Horizontal Inequity and Vertical Redistribution with Indirect Taxes: the Greek Case

Georgia Kaplanoglou* and David M Newbery**

Abstract

Non-uniform indirect taxes treat equals and those unequal differently (horizontal inequity and vertical redistribution). Horizontal inequity is caused by taste differences among similar households, but some excises are designed to reflect social, not revealed, preferences. We apply two methodologies for decomposing the overall redistributive effect of the present and three alternative indirect tax structures into vertical and horizontal effects for Greece, using the Household Expenditure Survey micro-database. In all cases the taste component is considerable, even when we allow for social preferences, while improvements in vertical redistribution can be achieved, albeit at the cost of increased horizontal inequity.

Keywords: distributional effect of taxes, horizontal inequality, vertical redistribution, indirect tax reform, Greece

JEL Code: D63, H23, D30

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I. Introduction

Horizontal equity requires equal treatment of equals, which in the context of taxation implies that individuals or households who are alike in the relevant way should bear the same tax burden. The principle of horizontal equity has much intuitive appeal and, with the principle of vertical equity, which calls for progressive taxation, provides an important criterion for designing a good tax system (Musgrave, 1959; 1990). Practically all the theoretical discussion of the undesirability of horizontal inequity in the context of taxation, and especially the controversy in the literature concerning the way to measure its extent empirically, has focused on *income taxation* (Atkinson, 1980; Plotnick, 1981; Pfähler, 1990; Lambert, 1995; Iyer and Seetharaman, 2000; Dardanoni and Lambert, 2001). Here the issues include whether income from e.g. work and wealth should be treated equally, or whether wealth conveys greater security than work (or vice versa) and whether the pursuit of either is affected differently by the proposed income tax.

The treatment of equals by *indirect taxes* has received much less attention. The theoretical debate on the optimal structure of commodity taxes is dominated by arguments mainly reflecting efficiency concerns and overall distributive justice (Ramsey, 1927; Diamond and Mirrlees, 1971a and b; Atkinson and Stiglitz, 1980; Stern, 1987; Ahmad and Stern, 1987). Empirical studies assessing existing indirect tax systems and potential reforms also focus on efficiency and overall redistribution effects (Hossain, 1995; Labeaga and Lopez, 1994; Davies and Kay, 1985; Cragg, 1991; Madden. 1995; Kaplanoglou and Newbery, 2003a, etc.).

The international evidence explicitly recognizing horizontal equity considerations and decomposing the redistributive impact of indirect taxes in vertical and horizontal inequity remains extremely sparse, limited to two case studies for Belgium and Australia (Decoster *et al*, 1997, and Creedy, 1999). This constitutes a serious gap, given that the "equal treatment of equals' doctrine features prominently in policy-makers' objectives. This is particularly true for countries like Greece where indirect taxes raise the bulk of tax revenue (excluding social security contributions) and their redistributive impact is much larger than that of the personal income tax,[1] the latter usually being perceived as the main tax instrument used for promoting the equity objectives of the government. Furthermore, the importance of indirect taxes as a

[1] According to OECD (????) the indirect/direct tax ratio is 0.4 in Australia, 0.6 in Belgium and 1.3 in Greece (data for 2003).

source of government revenue is unlikely to decline in the future, as many other tax bases are more open to tax competition, while the need for maintaining sound public finances becomes imperative for most countries especially when the fiscal consequences of ageing are taken into account.

This paper presents empirical estimates of the order of magnitude of horizontal inequality and other components of the redistribution induced by the current indirect tax structure in Greece, and investigates the extent to which they are undesirable (the unfortunate consequence of improved vertical equity) or defensible (targeted at improving social outcomes). For this purpose we adapt the methodology introduced by Lambert and Ramos (1995; 1997) and Aronson *et al* (1994) for the analysis of the redistributive effect of income taxation. The first of these papers produces a decomposition of the reduction in inequality, as measured by the mean logarithmic deviation (Theil, 1967), into vertical and horizontal effects. Aronson *et al* (1994) introduce a similar decomposition based on the Gini coefficient, which produces an additional reranking effect, referring to the case where the rank-order of households with different initial income is reversed as a result of the tax system. In applying this methodology to indirect taxes, we follow the work of Decoster *et al* (1997) and Creedy (1999).

We contrast the empirical results obtained for the current indirect tax system in Greece with those of three alternative reforms (or four, as the pre-tax case is equivalent to a uniform VAT tax regime, which is a useful benchmark). In March 2001, the Ministry of Finance set up a Tax Reform Committee with the task of examining all parts of the Greek tax system and making proposals for its reform. In March 2002, the Tax Reform Committee finalised its report, which includes an extensive study of the Greek tax system and wide-ranging proposals for its reform. The Committee's report presents proposals for reforming the system of indirect taxation. We construct two alternative tax reform scenarios that may be implemented in the event that the government decides to adopt some or all of the proposals put forward by the Committee.

The third reform is obtained by simulating the indirect tax system of the United Kingdom on Greek consumers. The choice of the UK tax system can be defended as one that balances equity, efficiency and administrative considerations (Stern, 1990). Ebrahimi and Heady (1988) show that allowing for non-separability, demand patterns varying with demographic characteristics and assuming that demogrants are not set optimally, produces a pattern of non-uniform tax rates that are similar to those in the UK, with lower rates on necessities. In addition its feasibility has been demonstrated and seems to be politically sustainable. Furthermore, it has been shown elsewhere (Kaplanoglou and Newbery, 2003a) that, compared to the current Greek indirect taxes, it produces substantial benefits in terms of overall distributional fairness.

It would be interesting to ask how these alternative reforms affect the interplay of rate structure differentiation and preference variation and its impact on the total redistributive power of the tax system. The detailed household dataset that we use in our empirical analysis is obtained from the latest available Household Expenditure Survey (HES) conducted by the

Greek National Statistical Service (NSSG) in 1998/99, which is representative of all private households in Greece.

One caveat should be born in mind. The literature on the optimal structure of indirect taxes suggests that there are multiple, often conflicting principles that guide tax design and any particular tax structure is a compromise between these principles. Arguably one of the more important is that the tax system may attempt to reduce harmful activities (harmful either to society or to the individual who may, unless dissuaded, regret certain consumption choices). 'Sin' taxes on alcohol, tobacco, and corrective excises on fuels to reflect the external costs of air pollution, global warming, come in this category, and this paper attempts to estimate their role in creating horizontal inequity.

By examining the Greek indirect tax structure primarily on equity grounds, we have inevitably ignored other principles of tax design. Consequently, our analysis is not intended to give immediately applicable policy prescriptions for the appropriate tax on specific commodities. Nevertheless, it is important to ask questions such as to what extent and in what ways a particular tax system sacrifices the goal of equity, perhaps for quite defensible reasons of discouraging certain activities, or how to measure inequity allowing for these other social objectives. Empirical contributions addressing such questions provide useful information and new insights and might help improve the rationality of the subsequent policy debate.

The structure of the paper is as follows. Section 2 briefly discusses various conceptual issues on the theory and measurement of horizontal equity and their application in indirect taxation. Section 3 summarises the decomposition methodology, while section 4 gives a brief description of the current system of indirect taxes in Greece, as well as of the three reforms to be examined. Section 5 presents the empirical results and section 6 concludes.

II. Horizontal equity: some conceptual issues

The notion of horizontal equity (HE), in the sense that equals should be treated equally, is intuitively appealing and generally accepted as important. Failure to ensure HE may indicate mistakes in welfare maximisation, and may induce income inequality, increase risk (in the sense of arbitrarily increasing the dispersion of post-tax incomes), and provoke envy by those treated less favourably than their peers (see Kaplow, 1989, Atkinson, 1980). Horizontal equity as a principle of tax design is generally perceived to require that people with identical pre-tax income should pay equal amounts of tax, at least if one leaves to one side differences justified on equity grounds, such as those related to age and family size.

However, the normative justification and the conceptual foundations of horizontal equity have been questioned. Horizontal equity seems to be implied by a general utilitarian social welfare framework and it is not clear whether it should be granted *independent* significance (see Feldstein, 1976). Furthermore, horizontal equity, by penalising the unequal treatment of equals, essentially calls for preserving the status quo. In the context of tax systems, the latter coincides with the pre-reform or pre-tax distribution of incomes, and any HE index measures the degree to which the tax or the tax reform modifies the initial distribution of income. This

automatically raises the question whether, and if so, why the initial income distribution has an intrinsic value, which is perhaps justified by an entitlement view of justice of the kind advanced by Nozick, but is less easily supported by utilitarian or Rawlsian theories of justice that give moral weight to end-result principles and attach no significance to changes in relative position induced by taxation. Nevertheless, measuring the degree of inequality induced by the tax system among equals is interesting in its own right, regardless of the ethical significance attached to such inequality. Furthermore, horizontal inequality in effect makes the tax system less progressive than in nominally appears and it is important to measure the extent to which this happens.

A further complication arises from the fact that the call for "equal treatment of equals" presupposes that there exist individuals who are equals, who must, in turn, be treated equally. The definition of equals can prove a challenging task for various reasons. In the context of tax systems, our underlying interpretation of horizontal equity is equal post-tax utility for people with equal pre-tax utility. Ideally one would like to be able to measure utility or welfare before and after taxes, starting from the indirect utility function or money metric utility of the household. In a world where preferences and abilities differ, this is a very hard task and no agreement has been reached in either the theoretical or the empirical literature. Thus, regarding welfare comparisons across households, we confine ourselves to the commonly used pragmatic approach of using equivalised after-tax household expenditure as a welfare indicator or proxy for utility. Differences in household size and composition have been accounted for by dividing household expenditure with the modified OECD equivalence scale.[2] Nevertheless, one should bear in mind that despite the fact that equivalence scales are widely employed in empirical studies on the redistributive impact of taxes and on income inequality, they assume full inter-household comparability of wellbeing, and also imply a purely material or financial notion of welfare, and in general are a rather crude way of making utility levels comparable across differently composed households. [3] Furthermore, defining equals in terms of utility levels fails to account for the possibility that we might alternatively wish to treat people who are observably similar in some other "relevant" characteristics similarly even if we knew that utility varied systematically with other "irrelevant" characteristics. To sum up, bearing these caveats in mind, horizontal equity is defined as equal tax payments among people with equal pre-tax expenditure.

Even if we use a simple observable measure to classify households, it remains unclear how to define groups of equals on the basis of a continuous variable like household expenditure recorded in the HES microdata. Typically there will be very few if any exact equals and this will lead to an under-estimation of horizontal inequality and an unreliable estimate of the vertical impact of the tax system. Lambert and Ramos (1997) propose to band

[2] The modified OECD equivalence scale assigns a weight of 1 to the first adult, 0.5 to subsequent members aged over 13 and 0.3 to children up to 13 years old.

[3] For these reasons, equivalence scales have been criticized; see, for example, Pollak and Wales (1979) and Nelson (1993). A weaker approach, not followed here in order not to overburden the analysis, would be to calculate measures of horizontal inequity among different household types.

pre-tax incomes (in our case equivalent household expenditure) into 'close-equals' groups and obtain a modified decomposition of the redistributive effect of taxation (see section 3 below). However, any boundary used to delineate groups of individuals would impose an arbitrary discontinuity, with a small change in household expenditure potentially moving someone across group boundaries. As a result the choice of the class width affects the allocation of inequality into vertical and horizontal components. If the class widths are very broad, the vertical action of the tax system would take place within classes of 'equals', while too narrow class widths would lead to an underestimation of the horizontal inequality effect induced by the tax system. As the class width is narrowed, more and more vertical action of the tax will be expected to take place *between* (rather than *within*) close equals groups. At the limit, if the entire population were allocated to the same close-equals group, the observed progressivity (regressivity) would be identified as a negative (positive) horizontal effect, with vertical redistribution equal to zero (Ven *et al*, 2001).[4]

In an attempt to overcome the problem of arbitrary specification of close-equals groups, Ven *et al* (2001) suggest an appropriate strategy whereby the class width used to combine individuals into groups of close-equals is chosen as the value that maximises the estimated vertical effect. We experiment and present the results for various alternative plausible class widths for all reform scenarios considered. Given the limitations explained above, one should be cautious in assigning exact proportions of the inequality induced by the tax system into vertical and horizontal components. Nevertheless, since in the present case we are interested in vertical and horizontal effects of the present indirect tax structure in Greece *vis-à-vis* those of alternative tax structures, we find that the choice of class width *per se* is not of crucial importance. In this sense, alternative group sizes are used in order to check the robustness of the relative effects of different tax systems.

1. The role of excises in influencing behaviour

Some horizontal inequity may, however, be justified. In income taxation, unequal treatment of equals and hence horizontal inequity may arise because of the specific intention of treating distinct groups differently (married, single, homeowners, etc.) or different sources of income or categories of expenditure differently (capital gains, charitable giving, mortgage interest, etc.). In the case of indirect taxation, horizontal inequity arises from the interaction of differences in tastes and variations in tax rates. Differences in tax rates may be defended as reflecting efficiency considerations (such as taxing inelastically demanded goods more

[4] Auerbach and Hassett (1999) propose an alternative method for measuring horizontal equity which gets round the problem of cliff-edge definitions of 'equals'. Their measure is based on a social welfare function which is used to derive indices of horizontal and vertical equity and they replace the statistical arbitrariness of the close equals groupings with the choice of kernel bandwidths which possess known statistical properties. This approach, despite its apparent merits, has been critised on a theoretical level by Kaplow (2000), while some arbitrariness still remains concerning the appropriate relative weights social preferences should attach to the two types of inequality. For these reasons, it is not followed here.

heavily, or concentrating taxes on goods with low administrative and compliance costs), in which case HE is an unfortunate by-product, or the differences may be defended as correcting socially undesirable patterns of consumption (smoking, drinking, polluting, or creating congestion). Excise taxes on such activities are typically set at rates that are considerably higher than for other consumer goods. Historically these excises were attractive as simple source of revenue (inelastic demand, often produced by a small number of easily monitored firms). With the growth in fiscal and philosophical sophistication, otiose examples such as salt taxes were dropped (often remarkably recently, as Ghandi's salt march reminds us) while other reasons were advanced for retaining higher taxes on tobacco, alcohol, and transport fuel. Reflecting other social concerns, governments often set lower tax rates on food and other necessities, mainly for distributional reasons (although they are if anything more likely to indirectly raise food prices to support a decreasing number of farmers).

Alcohol results in dangerous driving, which harms other road users – thus Ruhm (1996) estimates that a 78% increase in the US alcohol tax (that would restore its real value to that in 1975) would reduce highway deaths by 7-8% (although penalties for exceeding alcohol limits may have a larger effect), while Kenkel (1993) estimates that a 10% increase in the price of alcohol would reduce drunk driving by 7-8% (more for women than men). Other estimates (surveyed in Cnossen, 2005) suggest that higher alcohol taxes would reduce rapes, assaults (particularly domestic violence) and murder, and reduce sickness-related absenteeism at work (Maynard, Godfrey and Hardman, 1994). This last effect could justify alcohol taxes as a way of offsetting the distortionary effect of labour taxes. The same argument has been applied to tobacco, where with a national or subsidized health scheme, future health costs are borne by the exchequer and might be charged through tobacco taxes to those causing the costs, internalizing the pecuniary externality. This argument is weakened by noting that the exchequer may benefit from the earlier demise of heavy smokers and the consequent reduced pension costs (Shoven et al, 1989). Tobacco is an interesting example, where evidence of its severe health related effects post-dated excise taxation, and where most of the adverse effects of smoking are felt by the consumer (passive smoking is the obvious exception, but its full cost is hard to estimate and might be quite low). Smoking, gambling, drug use including alcohol, are often discouraged as the consumer is thought to be imperfectly informed about (or incapable of rationally reacting to) the future harm relative to the present pleasure. This paternalism is defended on the grounds that such consumers may subsequently wish they had never become addicted, and may be especially concerned that their children are protected (legally or through high excises) from becoming addicted. Logically, though, tobacco should be taxed on tar content, as high tobacco taxes appear to encourage more inhalation or a switch to higher tar tobacco (Evans and Farrelly, 1998, Adda and Cornaglia, 2006). High 'sin' taxes can also induce a switch to illegal drugs (especially marijuana, Frey, 2005) and support the resulting social corruption of the drug trade, as with prohibition in the US. On the other hand, 'sin' taxes can appear to sanction the activity, whereas a smoking ban in public places may be more effective at reflecting social disapproval.

Since goods are consumed in different amounts by different households at similar spending levels, such high excises will lead to differentiation in the tax burden of households at the same spending level, and thus, a violation of the simple application of the principle of horizontal equity. In this sense, it would be somewhat perverse to argue that a tax reform that leads to a more socially desirable pattern of consumption through differentiated taxes that discourage socially undesirable activities would be deemed undesirable as it increased horizontal inequity. Indeed, if effective, it might *reduce* horizontal and overall inequity in health outcomes. For this reason, we believe that it would be interesting to measure how much corrective excises contribute to horizontal inequity (and generally to the overall redistributive power of the tax system and its components) under the alternative tax regimes examined. Therefore, in section 5 we also provide estimates of the redistributive power of the different tax structures examined and its components if we isolate the impact of excises.

III. Decomposition of the redistributive effect of indirect taxes

The redistributive effect of any tax system can be judged by the degree to which it reduces (or increases) inequality when moving from pre-tax to post-tax total income distribution. Lambert and Ramos (1995) select as a measure of inequality the mean logarithmic deviation (MLD), so that the *RE*distributive effect of the tax system is defined as:

(1) $$RE_{MLD} = J^b - J^a ,$$

where J^b denotes inequality *b*efore, in the pre-tax distribution and J^a denotes inequality *a*fter, in the post-tax distribution. Since the MLD shares the desirable properties of symmetry and anonymity required of good inequality measures,[5] J^a is solely based on the post-tax distribution and neither uses nor conveys any information about the pre-tax distribution, nor about the respective contributions of vertical and horizontal effects.

The mean logarithmic deviation belongs to the generalised entropy family (Theil, 1967) and has the convenient property of being an additively decomposable inequality index. It thus permits a decomposition of overall inequality in any population into a weighted sum of the inequalities present in any exclusive and exhaustive set of subgroups, plus the "inequality between groups". The latter effect is computed by hypothetically eliminating within-group inequality, i.e. replacing each income (in our case total household equivalised expenditure) in each subgroup by the mean income for that subgroup. The weights for the subgroup inequality contributions depend on the population share of the relevant subgroup.

Lambert and Ramos (1995) show, in the context of income taxation, that if the splitting of the population into subgroups is done so that within each subgroup individuals have the same pre-tax income, the decomposition of the overall change in inequality into between-groups and within-group components serves to identify the vertical and horizontal

[5] The principle of anonymity ensures that the identity of a person is irrelevant, while the principle of anonymity means that if two individuals interchange their income positions, inequality remains unchanged. These axioms ensure impartiality between individuals.

contributions to the redistributive effect of the tax system. If we assume that there are N distinct subgroups in the population, in each of which the members have the same pre-tax income (in our case equivalised total household expenditure), then after-tax inequality, J^a, can be decomposed as:

$$J^a = J^{a*} + \sum_{k=1}^{N} w_k J_k^a \,, \tag{2}$$

where J_k^a denotes post-tax inequality within group k, J^{a*} denotes the inequality between the group means in the post-tax situation (obtained by replacing every post-tax expenditure within each group by the arithmetic mean) and w_k is the population share of group k. Now (1) can be written as:

$$RE = J^b - \left(J^{a^*} + \sum_{k=1}^{N} w_k J_k^a \right) = \left(J^b - J^{a^*} \right) - \sum_{k=1}^{N} w_k J_k^a = V_{MLD} - H_{MLD} \,. \tag{3}$$

The first term in parenthesis (V_{MLD}) measures vertical redistribution (and the subscript reminds us that this is for the MLD measure of inequality), while the remaining term (H_{MLD}) measures horizontal inequity. The fact that the weights used are pure numbers ensures that the importance attributed to a local horizontal inequity does not depend on the income level at which it is experienced.

To give an intuition of the above decomposition in the context of indirect taxes, the population is split into N population subgroups, in each of which the members have the same pre-tax equivalised household expenditure. Consider the subgroup k of individuals with equal pre-tax expenditure $X_k = \Sigma x_{kj}$ where x_{kj} is the expenditure by subgroup k on good j. If good j is now subjected to a tax at rate t_j then the after-tax expenditure X_k^a is $\Sigma x_{kj}(1\text{-}t_j) = X_k \Sigma s_{kj}(1\text{-}t_j)$ where s_{kj} is the expenditure share of subgroup k on good j. This can be written as

$$X_k^a = X_k (1 - \bar{t}) [\sum_j s_{kj}^a \, (1 + \frac{\bar{t} - t_j}{1 - \bar{t}})] \,, \tag{4}$$

where $\bar{t}$ is the average indirect tax rate. It follows that the mean logarithmic deviation is

$$-\frac{1}{N} \{ \sum_k \log X_k^a - \log[X(1-\bar{t})] \} = -\sum_k \frac{1}{N} \log(1 + u_k) \,, \tag{5}$$

where $X = \Sigma X_k$ and $u_k = \sum_j s_{kj}^a (\bar{t} - t_j)/(1-\bar{t})$. If u_k is small then this is approximately u_k. Note that if all tax rates are equal or all budget shares are equal then this expression is zero and there would be no horizontal inequity – it requires both to depart from uniformity to produce any inequity. Thus this measure of horizontal inequity, caused by differences in the taxes different households within the same subgroup pay, stems from variations in the consumption preferences of households and differentiation in the tax rate structure, this is why Decoster *et al* (1997) call it the 'tastes-effect'. Changes in the inequality between the population subgroups, each of which has different initial pre-tax equivalised expenditure, comprises vertical redistribution. The vertical equity effect of the tax is thus the change in inequality

that would have occurred had the indirect tax system treated equals equally (or if there were no preference variation within each 'equals' group).

Some of the horizontal inequality caused by tax changes will be unintended by-products of the tax reform, while some are the outcome of discouraging socially undesirable activities. To distinguish between the two types of horizontal inequity, we consider three adjustments for the subset of goods where social preferences differ from revealed preferences (taken as tobacco and alcohol, as vehicle use is treated separately as discussed below). The first assumes that the budget shares on these goods is held constant across the whole sample, while the second assumes that the budget shares on these goods is set to zero (adjusting the other expenditure shares to maintain overall expenditure unchanged). The first of these adjustments removes any direct differential impact of these sin taxes across individuals, while the second looks at the impact of the tax reforms assuming that socially undesirable goods have no direct influence on the assessment of tax reforms.[6] Finally, as a third way to isolate the impact of excises, we set the tax rate on these items equal to the average tax rate.[7] The thought experiment in this case is that the government taxed these like standard goods, rather than that the consumption of these items is either held constant across the population or set to zero.

A similar decomposition to that for the mean logarithmic deviation is proposed by Aronson *et al* (1994), based on the Gini coefficient. It is well known that the Gini coefficient fails to decompose across subgroups into between-group and within-group inequality components, but the authors treat the residual of the Gini decomposition as a measure of the reranking effect of taxation. Reranking is an effect among unequals and arises from taxpayers who were reranked in the transition from the pre-tax to the post-tax distribution.[8] Thus, similarly to (1) and (3), the redistribution effect of the tax system, as measured by the change in the Gini index between the pre-tax and post-tax distributions, is:

$$(6)\quad RE_G = G^b - G^a = G^b - \left(G^{a*} + \sum_{k=1}^{N} \widetilde{w}_k G_k^a + R \right) = \left(G^b - G^{a*} \right) - \sum_{k=1}^{N} \widetilde{w}_k G_k^a - R = V_G - H_G - R\,,$$

where G^b is the Gini measure of inequality in the pre-tax expenditure distribution, G^{a*} is the 'between-groups' Gini measure of post-tax expenditure obtained by replacing every post-tax expenditure within each group by the arithmetic mean and G_k^a is the Gini measure of inequality of the post-tax expenditure of those in the *k*th group. The weights, $\widetilde{w}_k$, are now the product of the population share and post-tax expenditure share of all those belonging in the *k*th group, i.e. $\widetilde{w}_k = w_k\, q_k$, where is the population share of group *k* and q_k is the post-tax

[6] There will be an indirect effect in that the expenditures on other taxed goods will be differentially changed across the population.

[7] We choose the average tax rate, rather than the standard VAT rate, in order for the tax system to raise the same amount of tax revenue.

[8] Such reranking is often interpreted as an infringement of horizontal neutrality, but this interpretation somewhat unclear; for a discussion see Kaplow (1989).

expenditure share of the equals group k.[9] In practice, R can be approximated by the Atkinson's (1980) or Plotnick's (1981) index. As previously, the first term in parenthesis (V_G) measures the vertical effect (again with subscript G reminding us this is for the Gini measure) of the tax system. The redistributive effect of the tax system is reduced now by the classic horizontal inequity as before (H_G) and the reranking component (R), both of which are a result of taste differentiation and tax rate variation.

Given that we work with sample microdata, the identification of groups of equals on the basis of a continuous variable like total or net equivalent expenditure poses a problem, as discussed in section 2. Lambert and Ramos (1997) propose to band pre-tax incomes (in our case equivalent household expenditure) into 'close-equals' groups and obtain a modified decomposition of the redistributive effect into what they call pseudo-horizontal and pseudo-vertical contributions. Horizontal inequity is the process whereby the expenditures of close equals get spread out in the transition from the pre-tax to the post-tax distribution. Thus, the pseudo-horizontal inequity component now measures the aggregated *increase* in inequality among households in the same group, which in the case of the mean logarithmic deviation equals to:

$$PH_{MLD} = \sum_{k=1}^{N} w_k \left(J_k^a - J_k^b \right) , \tag{7}$$

where J_k^a denotes inequality of pre-tax expenditure in group k, J_k^b denotes inequality of post-tax expenditure in group k[10] and w_k is the population share of group k, as before.

The pseudo-vertical effect now depicts the change in inequality *on average* between close equals groups. To quantify this effect, we assume that the expenditures of households in each close equals group are equalised, both before and after tax, with no change in their total expenditure in either case, and measure the inequality change in the transition from one to the other. Formally the pseudo-vertical performance component in the case of the mean logarithmic deviation (MLD) is:

$$PV_{MLD} = J^{b**} - J^{a**} , \tag{8}$$

where J^{b**} is the between-groups MLD of *pre-tax* expenditure obtained by replacing every pre-tax expenditure within each group by the arithmetic mean and J^{a**} is the between-groups MLD of *post-tax* (net) expenditure obtained correspondingly. Replacing (7) and (8) into (3) gives the decomposition of the redistribution effect of taxes based on sample microdata as follows:

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[9] See Shorrocks (1980). Since weights are income-dependent, the importance attributed to horizontal inequality depends upon the income level at which it is experienced, which is recognized by the authors (Aronson et al, 1994).

[10] In our initial setup in equation (3), $J_k^b = 0$ for all k, and therefore $J^b = J^{b*}$ for all inequality measures that respect the principle of population independence, i.e. that inequality remains the same if a proportionate number of persons is added at all income levels (see, Kakwani, 1980, p. 66), where J^{b*} denotes inequality between the group means in the pre-tax situation. This is no longer true in the case of 'close-equals' groups.

(9) $$RE = PV_{MLD} - PH_{MLD} = \left(J^{b**} - J^{a**}\right) - \sum_{k=1}^{N} w_k \left(J_k^a - J_k^b\right),$$

where the notation is as before.

A similar modification must be applied in the case of the Gini decomposition, so that (6) now becomes:

(10) $$RE_G = PV_G - PH_G - R = \left(G^{b**} - G^{a**}\right) - \sum_{k=1}^{N} \tilde{w}_k \left(G_k^a - G_k^b\right) - R \ ,$$

where G^{b**} is the between-groups Gini measure of *pre-tax* expenditure obtained by replacing every pre-tax expenditure within each group by the arithmetic mean, G^{a**} is the between-groups Gini measure of *post-tax* (net) expenditure obtained correspondingly, while G_k^b and G_k^a are the Gini measures of inequality of the pre-tax and post-tax expenditure respectively of those in the *k*th group. The reranking coefficient, *R*, is based on the ungrouped data and is therefore not affected by the grouping of households.

For the interpretation of the pseudo-vertical and pseudo-horizontal components, if they are found to be positive for a given tax system, it is as if the tax, horizontally, acts to increase inequality within close equals groups (compared with a uniform tax rate), while vertically it acts to reduce inequality among close equals groups.

IV. The Greek Indirect Tax Structure and Reform Scenarios

The first tax structure to be examined is that of Greece in 2004. Indirect taxes occupy a dominant position in the Greek tax system, yielding 1.5 times more revenue than direct taxes (excluding social security contributions). The tax structure is rather complicated, with VAT in 2004 being levied at three rates: 4%, 8% and 18%. The 4% VAT rate covers books, newspapers, periodicals and theatres, the 8% rate covers most food items, medicines, raw materials and other distributionally sensitive commodities, and the standard rate applies on all the remaining goods and services. Certain services, such as education and financial services are exempt from the VAT tax base. Special excise taxes, varying per category, are levied on tobacco, alcohol and liquid fuel. In an effort to control inflationary pressures, the Greek government has gradually adopted rates very close to the lowest permissible by the European Council.

Car ownership and use are subject to a multitude of taxes. The purchase of private means of transport is subject to a circulation license issue fee and an initial registration tax, varying according to the vehicle's engine power and technology. Cars are also subject to an annual transport due, also varying according to engine power. Stamp duties are levied on a large number of transactions outside the VAT base of taxation, at various rates that are usually very small. Other indirect taxes include the turnover tax on insurance companies, which are exempt from VAT. Certain taxes with low revenue yield, classified in government accounts under indirect taxes, are not modelled, since their allocation at a household level is meaningless (e.g. tax on capital transfer and accumulation).

We have defined three reforms with respect to the actual Greek indirect tax structure. Two of them are constructed on the basis of the report on taxation prepared by the Tax Reform Committee, which publicly became known as the "Georgakopoulos Committee" in March 2002. This Committee was set up by the Ministry of Finance in March 2001 with the task of assessing the entire taxation system in Greece and proposing a number of scenarios for its reform. The report thus comprised an attempt to deal effectively with the obvious drawbacks of the existing tax structure and to adjust it to the increasingly competitive environment of the Economic and Monetary Union. The principal objectives of the Committee's proposals are to simplify the tax structure and the mechanisms by which taxes are imposed and collected, support economic activity and employment, enhance the neutrality and transparency of the tax system and, finally, increase its distributional fairness.

The proposed reforms in indirect taxes reflect the targets set for the entire tax reform, namely simplifying the tax structure, abandoning taxes that entail high administrative costs, and abolishing exemptions and special tax regimes. More specifically, the Report recommends the abolition of all stamp duties, the business turnover tax on intermediate insurance services (which falls on intermediate consumption and harms competitiveness), the exemption from VAT of the purchase of immovable property, and the exemption of lawyers and notaries public from the requirement to pay VAT. It is also recommended that the reduced VAT rates currently applicable for the Aegean islands be abolished, and that the lower VAT rate of 4% for books, newspapers and theatres also be abolished and these goods and services be transferred to the 8% VAT rate. Lastly, the Committee points out ways to compensate possible revenue losses from elsewhere in the tax system by indicating which indirect taxes could be potentially increased. For instance, it is may be possible to reclassify certain products (e.g. soft drinks, restaurants and take-away food, electricity, natural gas) from the reduced to the standard VAT rate, increase gasoline, alcohol and tobacco excises, and transport dues, and, if absolutely necessary, even increase the VAT rates.

We combined various proposals of the Committee and constructed two tax reform scenarios, which overall point to an increase in the tax burden. The first scenario (A) involves the abolition of the 4% VAT rate and transfer of goods and services concerned to the 8% rate, transfer of restaurants, soft drinks, electricity, and natural gas to the 18% rate, inclusion of lawyers in the VAT regime, raising special excises nearer to EU averages and, lastly, raising transport dues by 20%. The second scenario (B) is a "heavy taxation" scenario, where in addition to the reforms is scenario A, we assume that the government needs to compensate for exogenous revenue losses through a one-percentage point increase in all VAT rates.[11] In March 2005, the government indeed raised all VAT rates by one percentage point in order to meet the 2005 budget deficit target.

The third reform scenario involves the replacement of the Greek indirect tax structure with the UK one. The latter is considerably simpler, involving a standard VAT rate applicable to most expenditure items, a lower rate (mainly for domestic energy), with certain

[11] For a detailed analysis of the distributional impact of all the changes in indirect taxation proposed by the Committee see Kaplanoglou and Newbery (2003b).

distributionally sensitive goods zero-rated (for example food, children's clothing, medicines, books, newspapers, water-supply and transport) or exempt. Special excises apply on tobacco, alcohol, petrol and diesel, all of which are higher than the respective Greek excises. Vehicles are also subject to an annual circulation license. In order to make the tax reform revenue-neutral, we have adjusted the standard VAT rate upwards from 17.5% to 21%. Table 1 presents the implications of each of the above reform scenarios for the structure of indirect tax revenue.

Each of the above four (existing and three reform) tax structures has been simulated on the household database provided by the latest Household Expenditure Survey, conducted by the National Statistical Service of Greece in 1998-1999. This survey contains information for 6,258 Greek households on around 400 items and on several socio-economic characteristics of the households. We work on the assumption that the change in tax is reflected fully in consumer prices, while for each reform scenario we calculate the distributional impact assuming a price elasticity of –1 for each commodity, so that the budget shares are assumed to be fixed as the tax structure is varied. In this sense, we measure the *impact* effects of the indirect tax structure. [12] Finally, part of the taxes on car use is assumed to comprise a road user charge and is subtracted from the household tax burden.[13]

V. Results

The decomposition of the redistributive effect of the actual indirect tax structure and of alternative reform scenarios has been estimated for several definitions of groups of equals. Table 2 presents results under the assumption that all households within the same 1%-quantile of pre-tax equivalised household expenditure are "equals". The upper part of the table shows the values of the mean logarithmic deviation under alternative tax structures and its components as defined in (9), while the lower part of the table shows the same figures relative to pre-tax inequality, J^b (as a percentage).

[12] Creedy (1999) follows the same line, noting that "it is essential to preserve the full variation in household budget shares, since it is the heterogeneity that influences the horizontal inequity and reranking effects, and the preference functions cannot of course be estimated for individual households" (p. 151).

[13] According to a strand of literature (Walters, 1968; Dewees, 1979; Harrison et al, 1986; Newbery, 1988, 1996, and 2005; HMSO, 1993; Newbery and Santos, 1999), some part of road taxes (i.e. car purchase taxes, annual transport dues, fuel taxes) should be viewed as road user charges rather than pure taxes. If road use could be priced through congestion charges (as in London since 2002), then a large part of the case for other taxes on fuel and vehicle purchase would disappear (Newbery, 2005). To cite the House of Commons, (1995) "the revenues associated with road pricing should be regarded as a charge rather than a tax." Our preferred approximation for the road user charge element is equal to the minimum of the car purchase tax and the annual transport dues recorded in the HES, plus the proportional taxes on car use (mainly fuel taxes). We assume that VAT is levied at the standard rate on the road user charge.

TABLE 1

Implications of the Tax Reform Scenarios for the Structure of Indirect Tax Revenue.

		Greek system		Tax Reform A		Tax Reform B		UK system	
	Budget shares (%)	Average tax rate	Tax shares (%)	Average tax rate	Tax shares (%)	Average tax rate	Tax shares (%)	Average tax rate	Tax shares (%)
Food	17.4	7.4%	10.3	7.7%	10.1	8.5%	10.7	0.7%	0.9
Tobacco	3.1	72.8%	18.1	74.5%	17.4	75.2%	16.8	84.7%	21.1
Housing (including central heating)	10.8	12.8%	11.1	11.7%	9.4	12.1%	9.4	6.1%	5.3
Communication	3.5	16.5%	4.7	16.5%	4.4	17.3%	4.4	12.6%	3.6
Alcohol	0.6	28.3%	1.3	30.7%	1.3	31.4%	1.3	49.1%	2.2
Restaurants	8.8	9.4%	6.6	15.2%	10.1	16.0%	10.1	16.7%	0.7
Clothing/Footwear	9.3	15.3%	11.4	15.3%	10.7	16.0%	10.7	14.2%	10.6
Medical	6.8	1.5%	0.8	1.5%	0.8	1.7%	0.8	0.5%	0.3
Recreation	4.9	9.0%	3.6	10.1%	3.7	10.8%	3.8	12.7%	5.0
Education	2.8	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0
Household.goods	8.1	13.3%	8.7	13.3%	8.1	13.9%	8.2	17.5%	11.4
Other	11.8	6.9%	6.6	7.5%	6.6	7.8%	6.6	7.9%	7.5
Transport	12.0	17.4%	16.8	19.2%	17.3	19.8%	17.1	20.5%	19.7
TOTAL	100	12.5%	100	13.3%	100	13.9%	100	12.5%	100

Note. Goods are ranked in order of necessities to luxuries. We measure that by the distributional characteristic, d_i, of the commodity group (Feldstein, 1972), which measures the extent to which consumption of the commodity is concentrated among those with high social marginal values of consumption (i.e. the 'socially deserving')

TABLE 2

Decomposition of Redistributive Effect for Alternative Tax Structures (MLD)
(equals are defined by taking 1%-quantiles)

Pre-tax inequality (J^b)	**0.18977**			
	J^a	RE_{MLD}	$= PV_{MLD}$	$- PH_{MLD}$
Greece 2003	0.19175	-0.00198	-0.00113	0.00085
Tax Reform A	0.19143	-0.00166	-0.00071	0.00095
Tax Reform B	0.19160	-0.00183	-0.00083	0.00100
UK taxes	0.18739	0.00238	0.00359	0.00121
(as a percentage of J^b)				
	J^a	RE_{MLD}	$= PV_{MLD}$	$- PH_{MLD}$
Greece 2003	101.04	-1.04	-0. 60	0.45
Tax Reform A	100.87	-0.87	-0.37	0.50
Tax Reform B	100.96	-0.96	-0.44	0.53
UK taxes	98.75	1.25	1.89	0.64

Note. PV is the pseudo-vertical performance measure defined in equation (9), MLD is mean logarithmic deviation.

The value of the RE_{MLD} for the first simulation shows that the actual Greek indirect tax system is regressive in the sense that it induces greater inequality than in the pre-tax distribution. Note that, under the constant expenditure assumption, the inequality of the pre-tax distribution is equivalent to the inequality of the expenditure distribution with a uniform tax on all commodities. In this sense the actual tax structure is more regressive than a uniform VAT on all commodities.

The reform scenarios A and B also correspond to regressive tax structures, though the overall negative redistributive effect decreases marginally compared to the 2003 structure. A complete reversal of the redistributive effect of the indirect tax system is achieved by adopting the UK tax structure, which decreases post-tax inequality instead of increasing it.

Let us turn to the decomposition results. Regarding the actual Greek tax structure, the vertical and horizontal inequity effects are of comparable magnitude.[14] This means that around half of the negative redistributive effect of indirect taxes is explained in terms of differences in expenditure patterns among households with the same pre-tax equivalised

[14] As discussed in section 2, theoretically, any balance between vertical and horizontal inequity can be achieved by adjusting group sizes. However, as presented in the appendix, this balance does not change dramatically at least for a range of plausible class widths usually employed in similar studies (see Decoster, et al, 1997, Lambert and Ramos, 1995).

expenditure. The other half is a pure negative vertical effect caused by the fact that on average luxuries are taxed less heavily than necessities.

Tax reform scenarios A and B imply still a negative, but slightly lower vertical redistribution effect. Necessities are still taxed on average at higher rates than luxuries, but less so than under the present indirect tax structure. This small gain in vertical redistribution is partly counter-balanced by greater horizontal inequality components. It seems that taste differentiation among households with the same initial expenditure matters (slightly) more under the new tax structures. Comparing reforms A and B (recall that reform B includes all reforms under scenario A, plus a one-percentage increase in all VAT rates), reveals that scenario B implies both a (slightly) larger negative vertical effect and (slightly) more horizontal inequality. Thus, the increase in VAT rates has a twofold adverse distributional effect: it increases inequality both between unequals (households at different pre-tax equivalised expenditure levels) and among equals (households at the same pre-tax equivalised expenditure level). Nevertheless, one has to keep in mind that reforms A and B are both designed to yield more revenue from indirect taxes, so comparisons with the present indirect tax structure regarding the degree of violation of horizontal neutrality and vertical progressivity should be interpreted with caution. Indeed, VAT rates were increased by one percentage point in March 2005 without any compensation to consumers, in response to the ECOFIN recommendation of 17th February 2005 to Greece to end the situation of an excessive deficit by the end of 2006 at the latest (see the 2005 Update of the Hellenic Stability and Growth Programme, 2005-2008, submitted to the European Commission in December 2005).

Turning to the UK tax simulation, the results are rather revealing. The UK tax structure is considerably simpler than any of the systems examined above. It zero-rates quite a few distributionally sensitive commodities, while taxing some others at quite a high rate (which was set at around 21% in order to have a reform that is revenue neutral relative to the existing Greek tax system). Moving from the current tax structure to the UK one makes the system progressive in vertical terms (V_{MLD} is now positive). The fact that several excises are increased and the VAT rate structure is more 'polarized' increases the variability of tax rates. Thus the coefficient of variation of tax rates under the UK tax system is substantially higher under the UK tax structure than under any other scenario examined.[15] This inevitably increases the inequality induced by taste differentiation among pre-reform equals. The horizontal inequity component, PH_{MLD}, under the UK simulation is (slightly) higher than under any of the other reforms examined. Overall, the increase in vertical progressivity has a larger effect on MLD than the increase in horizontal inequality. Adopting the UK indirect tax structure would significantly improve the redistributive effect of the tax system and make it progressive, but at the expense of slightly higher horizontal inequity.

[15] The coefficient of variation of tax rates is calculated as the square root of the sum of the squared deviations of the tax rate of commodities (for around 400 commodity groups) from the average rate, weighted by the respective budget shares and divided by the average rate.

However, when we adjust for the impact of high taxes on socially undesirable goods, these results are considerably modified. Table 3 shows just the lower part of table 2 for the three alternative adjustments that correct individual budget shares of tobacco and alcohol either to the same average value or to zero, or set the tax rate of these goods equal to the average rate.

TABLE 3
Decomposition of Redistributive Effect for Alternative Tax Structures (MLD)
Correcting for Socially Undesirable Goods (1%-quantiles)

Pre-tax inequality (J^b)	**0.18977**			
(as a percentage of J^b with budget shares at average value)	J^a	RE_{MLD}	$= PV_{MLD}$	$- PH_{MLD}$
Greece 2003	98.69	1.31	1.49	0.18
Tax Reform A	98.45	1.55	1.77	0.21
Tax Reform B	98.51	1.49	1.72	0.22
UK taxes	95.74	4.26	4.49	0.23
(as a percentage of J^b with budget shares set equal to zero)				
	J^a	RE_{MLD}	$= PV_{MLD}$	$- PH_{MLD}$
Greece 2003	100.10	-0.10	0.08	0.18
Tax Reform A	99.98	0.02	0.21	0.19
Tax Reform B	100.21	-0.21	0.00	0.21
UK taxes	96.26	3.74	3.92	0.18
(as a percentage of J^b with tax rate set equal to the average tax rate)				
	J^a	RE_{MLD}	$= PV_{MLD}$	$- PH_{MLD}$
Greece 2003	98.76	1.24	1.39	0.15
Tax Reform A	98.45	1.55	1.77	0.21
Tax Reform B	98.58	1.42	1.60	0.18
UK taxes	95.97	4.03	4.22	0.19

The adjustments have a considerable effect, as now none of the tax reforms materially increases inequality compared with the pre-tax (or uniform tax) case, although in purely in distributional terms the ranking of the reforms is similar, with the UK tax structure most redistributive and tax reform A the next best. (The ranking of the other two cases is ambiguous but essentially tax reform B shows no redistributive gain on the 2003 Greek tax system.) Most of the difference stems from the fact that excluding the effect of the tobacco tax (the second most regressive tax after taxes on food, see Table

1) greatly improves the vertical performance of all tax systems examined.[16] The horizontal effect of reforms remains negative but is now very small indeed.[17] Thus the horizontal effect of adopting the UK tax structure would reduce its redistributive effect by only 5% of the vertical effect.

Table 4 presents the results of the decomposition using the Gini coefficient (but not correcting for social preferences).[18] In quantitative terms, the results are different from the MLD decomposition. The additional reranking component seems to capture a large part of the infringement of horizontal neutrality, contrary to the findings of Decoster *et al* (1997) where the reranking-component is unimportant, but in agreement with the findings of Creedy (1999) and what is usually found for the income tax; see, for example, the findings of Wagstaff *et al* (1999) covering 12 OECD countries. As explained earlier, the reranking effect captures rank reversals going from the pre-tax to the post-tax distribution of equivalent expenditure and it appears to significantly reinforce the regressivity introduced by vertical inequity.

TABLE 4

Decomposition of Redistributive Effect for Alternative Tax Structures (Gini)
(equals are defined by taking 1%-quantiles)

Pre-tax inequality (G^b)	**0.33715**				
	G^a	RE_G	$= PV_G$	$- PH_G$	$- R$
Greece 2003	0.33909	-0.00194	-0.00133	0.00016	0.00045
Tax Reform A	0.33889	-0.00174	-0.00106	0.00017	0.00051
Tax Reform B	0.33904	-0.00189	-0.00118	0.00018	0.00053
UK taxes	0.33548	0.00167	0.00254	0.00019	0.00068
(as a percentage of G^b)					
	G^a	RE_G	$= PV_G$	$- PH_G$	$- R$
Greece 2003	100.58	-0.58	-0.39	0.05	0.13
Tax Reform A	100.52	-0.52	-0.31	0.05	0.15
Tax Reform B	100.56	-0.56	-0.35	0.05	0.16
UK taxes	99.50	0.50	0.75	0.06	0.20

Note. PV_G is the pseudo-vertical performance measure for the Gini decomposition in (10), R is the re-ranking effect and subscript G refers to the Gini measure.

[16] Setting the consumption of tobacco and alcohol to zero for all households decreases the overall tax rate compared to the correction based on average budget shares. Since the redistributive performance of a tax system depends on the average tax rate, this explains why the redistributive performance of all tax systems in the case of zero budget shares worsens compared to the correction based on average budget shares.

[17] Neutralising the effect of tobacco and alcohol on horizontal inequality has a substantial impact because the consumption of these goods displays very high volatility, as measured by the coefficient of variation of respective budget shares (for a definition, see footnote 8 above).

[18] A correction for social preferences based on the Gini produces the same qualitative results and therefore is not presented here.

Nevertheless, it is reassuring that the Gini decomposition leaves our basic conclusions unchanged. A move from the actual indirect tax structure towards either reform scenario A or B, would marginally improve the overall redistributive impact of the system. The vertical effect is still negative but would slightly improve, while more horizontal inequality, both in the classical sense and through re-ranking, would be introduced. Reform B is less favourable than reform A, since it introduces more vertical regressivity and larger pure horizontal inequality and re-ranking effects. The UK tax structure, on the other hand, makes the tax system more progressive, but there is a considerable loss of additional vertical redistribution because this structure introduces higher horizontal inequality and re-ranking effects.

Changing the definition of equals (class width) is expected to have a large quantitative impact on the results. We have explored the sensitivity of results to the choice of class width. Tables A1-A4 in the appendix show the decomposition of the mean logarithmic deviation[19] for all indirect tax structures under consideration, for different definitions of equals (the band width has been increased from 40 euros to 400 euros for the division in class of equal width, and from 1% to 5% for the classes defined as quantiles). Changing the class width indeed drastically changes the relative magnitude of vertical and horizontal components. For an explanation of the link between class width and the relative magnitude of the redistribution components, see Ven *et al* (1998). More importantly, though, changing the class width does not alter any of our main conclusions regarding the *comparisons* of the different tax structures under consideration. Since this comparison is the main purpose of our analysis, the sensitivity results rather reinforce the robustness of our basic insights.

VI. Concluding Remarks

The redistributive argument often put forward by policy makers for differentiation of the structure of indirect tax rates is based on variations in average budget shares as total household expenditure increases. At the same time, however, the heterogeneity in expenditure patterns among households with similar demographic characteristics and total expenditure level, leads to differences in the amount of taxes these households pay. The tax system therefore introduces an "unequal tax treatment of equals" effect, infringing the principle of horizontal neutrality, although part of this is an arguably socially intended steering of consumption patterns away from socially undesirable activities.

In this paper we presented empirical estimates of the order of magnitude of horizontal inequality and other components of the redistribution effect of alternative indirect tax structures in Greece. We applied the decomposition methodology proposed by Lambert and Ramos (1997) based on the mean relative deviation and the one proposed by Aronson *et al* (1994) based on the Gini measure of inequality. The current system of indirect taxation in Greece was examined along with three alternative reform scenarios. Two of these scenarios combine proposals made recently by the Tax Reform Committee in its final report on

[19] A sensitivity analysis on the basis of the Gini decomposition produced similar results and is not presented here.

reforming the Greek tax system (2002). The third scenario (simulation of the UK indirect tax structure on Greek consumers) aims at both simplifying the tax structure and making it more progressive.

In all tax structures considered, the 'tastes' effect turns out to be considerable when compared with the vertical impact, although a large part of this is a consequence of imposing higher excises on alcohol and tobacco to discourage socially undesirable consumption patterns. Once the budget shares are adjusted to take account of social preferences, the tastes effect becomes smaller. Adopting either of the two reforms devised on the basis of the proposals of the Tax Reform Committee appears to improve the vertical progressivity of the tax system, and although this improvement is slightly offset by higher horizontal inequality, the overall redistributive effect of the system is (slightly) improved. The UK tax simulation reveals an attractive alternative that achieves considerably greater positive redistribution in which horizontal inequality is only slightly increased.

The results established above regarding the distributional properties of indirect taxes in Greece and various reforms are important and even more relevant considering the leverage of indirect taxes in revenue terms, which implies that any distributional effects of indirect taxes cannot be easily overturned by any other part of the tax or transfer system. Nevertheless, as noted in the introduction, in order to reach firm policy conclusions regarding a desirable tax design, one needs to further embark on a broader analysis with multiple objectives and instruments.

APPENDIX. Sensitivity Analysis

TABLE A.1

Sensitivity of the Decomposition to Class Width – Mean Logarithmic Deviation

GREECE 2003

Pre-tax inequality (J^b)	**0.18977**			
Class width of equivalised pre-tax expenditure	J^a	RE_{MLD}	PV_{MLD}	PH_{MLD}
1%-quantiles	0.19175	-0.00198	-0.00113	0.00085
5%-quantiles	0.19175	-0.00198	-0.00109	0.00090
40 euros	0.19175	-0.00198	-0.00112	0.00087
100 euros	0.19175	-0.00198	-0.00113	0.00085
200 euros	0.19175	-0.00198	-0.00123	0.00075
400 euros	0.19175	-0.00198	-0.00132	0.00066
(as a percentage of J^b)				
1%-quantiles	101.04	-1.04	-0.56	0.45
5%-quantiles	101.04	-1.04	-0.57	0.47
40 euros	101.04	-1.04	-0.59	0. 50
100 euros	101.04	-1.04	-0. 60	0.45
200 euros	101.04	-1.04	-0.65	0.40
400 euros	101.04	-1.04	-0.70	0.35

TABLE A.2

Sensitivity of the Decomposition to Class Width – Mean Logarithmic Deviation

Tax Reform A

Pre-tax inequality (J^b)	**0.18977**			
Class width of equivalised pre-tax expenditure	J^a	RE_{MLD}	PV_{MLD}	PH_{MLD}
1%-quantiles	0.19143	-0.00166	-0.00071	0.00095
5%-quantiles	0.19143	-0.00166	-0.00066	0.00101
40 euros	0.19143	-0.00166	-0.00069	0.00098
100 euros	0.19143	-0.00166	-0.00075	0.00091
200 euros	0.19143	-0.00166	-0.00083	0.00083
400 euros	0.19143	-0.00166	-0.00097	0.00069
(as a percentage of J^b)				
1%-quantiles	100.87	-0.87	-0.37	0.50
5%-quantiles	100.87	-0.87	-0.35	0.53
40 euros	100.87	-0.87	-0.36	0.51
100 euros	100.87	-0.87	-0.40	0.48
200 euros	100.87	-0.87	-0.44	0.44
400 euros	100.87	-0.87	-0.51	0.36

TABLE A.3

Sensitivity of the Decomposition to Class Width – Mean Logarithmic Deviation

Tax Reform B

Pre-tax inequality (J^b)	**0,18977**			
Class width of equivalised pre-tax expenditure	J^a	RE_{MLD}	PV_{MLD}	PH_{MLD}
1%-quantiles	0.19160	-0.00183	-0.00083	0.00100
5%-quantiles	0.19160	-0.00183	-0.00078	0.00105
40 euros	0.19160	-0.00183	-0.00082	0.00102
100 euros	0.19160	-0.00183	-0.00088	0.00095
200 euros	0.19160	-0.00183	-0.00095	0.00088
400 euros	0.19160	-0.00183	-0.00110	0.00073
(as a percentage of J^b)				
1%-quantiles	100.96433	-0.96433	-0.43737	0.52555
5%-quantiles	100.96433	-0.96433	-0.41102	0.55576
40 euros	100.96433	-0.96433	-0.43210	0.53696
100 euros	100.96433	-0.96433	-0.46372	0.50248
200 euros	100.96433	-0.96433	-0.50061	0.46134
400 euros	100.96433	-0.96433	-0.57965	0.38642

TABLE A.4

Sensitivity of the Decomposition to Class Width – Mean Logarithmic Deviation

UK Tax Simulation

Pre-tax inequality (J^b)	**0,18977**			
Class width of equivalised pre-tax expenditure	J^a	RE_{MLD}	PV_{MLD}	PH_{MLD}
1%-quantiles	0.18739	0.00238	0.00359	0.00121
5%-quantiles	0.18739	0.00238	0.00359	0.00121
40 euros	0.18739	0.00238	0.00361	0.00123
100 euros	0.18739	0.00238	0.00351	0.00112
200 euros	0.18739	0.00238	0.00337	0.00099
400 euros	0.18739	0.00238	0.00299	0.00061
(as a percentage of J^b)				
1%-quantiles	98.74585	1.25415	1.89176	0.63648
5%-quantiles	98.74585	1.25415	1.89176	0.63794
40 euros	98.74585	1.25415	1.90230	0.64553
100 euros	98.74585	1.25415	1.84961	0.59083
200 euros	98.74585	1.25415	1.77583	0.51940
400 euros	98.74585	1.25415	1.57559	0.31938

References

Adda, J. and Cornaglia, F. (2006), "Taxes, cigarette consumption, and smoking intensity", *American Economic Review*, vol. 96, pp. 1013-28.

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*, Oxford University Press, New York.

Aronson, R.J., Johnson, P. and Lambert, P. J. (1994), "Redistributive effect and unequal income tax treatment", *The Economic Journal*, vol. 104, pp. 262-70.

Atkinson, A. B. (1980), "Horizontal equity and the distribution of the tax burden", in H.J. Aaron and M.J. Boskins (eds.), *The Economics of Taxation*, Washington D.C.: Brookings.

Atkinson, A.B. and Stiglitz, J.E. (1980), *Lectures on Public Economics*, McGraw-Hill International Editions, New York.

Cnossen, S. (2005), *Theory and Practice of Excise Taxation*, Oxford: Oxford University Press.

Cragg, M. (1991), "Do we care? A study of Canada's indirect tax system", *Canadian Journal of Economics*, vol. 24, pp. 124-143.

Creedy, J. (1999), *Modelling Indirect Taxes and Tax Reform*, UK: Edward Elgar.

Dardanoni, V. and Lambert, P. (2001), "Horizontal inequity comparisons", *Social Choice and Welfare*, vol. 18, pp. 799-816.

Davies, E.H. and Kay, J.A. (1985), "Extending the VAT base: problems and possibilities", *Fiscal Studies*, vol. 6, pp. 1-16.

Decoster, A., Schokkaert E. and Van Camp, G. (1997), "Horizontal neutrality and vertical redistribution with indirect taxes", *Research on Economic Inequality*, vol. 7, pp. 219-39.

Dewees, D.N. (1979), 'Estimating the time costs of highway congestion', *Econometrica*, Vol. 47, pp. 1499-1512.

Diamond, P.A. and Mirrlees, J.A. (1971a), "Optimal taxation and public production: Part I - Production efficiency", *American Economic Review*, vol. 61, pp. 8-27.

Diamond, P.A. and Mirrlees, J.A. (1971b), "Optimal taxation and public production: Part II - Tax rules", *American Economic Review*, vol. 61, pp. 261-78.

Ebrahimi, A. and Heady, C. (1988), "Tax design and household composition", *The Economic Journal*, Conference Papers, vol. 98, pp. 83-96.

Evans, W. N. and Farrelly, M. C. (1998), "The compensating behavior of smokers: taxes, tar and nicotine", *RAND Journal of Economics*, vol. 29, pp. 578-95.

Feldstein, M. (1976), "On the theory of tax reform", *Journal of Public Economics*, vol. 6, pp. 77-104.

Frey, B. S. (2005), "Excise taxes, economics, politics and psychology", in (Cnossen, eds.), pp. 230-244.

Harrison, W.J., Pell, C., Jones, P.M. and Ashton, H. (1986), 'Some advances in model design developed for the practical assessment of road pricing in Hong-Kong', *Transportation Research*, Vol. 20A, pp. 135-44.

HMSO (1993), *Paying for Better Motorways*, London, CM 2200.

Hossain, S.M. (1995), "The equity impact of Value-Added Tax in Bangladesh", *IMF Staff Papers*, vol. 42, pp. 411-430.

House of Commons (1995), *Urban Road Pricing*, Third Report of the Transport Committee, Session 1994-95, Cm 104-1, London: HMSO.

House of Commons, (1995), *Urban Road Pricing*, Third Report of the Transport Committee, Session 1994-95, Cm 104-1, London: HMSO.

Iyer, G. S. and Seetharaman, A. (2000), "An evaluation of alternative procedures for measuring horizontal inequity", *Journal of the American Tax Association*, vol. 22, pp. 89-110.

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

─ and Newbery, D.M. (2003a), "Indirect taxation in Greece: Evaluation and Possible Reform", *International Tax and Public Finance*, vol. 10, pp. 511-33.

─ and Newbery, D.M. (2003b), *The Distributional Impact of the Proposed Tax Reform on Greek Households*, Studies 52, Athens: Centre of Planning and Economic Research.

Kaplow, L. (1989), "Horizontal Equity: Measures in Search of a Principle", *National Tax Journal*, vol. 42, pp. 139-54.

Kenkel, D.S. (1993), "Drinking, driving and deterrence: the effectiveness and social cost of alternative policies", *Journal of Law and Economics*, vol. 36, pp. 877-913.

King, M. (1983), "An index of inequality: with applications to horizontal equity and social mobility", *Econometrica*, vol. 51, pp. 99-115.

Labeaga, J.M. and Lopez, A. (1994), "Estimation of the welfare effect of indirect tax changes on Spanish households: an analysis of the 1992 VAT reform", *Investigaciones Economicas*, vol. 18, pp. 289-311.

Lambert, P. J. (1995), "On the measurement of horizontal inequity", IMF, Working Paper No. WP/95/135, Washington D.C.: International Monetary Fund.

─ and Ramos, X. (1995), "Vertical redistribution and horizontal inequity", IFS Working Paper Series No. W95/1, London: Institute for Fiscal Studies.

─ and Ramos, X. (1997), "Horizontal inequity and vertical redistribution." *International Tax and Public Finance*, vol. 4, pp. 25-37.

Madden, D. (1995), "Labour supply, commodity demand and marginal tax reform", *Economic Journal*, vol. 105, pp. 485-97.

Maynard, A., Godfrey, C. and Hardman, G. (1994), "Conceptual issues in estimating the social costs of alcohol", prepared for an international symposium on the economic costs of substance abuse, Banff, Canada, 11-13 May. Available at http://www.ccsa.ca/Costs/maynard.htm

Musgrave, R. A. (1990), "Horizontal equity, once more", *National Tax Journal*, vol. 43, pp. 113-22.

National Statistical Service of Greece (2001), *Household Expenditure Survey 1998/99*, Athens: NSSG.

Nelson, J.A. (1993), "Household equivalence scales: theory versus policy", *Journal of Labour Economics*, vol 11, pp 471-493.

Newbery, D. M. (1988), 'Charging for roads', *Research Observer*, Vol. 3, pp. 119-38.

— (1996), 'Pricing and congestion: economic principles relevant to pricing roads', in T. Jenkinson (eds), *Readings in Microeconomics*, UK: Oxford University Press.

— (2005) 'Road User and Congestion Charges' in S. Cnossen (ed.) *Theory and Practice of Excise Taxation: Smoking, Drinking, Gambling, Pollution, and Driving axes on Pleasure,* Oxford University Press.

— and Santos, G. (1999), 'Road taxes, road user charges and earmarking', *Fiscal Studies*, Vol. 20, pp. 103-32.

Pfähler, W. (1990), "Redistributive effect of income taxation: decomposing tax base and tax rate effects", *Bulletin of Economic Research* vol. 42, pp. 121-9.

Plotnick, R. (1981), "A measure of horizontal inequity", *Review of Economics and Statistics*, vol. 63, pp. 283-8.

Pollak, R.A. and Wales, T.J. (1979), "Welfare comparisons and equivalence scales", *American Economic Review*, vol. 69, pp 216-221.

Ramsey, F. P. (1927), "A contribution to the theory of taxation", *The Economic Journal*, vol. 37, pp. 47-61.

Rosen, H. S. (1978), "An approach to the study of income, utility and horizontal equity", *Quarterly Journal of Economics*, vol. 92, pp. 307-22.

Ruhm, C. J. (1996), "Alcohol policies and highway vehicle fatalities", *Journal of Health* Economics, vol. 15, pp. 435-54.

Shorrocks, A. F. (1980), "The class of additively decomposable inequality measures", *Econometrica*, vol. 48, pp. 613-25.

Shoven, J. B., Sundberg, J. O. and Bunker, J. P. (1989), "The social security cost of smoking", in D.A. Wise (eds.), *The Economics of Aging*, Chicago, IL: University of Chicago Press.

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.

Stern, N. (1990), "Uniformity versus selectivity in indirect taxation", *Economics and Politics*, vol. 2, pp. 83-108.

Tax Reform Committee (2002), "Report on Reforming the Greek Tax System: a Scientific Proposal", Athens.

Theil, H. (1967), *Economics and Information Theory*, Amsterdam: North Holland.

Van de Ven, J., Creedy, J. and Lambert, P.J. (1998), "The redistributive effect of taxes revisited", University of Melbourne Department of Economics Research Paper, no. 657.

Wagstaff, A., Van Doorslaer, E. Van der Burg, H., Calonge, S., Christiansen, T., Citoni, G., Gerdtham, U., Gerfin, M., Gross, L., Häkinnen, U., John, J., Johnson, P., Klavus, J., Lachaud, C., Lauridsen, J., Leu, R.E., Nolan, B., Peran, E., Propper, C., Puffer, F., Rochaix, L., Rodríguez, M., Schellhorn, M., Sundberg, G. and Winkelhake, O., (1999), "Redistributive effect, progressivity and differentiatial tax treatment: personal income taxes in twelve OECD countries", *Journal of Public Economics*, vol. 72, pp. 73-98.

Walters, A.A. (1968), *The Economics and Road User Charges*, Baltimore, Md: Johns Hopkins University Press.