.)	-142	(0.70)	**-0.0030**	**(2.35)**
Higher education	-190	(0.52)	**-0.0079**	**(4.64)**
Housing tenure: (ref.hous.: owner-occupier)				
Rent	**624**	**(2.67)**	**0.0125**	**(9.46)**
Residual Sum of Squares	2,57E+11		9.84	
F-Statistic	123.26		24.45	
R^2 (R^2 adjusted)	0.3866	(0.3834)	0.1111	(0.1066)

[1] EQTAX: paid taxes per equivalent adult; excludes proportional car taxes. [2]TBURDEN: total indirect taxes/total expenditure; indirect taxes exclude proportional car taxes. [3]ref.hous.: reference household.

Source: 1987/8 HES data (NSSG, 1994), own calculations.

Table A4. **Calculation of marginal indirect tax rates under UK tax system simulation - LES versus Working Leser models**

	Linear Expenditure System		*Working-Leser Model*	
Dependent Variable: EQTAX[1] (for LES) **Dependent Variable: TBURDEN[2] (for W-L)**	***t*-ratios in parentheses** (significant coefficients in bold letters)			
Intercept	-454	(0.81)	**-0.0589**	**(4.80)**
Expenditure level:				
Non-dur expenditure per equiv. adult	**0.1330**	**(39.21)**		
ln(Non-dur expenditure per equiv.adult)			**0.0145**	**(14.00)**
Age of head of household (ref. hous[3]: 51<age<65)				
Less than 25 years old	**3454**	**(5.27)**	**0.0296**	**(8.68)**
Between 26 and 50 years old	**940**	**(6.11)**	**0.0101**	**(7.31)**
Over 65 years old	**-738**	**(4.48)**	**-0.0096**	**(6.26)**
Household composition:				
Two adults in the household (ref. hous: one adult)	**1731**	**(5.91)**	**0.0254**	**(10.85)**
Three or more adults in the household	**3083**	**(8.42)**	**0.0494**	**(16.28)**
One adult female in househ. (ref.hous.: no female)	**- 3001**	**(6.00)**	**-0.0352**	**(11.00)**
Two adult females in the household	**-3660**	**(6.65)**	**-0.0450**	**(9.22)**
Three or more adult females in the household	**-3757**	**(6.46)**	**-0.0435**	**(5.63)**
Dummy for head female (ref. hous.: male head)	350	(1.30)	0.0021	(0.99)
One child in the household (ref.hous.:no children)	**-765**	**(4.41)**	**-0.0053**	**(3.86)**
Two children in the household	**-1076**	**(6.20)**	**-0.0101**	**(6.85)**
Three or more children present in the household	**-1294**	**(5.04)**	**-0.0137**	**(6.30)**
One retired person (ref. hous.: no retired people)	**-564**	**(3.74)**	**-0.0094**	**(5.63)**
Two or more retired persons	**-521**	**(2.72)**	**-0.0120**	**(5.34)**
Degree of Urbanisation: (ref. hous.: urban area)				
Rural area	-33	(0.26)	0.0004	(0.26)
Semi-urban area	0	(0.00)	0.0005	(0.37)
Regional Location: (ref.hous.: E.Sterea and Islands)				
Peloponese and West Sterea	-124	(0.77)	-0.0002	(0.15)
Macedonia	**407**	**(2.86)**	**0.0051**	**(4.38)**
Crete	-365	(1.81)	**-0.0058**	**(2.62)**
Thessalia	**696**	**(3.41)**	**0.0082**	**(3.98)**
Islands of East Aegeon	**830**	**(3.12)**	0.0076	(1.91)
Thraki	863	(1.91)	**0.0077**	**(3.02)**
Ipiros	213	(1.01)	**0.0053**	**(2.26)**
Head's occupation: (ref.hous.:empl. in public sector)				
Student	**-2239**	**(2.86)**	-0.0084	(1.68)
Employee in the private sector	**511**	**(2.72)**	**0.0053**	**(3.64)**
Employer (own business with employees)	482	(1.14)	0.0016	(0.73)
Self-employed (without employees)	247	(1.28)	0.0018	(1.26)
Unemployed	1319	(1.76)	0.0070	(1.94)
Pensioner	673	(1.07)	**0.0069**	**(3.33)**
Level of education of head: (ref.hous.:no/basic ed.)				
High-school education (middle educ.)	-221	(1.63)	-0.0018	(1.58)
Higher education	-343	(1.49)	**-0.0046**	**(3.25)**
Housing tenure: (ref.hous.: owner-occupier)				
Rent	**607**	**(4.05)**	**0.0118**	**(10.14)**
Residual Sum of Squares	1.08E+11		7.91	
F-Statistic	451.85		66.29	
R^2 (R^2 adjusted)	0.6979	(0.6963)	0.2531	(0.2493)

[1] EQTAX: paid taxes per equivalent adult; excludes proportional car taxes. [2]TBURDEN: total indirect taxes/total expenditure; indirect taxes exclude proportional car taxes. [3]ref.hous.: reference household.

Source: 1987/8 HES data (NSSG, 1994), own calculations.

Appendix B The Robustness of Marginal Tax results

The choice of which indirect taxes to raise and which to lower to improve social welfare depends not only on value judgements (captured by the degree of aversion to inequality, (ν) but also on the specification of the demand system to estimate (and possibly the data set). Here we conduct a relatively simple test of robustness, by considering how much the ranking of commodities varies with the choice of the demand system and the ranking by tax attractiveness (capturing equity). Table B1 gives the rankings for the demand system estimated by Andrikopoulos et al (1992) (in the left panel), and by Alogoskoufis et al (1996) in the right hand panel. The rows are ranked by the order of the efficiency determinant of taxation, θ_i/f_i, from equation (7), i.e by $1 + \Sigma\tau_k\omega_k\varepsilon_{ki}/\omega_i$, in the column headed "Rank AIDS".

For each demand system, the ranking of the efficiency component is given, first for AIDS from (7), then for LES from (7a), and last for indirect additivity form from (7b).[23] The next column gives the rank by taxation (lowest ranks have highest tax rates, which would be *reduced* in a move towards uniformity), and the next gives the rank by tax attractiveness (computed by $\nu = 1$, though the ranking is relatively insensitive to ν, with the lowest rank least attractive for taxation). The final column in each part of the table gives the tax rank *less* the tax attractiveness or equity rank, and indicates the extent to which these two criteria are in conflict.

The table reveals the greatest such conflict over transport and food according to both Alogoskoufis and Andrikopoulos estimates. In terms of disagreements over the efficiency rankings with Andrikopoulos' estimates, housing is ranked considerably lower according to AIDS than according to the other two demand systems. Similarly, furniture is ranked lower by (7b) than the other two, and health by the LES than the other two. With Alogoskoufis' estimates, the AIDS rankings of housing, furniture and communications differ from the other two (which are remarkably close to each other).

Finally, Table B2 shows the ranking of desirable directions of tax reform for a moderate degree of inequality aversion of unity, for the various demand specifications (ranked by the AIDS specification of (7)). This shows an alarming degree of disagreement for many goods, though reasonable agreement on the desirability of raising taxes on furniture and "other" (though that is a very wide category for Alogoskoufis' estimates, and includes many goods that are given a low rank by Andrikopoulos' estimates). Food looks possibly worthy of higher taxes (though see the qualifications in the text), and tobacco and heating for lower taxes. The different estimates give ambiguous signals for the remaining goods, suggesting the serious limitations of the tax reform approach, at least in the present context.

[23] The correct way to do this would have been to re-estimate the various specifications on the original data, but that was not possible, and instead the own-price elasticities and the expenditure elasticities have been taken from the AIDS estimates.

Table B1. **Determinants of directions of tax reform**

Good	Andrikopoulos et al (1992) Ranking of efficiency component			Ranking by			Good	Alogoskoufis et al (1996)			Ranking by		
	AIDS	LES	Indirect	Tax	Equity	Tax-Equity		AIDS	LES	Indirect	Tax	Equity	Tax-Equity
Recreation/Entretainment	1	1	3	5	9	-4							
Alcohol	2	6	6	3	7	-4	Alcohol	1	2	3	3	7	-4
Transport	3	3	2	2	11	-9	Transport	3	3	1	2	9	-7
Housing	4	9	10	9	4	5	Housing	4	8	8	8	4	4
Tobacco	5	2	1	1	2	-1	Tobacco	2	1	2	1	2	-1
Heating/Lighting	6	10	4	4	1	3	Heating/Lighting	5	4	4	4	1	3
Clothing	7	4	9	6	10	-4							
Other	8	7	8	10	13	-3	Other	8	7	7	7	8	-1
Food	9	13	12	11	3	8	Food	6	9	9	9	3	6
Communication	10	8	7	7	5	2	Communication	7	6	6	5	5	0
Furniture	11	11	5	8	6	2	Furniture	9	5	5	6	6	0
Health	12	5	11	12	12	0							
Education	13	12	13	13	8	5							

Note: lower ranks suggest lowering tax rates, higher ranks raising

Table B2. **Ranking of tax reform for inequality aversion of 1**

	Andrikopoulos et al (1992)				Alogoskoufis et al (1996)		
Good	AIDS	LES	Ind	Good	AIDS	LES	Ind
Recreation	1	2	6				
Alcohol	2	9	9	Alcohol	1	3	4
Housing	3	4	5	Housing	4	7	7
Tobacco	4	1	1	Tobacco	2	1	2
Heating	5	3	2	Heating/Lighting	3	2	3
Transport	6	7	3	Transport	7	5	1
Food	7	6	7	Food	5	6	8
Communication	8	5	4	Communication	6	4	5
Clothing	9	8	10				
Other	10	13	12	Other	8	9	9
Furniture	11	10	8	Furniture	9	8	6
Education	12	11	11				
Health	13	12	13				

Note: ranked by AIDS of Andrikopoulos, lower ranks should have taxes lowered