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ECONOMIA REGIONAL

Document de treball 2004/4:

Income Taxation and Equity

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INCOME TAXATION AND EQUITY[a]

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ABSTRACT: This paper exposes and explains the various ways in which value judgements can be instilled into an income tax system, or, if inherent in a pre-existing one, can be drawn out and understood. A putative EU-wide income tax, additional to the national income taxes of the Member States, is analysed. When the identification of equals is done using an appropriate 'equivalent income function', and the equal treatment command modelled in terms of it, the resultant tax will in general be differentiated between countries. A supplementary command, "equal progression among equals", can be achieved if equals are defined as those at the same percentile point in the within-country distributions, and if these distributions differ in logarithms only by location and scale. Differentiated proportional taxes could even be equitable, the flat rate being higher in less unequal countries. The value judgements implicit in a given tax system can be exposed in terms of an equivalence scale which is in general "base dependent".

RESUMEN: Este trabajo expone y explica las diversas formas en que los juicios de valor pueden ser incorporados en un sistema de imposición personal sobre la renta o, en el caso de que sean inherentes al sistema fiscal pre-existente, puedan ser derivados y entendidos. Se analiza a través de un impuesto putativo sobre la renta para toda la UE, adicional a los de cada Estado miembro. Cuando los iguales se identifican a través de una "función de renta equivalente" apropiada, y su tratamiento se impone en esos términos, en general, el impuesto debe ser diferente entre países. Un requisito adicional, "igual progresividad entre iguales", puede ser alcanzado si los iguales se definen como aquéllos que se hallan en el mismo percentil de renta de la distribución dentro de cada país, y si estas distribuciones difieren en logaritmos sólo en localización y escala. Impuestos proporcionales diferenciados podrían incluso ser equitativos, siendo el tipo lineal mayor en los países en que la distribución de renta sea más igualitaria. Los juicios de valor implícitos en un sistema fiscal pueden ser expuestos en términos de una escala de equivalencia que, en general, es "dependiente de la base".

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1. Introduction

As the unique tax instrument through which the government approaches its citizens directly, the income tax is particularly subject to criteria of equity. Classical horizontal equity (**HE**) and vertical equity (**VE**), two basic commands of social justice, state respectively that equals should be treated equally, and unequals appropriately unequally. **HE** can be seen as a minimal rule of fairness, offering protection against arbitrary discrimination and reflecting the basic principle of equal worth. **VE** requires differentiation among unequals, and its degree is a matter of societal taste and political debate. See Musgrave (1990) and Steuerle (1999) for thoughtful discussion. In this paper, we outline the conceptual and measurement issues involved in characterizing the horizontal and vertical stance of an income tax or tax and benefit system, and sketch some appropriate measurement procedures. We also discuss the issue of *de novo* tax design from an equity perspective, taking as a case in point a putative EU-wide income tax, formed as an additional layer of tax rather than through harmonization of Member States' existing direct tax systems.

In thus exposing the equity (or, indeed, inequity) characteristics of an existing tax, alongside the principles which should govern the introduction of a new tax, the paper should provide a window into the methodologies economists have developed to analyze the value judgements governing the direct taxation of a country's citizens.

As simplistically described above, it might seem that **HE** *is an absolute,* and **VE**, being a matter of societal taste, *requires a value judgement*. Yet it is not this simple. Much recent analysis of the tax system's horizontal stance is designed to expose horizontal *in*equity (**HI**), for example by quantifying the extent to which a personal income tax fails to be equitable as a family tax. This assumes that the tax designers were incapable of achieving the **HE** ideal. Household equivalence scales are typically invoked to identify the equals (and unequals), a value judgement which becomes centrally important for the analysis. (And not the only one; what ought "equal treatment" to mean?). Analysis of the **HE** stance of the tax system is, in almost all current literature, *essentially normative*. As for the vertical stance, distributional analysts tend to assume that the social decision-maker has selected, and enacted, a desired degree of progressivity, manifest in the tax system's impact on inequality; if this belief is

followed, the characterization of a tax system's **VE** becomes *an exercise in positive economics*.[1]

The structure of the paper is as follows. In Section 2, we explain briefly the concepts underlying vertical and horizontal equity. This involves discussion of *progressivity* and *redistributive effect*, the definition of *equals* and the meaning of *equal tax treatment*. We begin Section 3, on evaluating existing tax systems, by outlining the dominating strand of literature of the 1990s, according to which **HE** violations are captured by indices as loss of redistributive effect (vertical performance) in a measurement system that attributes to the policymaker the same degree of aversion to both horizontal and vertical inequality. We go on to describe a recent development in **HI** measurement which obviates this restriction.

In Section 4, we discuss some of the issues that would face the designer of a new income tax, taking as a "vehicle" for this analysis a putative EU-wide income tax, additional to the national income taxes of the Member States, whose revenue would go directly to the centre. The question of an EU-wide social welfare function (henceforth SWF) arises, in which a person's domicile may or may not be a relevant factor. By drawing on recent work in the regional context, we observe that if a common income tax were devised, applicable in all countries, then however equitable, the **VE** of the entire system (in fact, overall inequality and welfare) can be unambiguously improved by allowing an element of differentiation in this tax, potentially admitting **HI**.

In Section 5, we explicitly allow for differences in the taxable capacities of persons or households in the Member States, and discuss the design issues this raises. A recently developed equity command, equal progression among equals, which could be said to mix vertical and horizontal aspects, may be achievable alongside **HE** and **VE**, and is so if the equals in different countries are defined as those at the same given percentile point in their within-country distributions, and if these distributions differ in logarithms only

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[1] A third equity criterion, that of "no reranking" (**NR**), has coexisted with **HE** and **VE** in the measurement literature for almost 25 years, and is variously seen as an alternative to **HE** or a supplement to **VE**. According to this line of analysis, inequity is conceptualized as lack of perfect association between pre-tax and post-tax living standards and "addresses the fairness of a *process* of redistribution" (Plotnick, 1981, p. 283). The classical view is that **HE** "enters as an end-state principle" (Musgrave, 1990, p. 120). We shall not dwell upon **NR** much in this paper; see Lambert and Yitzhaki (1994) and Dardanoni and Lambert (2001) for further discussion. For discussion of equity issues surrounding indirect taxes, which are not dealt with here, see for example Loomis and Revier (1988) and Decoster *et al.* (1997).

by location and scale (as would be the case for lognormality). In such a scenario, we show, differentiated proportional taxes would be equitable, with the flat rate being higher in less unequal countries.

Finally, in Section 6, we discuss the detection of the value judgements that might underlie such a future EU-wide tax, were it to have been imposed by the politicians without the advice of the economists. New work is explained which can draw out of the tax itself the implied value judgements of the decision makers about equals, through a base-dependent equivalence scale, turning horizontal tax analysis into a positive exercise, much as vertical analysis now is. Section 7 concludes with an assessment of what has been achieved in the paper, namely, an exposition and explanation of the various ways in which value judgements can be instilled into an income tax system, or, if inherent in a pre-existing one, can be understood.

2.   Vertical and horizontal equity

The simplest model of an income tax schedule is one in which the tax liability on an income of x is a pure function of that income; let us write it $t(x)$. We might assume that $t(x)$ is differentiable (almost everywhere), that $0 \le t(x) \le x$ and $0 \le t'(x) \le 1$ for all x, and, for progression, that $t(x)/x$ is increasing (i.e. $t'(x) > t(x)/x$). If net incomes $n(x) = x - t(x)$ are plotted against gross incomes x, the relationship is typically upward sloping and concave, showing clearly that relative income differentials get compressed in the transition from gross to net income (see Figure 1). As this figure also shows, negative income taxes, i.e. cash benefits, can be incorporated into the model simply by dropping the assumption that $0 \le t(x)$. Then the graph cuts the 45º line at the break-even point between cash benefits and taxes. Letting g be the fraction of all income taken in tax, or 'total tax ratio', $g = \Sigma t(x)/ \Sigma x$, the distributive effect of the actual tax can be compared with that of an equal-yield proportional tax (hence at rate g) on all income units: clearly the rich pay more, and the poor pay less, under the actual (progressive) schedule. It is as if, first, a flat tax at rate g were imposed, with no exemption, and then rich-to-poor transfers undertaken. The redistributive effect (RE) of such an income tax schedule is measured by its inequality effect relative to that of the flat tax (which is, of course,

neutral in inequality terms):

(1) $\qquad RE = I_N - I_{X[1-g]} = I_N - I_X$

where I is an index of relative inequality and the subscript indicates the distribution of income concerned (N for net incomes n(x), X for gross incomes x, etc).
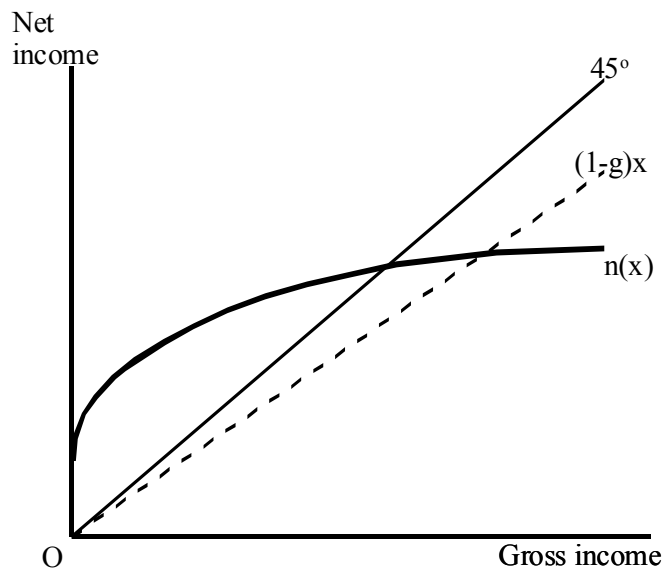

Figure 1: Tax and benefit schedule

This model stood throughout the late 1970s and 1980s, following the seminal articles of Fellman (1976), Jakobsson (1976) and Kakwani (1977a,b).[2] The model is good if the population in question is homogeneous in all attributes but income, but plainly inadequate if we wish to take account of non-income attributes which differ between income units in the tax code. This is very common. For example, deductions and exemptions may be awarded for charitable giving, medical expenditures, mortgage interest (Johnson and Mayer, 1962), life insurance premia, work expenses, childcare costs, etc. Differences in income tax treatment on non-income grounds may also arise through different sources and disposition of income (Gravelle, 1992), tax evasion and

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[2] But see Eichhorn *et al.* (1984) for a relaxation of some of the assumptions.

non-compliance (Bishop *et al.*, 1994), and the different treatment of urban and rural incomes especially in developing countries. In such cases, we need to model the income tax code as a multi-attribute one.

The question arises, whether the tax deductions (etc) are equitable, and this is usually taken to mean *horizontally equitable*: do pre-tax equals get equal tax treatment? Towards the end of the paper, we shall see how to impute a concept of equal treatment to the tax designer, which is such that an automatic response of "yes" can be given in answer to this question. More typically, we might want to know if a given multi-attribute income tax can be judged equitable in its treatment of families of different compositions and needs. The **HE** ideal, or aspiration, typically refers to individuals. To extend it to families, equivalence scales are usually invoked.

The first step is to turn the business of identifying the equals - and the unequals, for that matter - into a unidimensional problem.[3] We shall require income units' pre-tax incomes, or living standards, call these x, to be measured on a scale which identifies the equals: *equals will be those having the same pre-tax income x.* Manser (1979) discusses the modelling of household objectives including different leisure times of their members, and Rosen (1978) demonstrates an empirical procedure which, given rich enough microdata, will "generate two vectors, one of family utilities before tax and one of family utilities after tax", and he goes on to say that "the real problem in measuring horizontal equity is to summarize the differences between these vectors in a meaningful way" (p. 314). Gravelle (1992) quotes Steuerle (1983) as advocating an equivalization procedure to provide "a working definition of equity" across family sizes. As we shall see, a generalized notion of equivalence scale is called for in order to explain some features of the typical income tax system, and to articulate new equity criteria.

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[3] Many public economists would dispute the unidimensional form to which the **HE** problem is reduced by recourse to a living standards criterion. Why, for example, should the tax treatment of a person whose income derives from his chosen holding of government bonds, with tax-privileged yield, be the same as that of another person whose living standard is derived from earnings or profits? This kind of objection suggests extending the dimensionality of the problem, possibly *ad infinitum*. If we would give full credence to questions of the form "Can we ever find true equals?", we would be led simply to inspect the tax code for society's chosen form of tax treatment, and its inferred definition of equals; this would all but throw the baby away with the bath water, turning the **HI** question simply into one of tracking down assessment and payment errors.
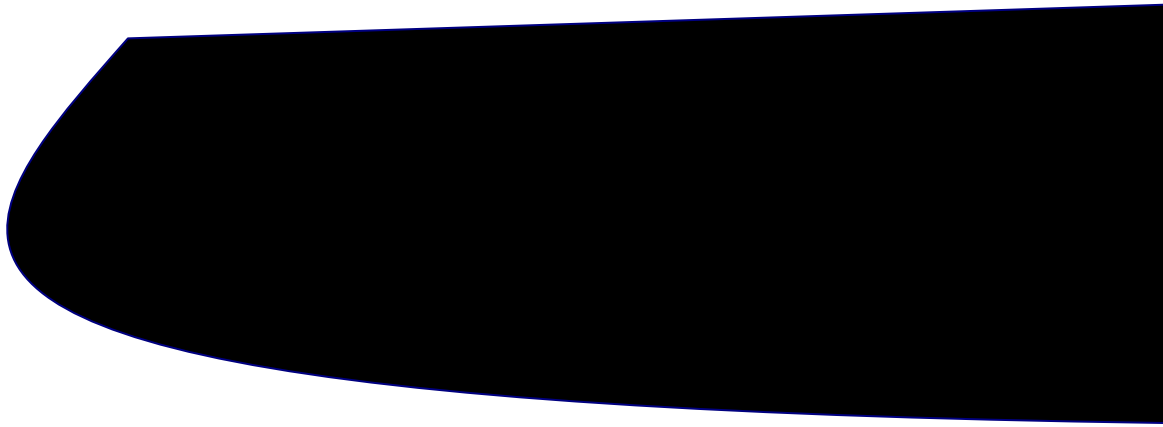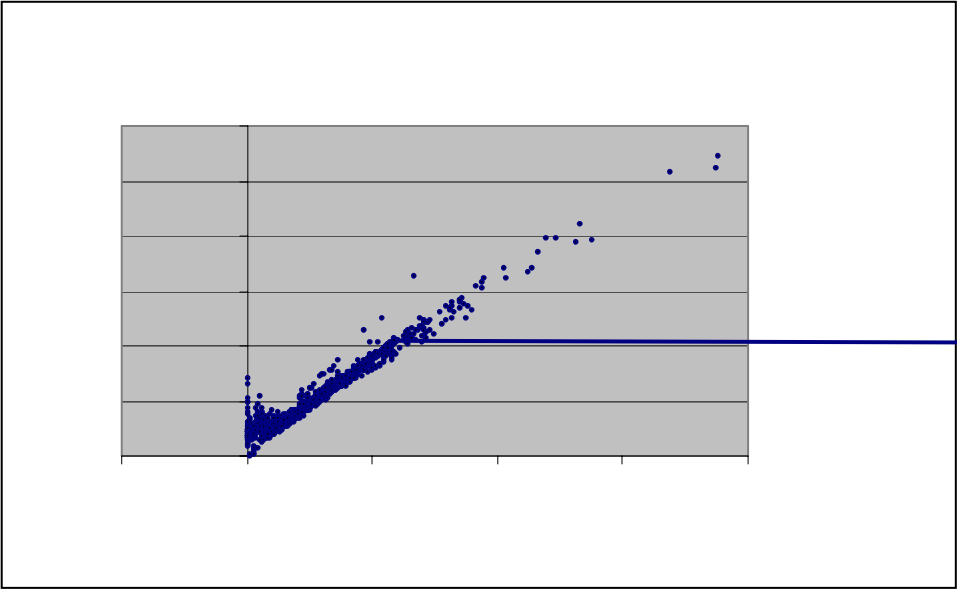
If the first problem is how to define the equals, the second, which follows hard upon it, is, what do we mean by "equal treatment"? A widely accepted equal treatment command is, *equal post-tax living standards for pre-tax equals*; other commands, equal average tax rates and equal taxes among equals respectively, can be interpreted as variants on this (see Lambert, 2003).

The income unit may be the individual, the family, the household or that virtual person known as the 'equivalent adult', advocated for welfare analysis when using equivalent income distributions by Ebert (1997).[4]

One equivalence scale which is popular with distributional analysts is the doubly-parametric scale of Cutler and Katz (1992), in which household money income is deflated by a factor $m = (N_A + \theta N_C)^{\Phi}$, in which N_A and N_C are the numbers of adults and children in the household respectively, $\theta \in [0,1]$ measures the relative importance of children and $\phi \in [0,1]$ represents economies of scale. Figure 2 shows the relationship between gross equivalent income and net equivalent income for the UK tax and benefit system for 1993 when $\theta = \phi = \frac{1}{2}$. As is apparent, there are plenty of instances of **HI** here: vertically aligned data points represent families with the same pre-tax living standard but differing post-tax living standards.[5]

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[4] Suppose that z(n) is the equivalence scale value to be used to deflate the money income x of a family of size n. Ebert shows that if z(n) virtual persons are each allotted an equivalent income or living standard of x/z(n), then - *and only then* - will small money transfers from higher to lower living standard families necessarily be overall welfare-improving. Empirically, it is a matter of using the equivalence scale deflators as sample weights.

[5] There are also plenty of instances of reranking (recall footnote 1).

Lambert and Ramos (1997) and Duclos and Lambert (2000) each provide a decomposition of redistributive effect into orthogonal vertical and horizontal components:

(2)   RE = V- H

in which V measures the inequality-reducing impact of the tax system on average, and H a loss due to the 'new' inequality introduced by the presence of **HI**.[6, 7]

All three of the studies just cited could be said to "impose **HI** from the outside" since they use the Cutler and Katz (1992) equivalence scale for selected parameter values. A more defensible procedure would be to search for the **HI**-minimizing choice of equivalence scale parameters for each regime, *before* undertaking any comparisons: this could both reveal the equivalence scales most nearly implicit in the tax systems under examination, and enable comparisons of residual **HI** given those scales. This kind of analysis has not been seen yet (but see Aronson *et al*. 1994, and van de Ven *et al.* 2001 for steps in this direction).

Finally, we mention a very recent **HI** contribution, that of Auerbach and Hassett (2002), which offers new scope for understanding a tax system's horizontal and vertical equity characteristics. The authors' point of departure from the mainstream of the 1990s, as already described, is to institute a measurement system in which the SWF "need not evaluate 'global' (vertical equity) differences in after-tax income using the same weights

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[6] In each paper, this loss is measured locally as inequality of post-tax income among pre-tax equals, and aggregated into a global index using a weighting scheme. In the first, which uses the Gini coefficient, the "- H" term is augmented by a measure of reranking. See also Aronson and Lambert (1994) on this. Musgrave (1990) suggested the business of devising a local **HI** measure and then aggregating. The "identification problem" had beset many earlier studies of **HI**. If a sample contains few or no exact equals, how can we make it tell us anything about **HI**? One solution is to band people pre-tax, into 'close equals groups', and to measure inequality effects between and within these groups (see van der Ven *et al.*, 2001 for more on this in respect of the Gini approach). The other solution is to use a kernel procedure to estimate non-parametrically and consistently the continuous population distributions of pre- and post-tax living standards from the sample joint distribution, and thence the indices V and -H (see Duclos and Lambert, 2000).

[7] In order to track the changing vertical and horizontal characteristics of a tax system through time, concomitant with an ever-changing income distribution, point measures of vertical and horizontal performance *at each percentile in the pre-tax distribution* have been developed, in Hayes *et al* (1994) and Duclos and Lambert (2000) respectively. Given suitable data over a run of years, it is possible to produce 2-dimensional contour plots of the levels of progression and local horizontal inequity, at each (date,percentile) coordinate pair.

as it applies to 'local' (horizontal equity) differences". It is the very sameness of these weights, in the studies already cited, which leads to the commensurate vertical and horizontal components V and -H of redistributive effect. Auerbach and Hassett allow that a social decision-maker could have a different aversion to *inequality between unequals* from his aversion to *inequality introduced by the tax system among equals.*[8] With the measures these authors present, a search for the **HI**-minimizing values of the two respective inequality aversion parameters could reveal the horizontal and vertical stance most nearly implicit in the tax system.

4. A putative EU-wide income tax: VE and HE

Suppose, for the sake of argument, that a new layer of income tax were to be introduced in the EU, with the proceeds going directly to the center. What would be the issues facing the designer of such a tax? What would be the appropriate base for it? Should the tax be proportional, or one embodying the progressive principle? One can imagine the new tax being levied at a flat rate on all disposable incomes, in order not to interfere with relative income differentials within countries. It is a small leap from there to suppose that a concessionary rate for the poorest countries might be instituted, and another small leap to a plethora of flat rates, negotiated country-by-country by the politicians. (Note, though, that an EU-wide income tax has *not* been advised by economists, see *e.g.* Cnossen 2002, pp. 76-76 on this; however the spectre of such a development has been mentioned from time to time in the popular press, in the UK at least).[9] In this section of the paper, we make some pertinent observations, before proceeding, in the next section, to develop formally an equity criterion taking into account, through an EU-wide SWF, the possibly differing taxable capacities of persons or households in the various Member States.

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[8] This construction clearly meets a view expressed by Steuerle (1999): "Many people strongly support horizontal equity even though they reject the notion that government must adjust the position of any individual along any particular scale (for example, they may oppose redistribution). I do not think they are inconsistent in holding these two positions".

[9] To whit, consider the headline ""Now Britain faces single European tax system: France and Germany spearhead plan to control revenue and social security" in *The Independent* newspaper of 16th January 1997.

A theoretical construction of Cubel and Lambert (2002a,b) points the way. Even in the absence of country-specific dimensions in the EU-wide SWF, it can be welfare improving, and inequality reducing in the strongest sense (of Lorenz dominance), to impose country-specific income taxes rather than a common one across all countries. Specifically, these papers demonstrate that if two (or more) regions in a federation have very different levels of well-being then, whatever common new tax layer t(x) one might envisage, where x is a person or household's disposable income regardless of domicile, be it proportional or progressive, **VE** can be enhanced by rewriting the tax code to include an appropriate differentiation. Let n(x) = x - t(x) be a person or household's net disposable income after application of the EU-wide tax t(x). Let A and B be regions (groups of countries, for example) such that people in A are "generally poorer" than people in B (there is a precise technical condition for this which can be found in either paper; it permits significant overlap between the distributions). A welfare improvement and inequality reduction obtains if, instead of t(x) being imposed, a differentiated tax were instituted such that net incomes became $(1+\theta)n(x)$ for a person with income x living in A, and $(1-\lambda)n(x)$ for a person living in B, where θ and λ are small, and such that total revenue is maintained.[10]

But of course this recipe introduces **HI**: people with a given income (living standard) x who live in A will pay less tax than people with x who happen to live in B. It may seem strange that the introduction of **HI** could improve matters, for the conventional wisdom says the opposite: whenever disparity is introduced, where there was equality before, welfare is reduced (Atkinson, 1970). In the tax context, Kakwani and Lambert (1999, p. 28) put their finger(s) on it: "Discrimination can be interpreted as the loss of vertical equity attributable to group specificity of schedules in the tax code. If the code were to be replaced by the averaged schedule, there would be a welfare increase". There appears to be a conundrum here. Starting with a common schedule t(x), differentiation reduces inequality and raises welfare; but then averaging liabilities across the differentiated regions would also do that - and so on, re-differentiating, re-averaging.... welfare improvements *ad infinitum*?

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[10] In the case of proportional taxes, this says that rather than taxing all people in the EU at a common rate flat g, **VE** would be unambiguously enhanced by taxing people in the poorer group of countries at a lower rate g_A, and in the richer group of countries at a higher rate g_B, where $(1+\theta)(1-g) = 1-g_A$, and $(1-\lambda)(1-g) = 1-g_B$.

The conundrum is resolved by noticing that the informational requirements involved in this (continual) re-processing of tax liabilities place a limit on its feasibility. After averaging the differentiated tax, net income for somebody with living standard x would become $(1+\theta)p(x)n(x) + (1-\lambda)(1-p(x))n(x)$, where p(x) is the proportion of income units having living standard x who live in region A. This would bring demographics into the tax code (when $p(x) \neq 0$ or 1), complicating the informational requirement and causing a loss of transparency, surely an important consideration.

Differentiation of an income tax across countries can as well be rationalized if the EU-wide social welfare function contains country-specific dimensions, and in this case obviously need not involve **HI**. For example, the equal sacrifice model, but with a different utility-of-income function in each country, could be invoked to rationalize different taxes.[11] Atkinson and Bourguignon's (1987) utilitarian SWF admits of dimensions other than income. For a population divided into "needs groups" i = 1,2,....n, a different utility-of-income function $U_i(x)$ is attributed to each group, with a hierarchy of needs specified by a systematic ordering of marginal utilities $U_i'(x)$, i = 1,2,....n, at each fixed income level x. This model could perhaps be adapted to the equal sacrifice framework, but such an extension has not yet been made. In fact, it is not clear that such a model would be appropriate in the EU context. As between an income unit in Germany having $60,000 p.a. and an income unit in Latvia also having $60,000 p.a., which is socially the more deserving of an additional dollar? Arguably the one in Germany suffers more relative deprivation than the one in Latvia, being further down its country-specific distribution of living standards (Runciman, 1976); but would this merit a more lenient income tax in Germany? Does not one's intuition go the other way? There is an intricate issue here for income tax design, to which we now turn.

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[11] According to equal (absolute) sacrifice theory, if U(x) is the utility-of-income function, the income tax t(x) should be designed to satisfy $U(x) - U(x-t(x)) \equiv u_o$ $\forall x$. Samuelson (1947) showed that if -xU''(x)/U'(x) > 1 $\forall x$ > 0 then such a t(x) is progressive. Ok (1995) demonstrated a reverse result, that if an income tax schedule t(x) satisfies t'(x) > 0 and t''(x) > 0 $\forall x$, then there exists a U(x) with respect to which t(x) is equal sacrifice. See also Mitra and Ok (1996,1997) and D'Antoni (1999). Musgrave and Musgrave (1984) point to a perceived problem with equal sacrifice taxes, that they provide no link between tax payments and the benefits received by income units from the proceeds: "This approach leaves the expenditure side of the public sector dangling" (*ibid.*, p. 228).

5. Designing a differentiated income tax: equity issues

For simplicity at this point, let us confine attention to a population divided into *two* mutually exclusive and socially homogeneous subgroups, A and B say, and let us assume that group membership enters into the SWF as well as income level. Then we may adapt the equivalizing concept, and posit an *equivalent income function*, which can be used to identify the equals across groups in terms of their living standards. For group A, we could suppose that living standard is expressed by money income, and then let S: $\mathbb{R}^+ \to \mathbb{R}^+$ be the function which expresses the living standard of an income unit belonging to group B with income x. For n > 2 groups, n-1 such functions would be needed. The equivalent income function has been proposed in this more general setting by Donaldson and Pendakur (1999), and examined in detail in Ebert (2000). The most obvious context for all of this is when A an B denote different household characteristics, e.g. A comprising singles and B couples. We shall use this example to interpret some of the results which follow, but the setting is general enough for A and B to be two (groups of) countries. The function S(x) need only be continuous and strictly increasing.

Thus a member of group A with income x_A and a member of group B with income x_B are equals if and only if $S(x_B) = x_A$. Let the tax schedules for A and B be $t_A(x)$ and $t_B(x)$ respectively, and let $v_A(x) = x - t_A(x)$ and $v_B(x) = x - t_B(x)$ be post-tax income functions. If by equal treatment we mean that those with the same pre-tax living standard should also have the same post-tax living standard, this requires the following property: $S(x_B) = x_A \Rightarrow v_A(x_A) = S(v_B(x_B))$; or, writing x_B as x and substituting,

(3) $S(v_B(x)) = v_A(S(x))$

In words, the living standard after tax of a member of group B (e.g. a couple) having x before tax should be the same as that of a member of A (single) having S(x) before tax.[12]

The equivalent income function for a constant relative equivalence scale is of the form S(x) = x/m where *m* is the deflator for the money incomes in B. This is the familiar

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[12] If, on the other hand, 'equal treatment' would mean that pre-tax equals should experience equal average tax rates, the criterion would be $t_A(S(x))/ S(x) = t_B(x)/ x$. If equal treatment is taken to mean equal tax payments, then $t_A(S(x)) = t_B(x)$ is the criterion. For more on these two, see Lambert (2003).

scenario for equivalizing household incomes. In a regional context, m could be a price deflator rendering region B money incomes into real terms as measured in A; then equals are those with the same real incomes (but see on for other possible definitions of equals in this context). Substituting in (3), the horizontally equitable tax for B, given a schedule $t_A(x)$ for A, must satisfy:

(4) $v_B(x) = m.v_A(x/m)$

In the context of families, this is precisely the *quotient familial* tax system, as used in France and Luxembourg and already anticipated by Vickrey (1947, pp. 295-6): "A more thoroughgoing and equitable procedure [than exemptions and credits] would be to set up some factor indicative of the needs of the entire family, divide the total income by this factor, compute a per capita tax on this 'per capita income', and multiply the tax so computed by the family size factor to obtain the total tax for the family". In the regional context, with m as the price deflator, it simply says that people in B should be taxed as they would be in A on the real value of their incomes.

The equivalent income function for a constant absolute equivalence scale is of the form $S(x) = x-a$, where $a > 0$ is a constant. Members of B (couples) need a fixed addition a to their income to be judged equal to members of A (singles) at the same income level. Substituting in (3), the horizontally equitable tax for B satisfies

(5) $v_B(x) = v_A(x-a) + a$

In the singles/couples context, the constant a is a married couple's exemption or allowance: couples should receive the first a of their income tax-free and pay tax at the same rate as singles on the balance $x-a$ (assuming $x > a$).

In the family context, if an income tax system is *not* of one of these two very straightforward types, then it cannot be rationalized in terms of a constant relative or absolute equivalence scale using the equal treatment command in (3). Insofar as the British, Spanish and Canadian direct tax systems are not of this type - and they certainly are not - the analyses of Aronson *et al*. (1994), Lambert and Ramos (1997) and Duclos and Lambert (2000) of **HI** in the UK, Spanish and Canadian direct tax systems, which are undertaken using constant relative equivalence scales, are indeed vulnerable to the

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accusation of "imposing **HI** from the outside".

In order to design an equitable EU-wide additional layer of tax, an equivalent income function S: $\mathbb{R}^+ \rightarrow \mathbb{R}^+$ (or set of equivalent income functions S_i: $\mathbb{R}^+ \rightarrow \mathbb{R}^+$, $2 \leq i \leq n$) would first be needed, to relate living standards in countries in group B at a given taxable income level with those in group A (or to relate living standards in countries 2,3.... n with those in country 1, in the case of fully differentiated taxes). Then, setting $t_A(x)$ as the "reference" schedule which can embody any chosen degree of **VE,** $t_B(x)$ would have to be designed to satisfy (3) (or, $t_i(x)$ $2 \leq i \leq n$ would have to be designed to satisfy (3) with respect to $t_1(x)$) for full-blown equity. This kind of analysis has not been undertaken as yet, even in the family context,[13] but a recent finding of Ebert and Lambert (2002) provides a potentially interesting way forward.

Suppose that the equivalent income function can be argued to take the isoelastic form, $S(x) = (x/b)^a$ where a > 0 and b > 0 are constants. Ebert and Lambert (2002) examine the consequences for the degree of progression faced by equals in this scenario. When the tax system $\{t_A(x), t_B(x)\}$ is constructed to obey (3) and S(x) is isoelastic, members of group A with a given pre-tax living standard face the same degree of progression as members of group B with that same pre-tax living standard. Thus an extended concept of equity, *equal progression among equals*, is attainable in this case (and in fact, in only the isoelastic case).[14]

Putting $S(x) = (x/b)^a$ into (3), and taking $t_A(x)$ as given, a formula for $t_B(x)$ results which is in general complicated, but in the special case in which $t_A(x)$ is proportional, $t_A(x) = g_A x$ say, we find from (3) that for equity, $t_B(x)$ should also be proportional:

(6) $t_B(x) = g_B x$ where $g_B = 1 - (1 - g_A)^{1/a}$

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[13] In that context, if the Atkinson and Bourguignon (1987) SWF were adopted along with the equal sacrifice model, then the type-specific utility functions $U_A(x)$ and $U_B(x)$ would define the equivalent income function S through the property $U_B(x_B) = U_A(S(x_B))$; that is, $S = U_A^{-1} \circ U_B$.

[14] See *op cit*. for further details, and also Dardanoni and Lambert (2002). The progression measure is residual progression, defined for a schedule t(x) as the elasticity of post-tax income v(x) = x - t(x) with respect to pretax income, i.e. as $xv'(x)/v(x)$. In the family context, the isoelastic form been recommended by Donaldson and Pendakur (1999) on positive grounds, as one which provides less restrictive household demand functions than any constant equivalence scale m (*viz*. than S(x) = x/m for any m > 0), and can be uniquely estimated from demand data.

In contradistinction to the result discussed in the previous section of the paper, we see from this that an EU-wide layer of differentiated proportional taxes could be supported as fully equitable if $a \neq 1$.[15]

An intriguing possibility arises if we suppose that the country-specific income distributions are all lognormal, or indeed, belong to any family of distributions which in logarithms is location and scale invariant.[16] In precisely this case, an isoelastic function $x_B = S(x_A)$ exists which matches the incomes in A and B position by position. If in this case we would assert that, in the different EU countries, *the equals are those at the same percentile point,*[17] then (3) can be used to specify an EU-wide layer of additional income tax which both assures "equal treatment by percentile" in the classical sense and also "equal progression by percentile". Proportional EU taxes (which, as we have said, have the advantage of not interfering with relative income differentials within countries) would have to be differentiated to the extent that inequality differed between countries; the rate would be higher in less unequal countries, and lower in more unequal countries.[18]

6. Understanding a differentiated income tax

It is more than likely that any eventual EU-wide layer of direct tax will be the outcome of negotiations by the politicians, each seeking to build in concessions for the country he or she represents. If such a tax package emerges, how may we infer its equity characteristic? In formal terms, the problem is this. Suppose that we the economists are presented, *fait accompli*, with differentiated schedules $\{t_A(x), t_B(x)\}$ for countries

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[15] It is clear from (6) that $g_B > g_A$ if $a < 1$ and $g_B < g_A$ if $a > 1$. The case $a = 1$ in the family context would be that of a constant relative equivalence scale. In this case, if the singles are taxed proportionally, then for equity so should the couples be, and at the same rate. That is, a common proportional tax on the living standards of all households is equitable.

[16] Other examples include the Pareto and Singh-Maddala distributions.

[17] Clearly this would argue for the different tax treatment of an income unit in Germany having $60,000 p.a. and an income unit in Latvia also having $60,000 p.a., a question we posed earlier.

[18] If $ln\ x_A \sim N(\mu_A, \sigma_A^2)$ and $ln\ x_B \sim N(\mu_B, \sigma_B^2)$ then $S(x) = (x/b)^a$ matches incomes position by position for $a = \sigma_B/\sigma_A$ and $b = exp\ (\mu_A - a.\mu_B)$. If the Lorenz curves for A and B differ (so that $\sigma_B \neq \sigma_A$, *i.e.* $a \neq 1$), and if $t_A(x)$ is proportional, then (as already noted) for "equity by percentile" $t_B(x)$ would be proportional too, but with a different rate. As observed in footnote 17, $g_B > g_A$ if $\sigma_B < \sigma_A$ and *vice versa.*

classified into two groups A and B (or more generally with a bundle $\{t_i(x) : 1 \leq i \leq n\}$ of schedules, one for each country). Can we find an equivalent income function S(x) (or bundle of n-1 such functions $\{S_i(x) : 2 \leq i \leq n\}$) such that (3) holds between the net income functions $v_A(x)$ and $v_B(x)$ (or the analogue of (3) between $v_1(x)$ and each $v_i(x)$, $2 \leq i \leq n$)? If so, we can judge the package to be equitable, and explain to the public through an examination of S(x) the value judgement about equals across EU countries that is implicit. If not, the EU-wide tax must be judged inequitable by the standard of our equal treatment command (3).

In general, given $\{t_A(x), t_B(x)\}$, no such function S(x) exists. A particular result of Lambert and Yitzhaki (1997) deomonstrates this: in the family context, there exists *no* equivalent income function S(x) compatible with the equal treatment criterion (3) for a tax system which corrects for differences in need by means of a tax credit.[19]

Of course, we can recognize the equity characteristic of a tax system $\{t_A(x), t_B(x)\}$ satisfying (4), (5) or (6), since we drew these tax systems out of particular functional forms for S(x). We could push things a little further. If S(x) does exist for a tax system $\{t_A(x), t_B(x)\}$, define m(x) and a(x) by $S(x) = x/m(x) = x - a(x)$. That is, regard the equivalizing procedure as generated by an *income-related* relative or absolute equivalence scale.[20] Now apply (3):

(7) $\qquad v_B(x) = m(v_B(x)).v_A(x/m(x)) = v_A(x-a(x)) + a(v_B(x))$

The interpretation of these forms is clearest in the family context. On the left, we have a *quotient familial*-type rule, in which the household is split into m(x) parts, each being taxed separately - but then the taxes are re-combined with a correction, for equity, to allow for the change in the scale value in the transition from pre-tax to post-tax income.

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[19] The point is very simply shown. Let C be the married couple's tax credit and substitute $v_B(x) = v_A(x) + C$ into (3): $S(v_A(x) + C) = v_A(S(x))$. Supposing only that $v_A(x) \leq x \ \forall x$ and that $\exists x_o : v_A(x_o) = x_o$ (*i.e.* that there are no single benefit recipients and there exists at least one income level at which the tax liability for a single is zero), we find from (3) that $S(x_o + C) = v_A(S(x_o))$, i.e. that $v_A(S(x_o)) > S(x_o)$, an immediate contradiction. Lambert and Yitzhaki (1997) reach the same conclusion in a more general model with n > 2 household types.

[20] Income-related equivalence scales have been around in the equity context since at least Seneca and Taussig (1971), who remark that "the most interesting and important issues involving the application of equivalence scales to tax equity questions are intimately bound up with the variation of equivalence scales with the level of income" (ibid, p. 255).

On the right, we have an income-related married couple's deduction: couples receive the first portion a(x) of their income x tax-free, and pay tax at the same rate as singles on the balance x-a(x), but again there is a correction for equity, an extra $a(v_B(x)) - a(x)$ of tax-free income being given to allow for the change in the absolute equivalence scale value in the transition from pre-tax to post-tax income. If the putative EU-wide tax system $\{t_A(x), t_B(x)\}$ took either one of these two forms, it would be equitable for the relevant income-related equivalence scale.

How should we analyze the **VE** and **HI** characteristics of an EU-wide income tax system for which we *cannot* recognize a function S(x) providing the definition of equals? We are left only with normative analysis. If the tax is in operation then, starting with sample data drawn from the joint distribution of pre-tax and post-tax living standards across EU countries, we could impose a constant relative scale (*e.g.* one rendering nominal incomes in B into real values in A's terms), and assess the vertical and horizontal contributions to overall redistributive effect as in (2). This would tell us to what extent the EU-wide tax departs from an idealized tax on citizens' real incomes, and how unequally citizens at different real income values are dealt with on average.

In fact, a model of Ramos and Lambert (2003) may be appropriate here, which extends the **HI** measurement framework of the 1990s by admitting some "deserving attributes" into the idealized tax function, in addition to (real) income. The idea here would be to assess the performance of the EU-wide tax against that of an idealized tax schedule $\tau(e,d)$, where *e* is living standard and *d* denotes domicile (in the EU context; but more generally *d* can be any attribute for which special tax treatment has been sanctioned by the politicians or tax authorities). The measurement system permits the inequity effect of sanctioned tax breaks to be distinguished from the inequity effect of non-sanctioned differences in tax treatment (if any), the former amounting to an authorized loss of **VE**, and the latter to a residual form of classical **HI**. Equation (2) becomes

(8)   RE = [V - D] - J,

in this context, where, as in (2), V is the redistributive effect of the tax on average (in our case, on the real incomes of EU citizens), D denotes the loss of **VE** due to the country-specific factors in the tax system, and J is the loss from non-domicile related

differences in tax treatment apparent in the data (such as assessment and recording errors) at given real income levels.

Such a measurement exercise, intrinsically normative, can be said to "impose **HI** from the outside" since it assumes a definition of equals known *not* to be implicit in the tax system, and measures departures of the tax from such an ideal. In a recent and very exciting development, Muellbauer and van der Ven (2002, 2003) have found a way forward for positive analysis, by varying the definition of equals and the equal treatment command used in this paper to show that: "...tax and benefits systems are *consistent* with the equivalence scale methodology, even if they are not *designed* in *coherence* with it".

Thus far we have defined equals through the equivalent income function $S(x)$, and equal tax treatment by (3). Defining income-related equivalence scales $m(x)$ and $a(x)$ by $S(x) = x/m(x) = x - a(x)$, we demonstrated how the equitable taxes (in (7)) would have to contain "equity corrections" for the variations which take place in the scale value in the transition from pre-tax income x to post-tax income $v_B(x)$. But if we think of $m(x)$ and $a(x)$ as *constant for the couple with gross income x* – defined, for example, in terms of their ability or effort - that is, *base-dependent* rather than income-level-dependent[21] - then a different equal treatment command obtains. Specifically, the command becomes $x_A = x_B/m(x_B) \Rightarrow v_A(x_A) = v_B(x_B)/m(x_B)$ in the relative case and $x_A = x_B - a(x_B) \Rightarrow v_A(x_A) = v_B(x_B) - a(x_B)$ in the absolute case. These lead to a quotient-familial-type tax in the one case, and a tax with an income-related deduction in the other, but in each case no correction is required for equity:

(9) $\qquad v_B(x) = m(x).v_A(x/m(x)) \ \& \ v_B(x) = v_A(x-a(x)) + a(x)$

(compare (7)).

The specifications in (9) cannot be represented by our (3). For members of group B, *the same deflator* $m^* = m(x_B)$ *or subtraction* $a^* = a(x_B)$ *is applied to create equals after tax as was used to identify the equals before tax,* which our (3) does not do. Muellbauer and

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[21] Muellbauer and van der Ven (2002) discuss this form of equivalizing in some detail in an optimal tax scenario, showing how it could arise if the government's objective is to relate needs to ability but cannot due to an unobservability constraint.

van de Ven show that there exists a base-dependent equivalence scale which is implicit in (almost) *any* tax system $\{t_A(x), t_B(x)\}$ - the case of a family tax credit included - and they also provide an algorithm to recover that scale.[22]

The Muellbauer and van der Ven construction thus rationalizes (almost) any tax system as horizontally equitable, finding, by the use of positive analysis, the implied equivalence scale, which is base-dependent in general. According to this approach, **HE** is imposed from the outside, by assuming rationality on the part of the policymaker, and **HI** analysis all but ruled out.[23]

7. Concluding remarks

In this paper, we first explained the value judgements which underlie the concepts of **VE** and **HE**. We then described the measurement system that stood throughout the 1990s for capturing the extent of **HI** in a tax system, and showed that, in essence, invoking this methodology amounts to "imposing **HI** from the outside". A common degree of aversion to both horizontal and vertical inequality is implicit in this methodology, and this is why the horizontal and vertical stances of the tax system are assessed commensurately. A more recent **HI** development, that of Auerbach and Hassett (2002), breaks the link between horizontal and vertical inequality aversion and brings possibilities for deeper analysis.

We went on to discuss some of the issues that would face the designer of a new income tax, taking as a vehicle for this analysis a putative EU-wide income tax, additional to the national income taxes of the Member States. By drawing on recent work in the regional context, we observed that, relative to a common tax on the (real disposable) incomes of

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[22] See Muellbauer and van der Ven (2003, pp. 86-90). As the authors remark, "..continuity, monotonicity and progressivity are sufficient for the equivalence scale function [m(x) or a(x)] to be unique".

[23] A residual term in Muellbauer and van der Ven's econometric estimation procedure provides an upper bound for **HI** in their system. It is interesting to note that the studies cited earlier, which "impose **HI** from the outside", all assume **VE**, and detect it in terms of the stance of the tax "on average between unequals" (following Musgrave, 1990, in fact). In the **NR** strand of the literature, a suggestion of King (1983) is followed, such that the vertical stance of a tax system is given by breaking the disassociation between pre- and post-tax living standards, that is, by independently sorting pre- and post-tax living standards vectors and making a one-to-one mapping. In each case, analysts effectively "impose **VE** from the outside". See Lambert (2001, chapter 10) for more on this.

all EU citizens, **VE** could be enhanced, without necessarily introducing **HI**, by admitting an element of differentiation in this tax. By formally modelling the identification of equals in different countries through an 'equivalent income function', we developed a criterion, in equation (3), for the equal treatment command of **HE**, and discussed the design issues this raised. In particular, we showed that a new command, "equal progression among equals", can be achieved if the equals in different countries are defined as those at the same given percentile point in their within-country distributions, and if these distributions differ in logarithms only by location and scale. Differentiated proportional taxes would be equitable in this scenario, the flat rate being higher in less unequal countries.

Finally, we discussed in greater depth the detection of value judgements in an existing tax system, adducing recent work of Muellbauer and van der Ven (2002, 2003) which allows the analyst to draw out of the tax itself the implied value judgements of the decision makers, in terms of an equivalence scale which is in general "base dependent". We observed that this development turns horizontal tax analysis into a positive exercise, in essence "imposing **HE** from the outside" through the assumption of a rational tax designer.

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