NATIONAL INSTITUTE OF ECONOMIC AND SOCIAL RESEARCH

Discussion Paper No. 444

9th January 2015

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IDENTIFYING TAX IMPLICIT EQUIVALENCE SCALES

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Identifying tax implicit equivalence scales

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Abstract

This paper describes a simple and tractable method for identifying equivalence scales that reflect the value judgements implicit in a tax-benefit system. The approach depends on two identifying assumptions and a functional description for transfer payments that can be estimated using common micro-data. We use this approach to evaluate tax implicit equivalence scales for the UK tax-transfer system that applied in April 2009. The estimated tax implicit scales vary positively with tax unit size and generally decrease with gross earnings, consistent with recent estimates calculated on consumption data. We conclude by discussing potential applications for the proposed tax implicit scales.

Key Words: equivalence scale, taxation, horizontal equity
JEL Classifications: D31, H23, I38

1 Introduction

Equivalence scales are a commonly used metric to summarize differences in the relative needs of heterogeneous tax units. Despite their widespread use, however, there is no consensus about how such scales should be identified. This paper contributes to the existing literature by proposing a simple analytical approach to derive equivalence scales that reflect the value judgements implicit in tax and transfer policy; hereafter referred to as tax implicit (equivalence) scales. The proposed tax implicit scales depend upon qualitatively different assumptions to other scales that are in common use, and can be identified using widely available data sources. The proposed scales consequently provide both a transparent measure of the relative treatment by the tax-transfer system of alternative tax units, and a useful alternative statistic to control for tax unit heterogeneity when conducting distributional analyses.

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Most empirically evaluated equivalence scales are based on consumer demand theory.[1] A notable criticism of this approach, however, is that consumer demand provides a weak basis for the cardinal comparisons that are the focus of equivalence scales. Such criticisms have long been recognised, resulting in claims that "the equivalence scales required for welfare comparisons are logically distinct from those which arise in demand analaysis", Pollak and Wales (1979, p. 216); Muellbauer (1975). The resulting confusion concerning how equivalence scales are most appropriately identified has motivated a popular trend toward the use of scales that take highly stylised forms for distributional analyses. The modified OECD scale, first proposed by Hagenaars et al. (1994), is one such measure.[2] Although such scales are transparent, they provide a restrictive description of the relative needs of heterogeneous tax units, which suggests a need for associated sensitivity analysis. This points to the usefulness of an identification approach for equivalence scales that differs substantively from those applied in the established literature.

Tax implicit equivalence scales are rarely considered in the existing literature. Yet, tax and transfer systems translate a defined set of tax unit characteristics into disposable income. The positive relationship that exists between disposable income and welfare implies that transfer systems reflect a set of value judgements concerning the relative merits of alternative tax units; value judgements that provide a potential basis for identifying an equivalence scale.

A small number of studies have evaluated the equivalence scales implicit in selected transfer schemes, usually focussing upon minimum income payments. Olken (2005) suggests a method for identifying 'community equivalence scales', on the assumption that the individuals who receive social assistance are selected to maximise an assumed social welfare function. Given explicit assumptions concerning the social welfare function, it is possible to derive a closed form solution for the proportion of the population in receipt of support. This closed form can be estimated as a standard binary choice model to identify the parameters of a policy implicit equivalence scale. Olken uses this approach to estimate the equivalence scales implied by a subsidised rice program offered to poor

[1] Deaton & Muellbauer (1980), chapters 7 to 9, provides a detailed discussion of the theoretical underpinnings of the demand based approach for estimating equivalence scales. For a discussion of the advantages and disadvantages of alternative equivalence scales, see also Coulter et al. (1992).

[2] The modified OECD scale is based upon "expert opinion"; see Orshansky (1965) for a comparable scale also based on expert opinion.

households in Indonesia.[3]

Other studies have evaluated the scales implicit in selected transfer schemes by taking the ratio of the payments made to alternative household types; e.g. HMSO (1978) for an early example in relation to UK income support payments, and Stewart (2009) for old age pensions. This latter approach has the advantage that it does not depend upon assumptions concerning the existence of a social welfare function or the specification of the equivalence scale. It is also tacitly supported by the observation that some countries (e.g. Germany, the Netherlands, Sweden, Norway) have set income support payments with reference to budget standards for low income households.[4]

This study contributes to the above literature by describing a simple analytical approach for identifying equivalence scales implicit in an entire tax and transfer system, based on two identifying assumptions and a functional description for transfer payments.[5] The two assumptions upon which our identification approach is based - horizontal equity and tax independence - bear close similarities to assumptions commonly adopted in empirical studies of inequality and tax progressivity. Furthermore, the functional description of the transfer system required for the identification approach is present in a range of tax-benefit calculators in current use (e.g. EUROMOD, TAXSIM, TAXBEN, MITTS, etc), or can be estimated from common microdata sources (e.g. EU-SILC, the US Current Population Survey, the UK Family Resources Survey, the Australian Survey of Income and Housing Costs).

We describe our analytical approach in Section 2, and present a practical example in Section 3. Discussion, and directions for further research are provided in a concluding section.

2 A simple method for identifying tax implicit equivalence scales

We are concerned with identifying the value judgements implicit in the relative treatment of alternative tax units by an entire tax and transfer system, and not any single transfer

[3] See also Lall et al. (2012) for equivalence scales implicit in a housing subsidy in South Africa.

[4] Budget standards, also referred to as minimum income standards or reference budgets, are priced baskets of goods and services; e.g. Hirsch (2013), Storms et al. (2013).

[5] Econometric methods for identifying tax implicit equivalence scales from microdata sources are also suggested in Muellbauer & van de Ven (2003) and Muellbauer & van de Ven (2004). van de Ven & Creedy (2005) explore the relationship between tax implicit equivalence scales and measures of horizontal inequity.

scheme taken in isolation. Assume that there exists a decision body that designs and implements $T \in \mathbb{R}$, which assigns a unique net-transfer payment, t_i, to each individual i from a set of tax units I. $t > 0$ indicates a net tax levied, and $t < 0$ a net benefit received. Assume that the design of T depends upon the rank-ordering of all tax units $i \in I$ in terms of relative merit, as perceived by the decision body.[6] We allow the 'merit' of a tax unit to depart from individual specific welfare to accommodate non-welfarist objectives that might influence the design of tax-transfer policy, such as the determinants of electoral success or the goals of an established bureaucracy (e.g. Atkinson and Stiglitz, 1980, p. 9).

Assume that the merit of any tax unit i depends only on that unit's characteristics vector $(x_i, \phi_i, t_i; x_i \in X, \phi_i \in \Phi, t_i = T(x_i, \phi_i))$, and is independent of the characteristics of all other units in population I. X is the vector of pre-tax incomes, and Φ the set of all other relevant characteristics including, for example, labour status, marital status, number and ages of children, health status and so on. The net transfer payment t_i is included in each tax unit's characteristics vector, which is central to the identification strategy set out below.

Denote by $\succeq_D$the rule governing the merit ordering of alternative tax unit vectors (x, ϕ, t). Thus, $(x_i, \phi_i, t_i) \succeq_D (x_j, \phi_j, t_j)$ implies that tax unit i is at least as meritorious as tax unit j for the purposes of taxation. Similarly, $(x_i, \phi_i, t_i) \sim_D (x_j, \phi_j, t_j)$ implies that tax units i and j have the same merit for tax purposes. It is assumed that the rule $\succeq_D$ can be represented by the real-valued function $W(x, \phi, t) \in \mathbb{R}$, such that $W(x_i, \phi_i, t_i) \geq W(x_j, \phi_j, t_j)$ if and only if $(x_i, \phi_i, t_i) \succeq_D (x_j, \phi_j, t_j)$ for all $(i, j \in I)$.

We seek a convenient description of the bearing that characteristics (x, ϕ, t) have on tax unit merit, relative to a reference unit. Without loss of generality, define:

$$W(x, \phi, t) = \frac{x - t}{w(x, \phi, t)} \tag{1}$$

From equation (1), the bearing that alternative characteristics have on tax unit merit can be defined in the familiar form of a (relative) equivalence scale. Suppose that all reference units possess the characteristic vector ϕ_r, and consider the impact that any given characteristic vector, ϕ_i, has on tax unit merit. If tax unit i with characteristics

[6] We do not suggest that T can be interpreted as representing a 'social consensus'; the heated debate that often accompanies transfer policy reforms suggests that no consensus view may exist (Coulter *et al.*, 1992, p. 100).

(x_i, ϕ_i, t_i) has the same merit as reference unit r with characteristics (x_r, ϕ_r, t_r), then:

$$W(x_i, \phi_i, t_i) = W(x_r, \phi_r, t_r) \Rightarrow a(x_i, \phi_i, t_i) = \frac{w(x_i, \phi_i, t_i)}{w(x_r, \phi_r, t_r)} = \frac{x_i - t_i}{x_r - t_r} \tag{2}$$

In equation (2), $a(x_i, \phi_i, t_i)$ is our focus of interest, which we refer to as a tax implicit equivalence scale. Discounting the after-tax income of tax unit i by the relevant tax implicit scale $a(x_i, \phi_i, t_i)$ gives the after-tax income that the reference unit with characteristics ϕ_r, $(x_r - t_r)$, would require to be of equal merit to tax unit i.

For any given vector $(x_i, \phi_i, t_i) \neq (x_r, \phi_r, t_r)$, both $a(x_i, \phi_i, t_i)$ and $(x_r - t_r)$ are unobserved, and therefore cannot be inferred from equation (2) alone. To resolve this indeterminancy, assume that T satisfies the principle of *horizontal equity* (HE):[7]

Condition HE: *Any two tax units of equal tax merit in the presence of a tax must also have equal merit if, ceteris paribus, all taxes were set to zero*

The condition HE requires:

$$W(x_i, \phi_i, t_i) = W(x_r, \phi_r, t_r) \Leftrightarrow W(x_i, \phi_i, 0) = W(x_r, \phi_r, 0) \tag{3}$$

Substituting equation (1) into (3) and rearranging:

$$a(x_i, \phi_i, t_i) = \frac{w(x_i, \phi_i, t_i)}{w(x_r, \phi_r, t_r)} = \frac{x_i - t_i}{x_r - t_r} \Leftrightarrow a(x_i, \phi_i, 0) = \frac{w(x_i, \phi_i, 0)}{w(x_r, \phi_r, 0)} = \frac{x_i}{x_r} \tag{4}$$

Note that HE has not resolved the indeterminacy of our problem, as it has added one equation and one unknown.[8] An additional restriction is therefore required for identification. We propose the condition of *tax independence* (TI) to resolve the remaining indeterminacy:

Condition TI: *Relative merit for tax purposes is independent of the tax function*

TI requires that the same tax implicit scale applies to both pre-tax and after-tax incomes; i.e. $a(x, \phi, 0) = a(x, \phi, t) = a(x, \phi)$ for all $(x \in X, \phi \in \Phi)$. A necessary and sufficient condition for TI is that $w(x, \phi, t) = w'(x, \phi)$ for all $(x \in X, \phi \in \Phi, t \in T)$. Note that this restriction does not also imply that $W(.)$ is independent of t; rather, it requires that there exists a monotonic transformation of $W(.)$ that is linear in t. Imposing TI, and rearranging (4) gives:

$$\frac{t_r}{x_r} = \frac{t_i}{x_i} \tag{5}$$

[7] This interpretation of HE can be contrasted with stronger interpretations that impose no-reranking conditions as considered, for example, by Plotnick (1982) and King (1983).

[8] $a(x_i, \phi_i, 0)$ is the additional unknown.

which defines equals unambiguously, if average tax rates vary monotonically with pre-tax income for the reference tax unit. Average tax rates are commonly strictly increasing in pre-tax income for most modern transfer systems considered as a whole, in which case condition (5) permits identification of the tax implicit scale $a(x, \phi)$, as indicated by equation (2).[9] Note that HE and TI do not require $a(.)$ to be independent of pre-tax income x, which is likely to be important in most practical contexts.

The structure that we impose on preference orderings to identify equivalence scales is not exclusive to our approach. Consider, for example, the established literature that identifies equivalence scales based on consumer demand theory. As observed data do not generally provide information on the joint distribution of preferences over goods and household demographics that are required for welfare comparisons (Pollak & Wales (1979); Blundell & Lewbel (1991)), an influential method for identifying equivalence scales based on consumer demand theory is to assume a utility structure that satisfies the condition of *Independence of Base* (IB; Lewbel (1989) and Blackorby & Donaldson (1993)).[10] IB requires that utility equality is preserved under income scaling. This is similar in spirit to the constraints imposed by HE and TI, which require that tax merit equality is preserved by scaling of average tax rates. Whereas IB implies that the equivalence scale will be independent of utility and income, HE and TI imply that tax implicit equivalence scales will be independent of the tax function, T.

A nice feature of the literature that explores expenditure-based equivalence scales is that identifying assumptions like IB tend to impose limitations on preferences that vary across households types, or the way that demographic variables enter demand equations, which facilitate econometric evaluation. In contrast, the system that we suggest above for identifying tax implicit scales is exactly identified, so that the joint assumptions of HE and TI cannot be tested.

Testable implications require over-identifying assumptions, and there are very few generally accepted principals of taxation that we might refer to when formulating such

[9] Recall that we are exclusively concerned here with the value judgements implicit in entire tax and transfer systems, and not individual tax or benefit schemes. Any transfer system that provides a net welfare benefit at zero pre-tax income, withdraws net benefits as pre-tax income rises, and imposes non-decreasing marginal (effective) tax rates at higher incomes will result in average tax rates that strictly increase from negative infinity at zero pre-tax income and asymptote toward the highest marginal tax rate.

[10] Blackorby and Donaldson (1993) call this property equivalence scale exactness, and show that it permits identification if preferences are not piglog. Donaldson & Pendakur (2003) propose a generalisation of the IB property that imposes less restrictive conditions on preferences allowing equivalence scales to vary with utility levels.

assumptions. The condition of HE is a notable exception, but as our above analysis shows, this condition is insufficient to permit identification of a tax implicit equivalence scale on its own. Any attempt to define a testable criterion for identifying tax implicit equivalence scales must therefore take account of alternative considerations.

One justifiable approach is to select identifying assumptions that are in some sense analytically convenient. This is one motivation for relying on the condition TI, which ensures that the same tax implicit scale is applicable for both pre-tax and post-tax incomes. Our above analysis indicates that a stronger set of assumptions would be required to ensure that tax implicit equivalence scales are independent of income. A further implication of our above analysis is that the assumptions required to ensure income independent tax implicit equivalence scales would also result in testable implications, consistent with consumer demand theory. We have not, however, pursued this line of enquiry for two reasons. First, we sympathise with the proposition of Seneca and Taussig (1971, p. 255), who suggest 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". Secondly, the limited empirical analysis that we have conducted using the above identifying criteria suggest that any over-identifying assumptions required to ensure that tax implicit equivalence scales are independent of income are likely to be strongly rejected by the data, echoing findings in the consumer-demand literature.[11] We present one such analysis below.

3 Tax Implicit Equivalence Scales for the UK

The method for identifying tax implicit equivalence scales that is set out in this paper requires post-tax (and benefit) income to be described as a function of a range of tax unit characteristics. In this section we provide a practical example of the approach, using the Tax Benefit Model Tables (TBMTs) produced for the UK by the Department for Work and Pensions, applicable for April 2009.[12] The TBMTs calculate UK taxes and benefits for a set of hypothetical individual characteristics using an Excel spreadsheet. This spreadsheet is freely downloadable from the internet (at the time of writing), and it should be possible for the reader to replicate the results reported here within a matter

[11] Several papers have tested the independence of base assumption using parametric (Blundell and Lewbel 1991; Pashardes 1995) and semiparametric methods (Blundell *et al.* 1998; Pendakur 1999). Dickens *et al.* (1993) test the IB hypothesis in the context of linear and non-linear demand models. All these papers find statistical evidence to reject the demand restrictions implied by the IB condition.

[12] The TBMTs were produced annually from 1996 to 2009; see DWP (2009) for details.

of hours.[13]

The TBMTs report the relationship between pre-tax income and post-tax income for 34 hypothetical combinations of tax unit characteristics, varying over relationship status, number and age of dependent children, employment status, housing, and child care costs. We report here the tax implicit equivalence scales of families that are private tenants, do not incur child care costs, and in which the principal income earner either does not work, or works between 16 and 30 hours per week (exclusive). These scales are based on the tax schedules reported in DWP (2009), sections 1.1c (single adults with no children), 1.2f (lone parents with one child), 1.3f (lone parents with 2 children), 1.4c (couples with no children), 1.5c (couples with one child), 1.6c (couples with two children), and 1.7c (couples with three children).

Tax implicit equivalence scales were evaluated for each tax unit via the procedure that is described in Section 2.[14] A single adult without dependent children was adopted as the reference group for analysis, noting that the average tax rates of all tax unit types are strictly increasing in pre-tax income over the considered range. Results from this analysis are reported graphically in Figure 1.

The equivalence scales reported in the figure provide a fascinating insight into the relativities that are implicit in the UK transfer system. Starting with the statistics for unemployed tax units, represented by the dots along the axis at zero pre-tax income, we see that larger families are unambiguously associated with higher tax implicit scales. This reflects the higher unemployment benefits that are payable to larger families. Comparing the scales evaluated for single adults with those of couples indicates that an additional adult increases the tax implicit scale by a factor of 0.2, irrespective of the number of children in the tax unit. The implication is that the UK transfer system treats the second adult in a couple as equivalent to one fifth of a single adult in the determination of the income support payments to unemployed households. In

[13] `http://webarchive.nationalarchives.gov.uk/20130107093842/http:/statistics.dwp.gov.uk/asd/index.php?page=tbmt`. Please feel free to contact the corresponding author if this link becomes inactive.

[14] The spreadsheet was used to calculate, for each tax unit, post-tax income before housing costs for values of pre-tax income increasing at £1 per week increments from £0 to £1200 per week. The average tax rate associated with each evaluated measure of pre-tax income was then calculated. The 'VLOOKUP' Excel search routine was used to identify, for each measure of pre-tax income and for each tax unit, the measure of pre-tax income for single adults that equated the respective average tax rates. The tax implicit equivalence scale relevant for any combination of pre-tax income and tax unit was then calculated as the ratio of pre-tax income of the respective tax unit to the pre-tax income of single adults that equated their average tax rates.

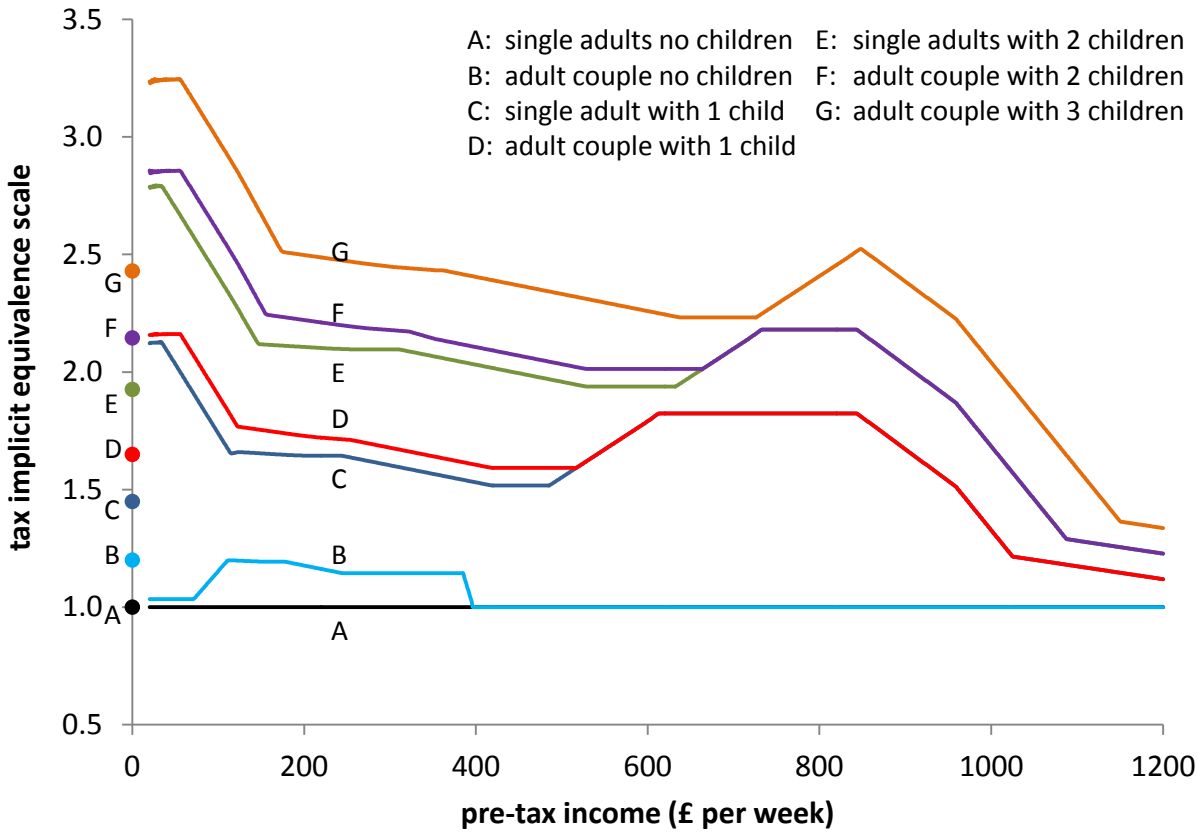

Figure 1: Tax implicit equivalence scales of selected family types evaluated for the UK transfer system applied in April 2009

contrast, an additional child increases the tax implicit scale by a factor of around 0.45 for the first and second child, falling to 0.3 for the third child in the case of couples. The observation that children tend to increase the tax implicit scale by a wider margin than adults is in sharp contrast to most other scales in popular use; the modified OECD scale, for example, assigns a value of 1.0 to the first adult in a household, 0.5 to any other household member aged 14 or over, and 0.3 to each child aged 13 or under. The value judgement, implied by the scales reported here, that a child is associated with a higher weight in the determination of welfare benefits than an adult, suggests that the formulation of transfer policy depends on much more than relative consumption needs. We return to discuss this observation in Section 4.

Figure 1 also indicates that the tax implicit equivalence scales display a great deal of variation with pre-tax income. In the case of couples without dependent children, the tax implicit scale falls from a value of 1.2 at zero pre-tax income to a value that approximates 1.0 at very pre-tax income, implying a negligible adjustment for the second adult as means-tested (income support) benefits are withdrawn. The scale then rises back to a value of 1.2 at earnings of £110 per week, which is in the region of the national minimum wage for someone working 16 hours per week.[15] The adjustment made for the second adult is then approximately stable, before being withdrawn fully at pre-tax income of £400 per week, which is equal to median earnings.[16] For all earnings in excess of £400 per week, the tax implicit equivalence scales reported in Figure 1 indicate that single adults and adult couples without dependent children are treated identically.

The tax implicit equivalence scales for tax units with children display greater variation with pre-tax income than described above for childless adults. First, and in contrast to childless adults, the tax implicit equivalence scales of tax units with dependent children rise appreciably as pre-tax income increase from zero to peak at very low earnings. This reflects the fact that child related welfare payments are not withdrawn as rapidly as those for adults, so that the gap between the post-tax incomes of benefits units with and without children initially widens. From this initial peak, the (relative) disparity in tax treatment between childless adults and parents shows a persistent downward trend with pre-tax income, subject to some non-smoothness that is introduced by the organisation of the UK transfer system into a series of individual tax and benefit schemes. At

[15] The national minimum wage for the UK of someone aged 21 or over in 2009 was £5.73 per hour.

[16] Median gross weekly earnings for all employees were £397 in April 2009; see *2009 Annual Survey of Hours and Earnings*, published by the Office for National Statistics.

pre-tax income of £1200 per week (three times the median), an adult couple with three dependent children is treated by the UK transfer system as equivalent to one and a third single adults (down from a peak of three and a quarter single adults at low earnings).

4 Discussion

This paper describes a simple and tractable method for identifying equivalence scales that reflect the value judgements implicit in a tax and benefits system. We use this approach to evaluate tax implicit equivalence scales for the UK transfer system that applied in April 2009. The tax implicit scales that we identify vary positively with tax unit size and are predominantly decreasing in pre-tax income, in contrast to the common assumption of base independence in the existing literature. This last finding is consistent with results reported in recent literature that tests the assumption of base independence in the consumer demand literature (see Section 2).

A desirable property of tax implicit equivalence scales is that they provide an explicit description of the value judgements (implicitly) made by government when acting in its role as administrative agent for society. These value judgements are interesting in their own right, and in many countries are highly opaque. It seems reasonable to suppose that the complexity and fragmented nature of many modern transfer systems may have detached the relative tax treatment of heterogeneous individuals from popular perceptions concerning relative needs. In such contexts, cutting through the complexity to produce transparent measures of relative tax treatment may help to improve the evidence based for policy design and reform.

Comparing tax implicit scales through time could provide an interesting description of changing social value judgements within a given country. Comparing scales across tax jurisdictions could provide interesting information concerning differences in value judgements across state or country boarders. It could also help to make clear behavioural incentives embedded within transfer policy. Comparisons of tax implicit scales across tax jurisdictions, for example, could provide useful detail concerning the associated incentives for migration, which are likely to be particularly relevant in context of weak migratory controls (as within the European Union or between US states). Alternatively, comparing tax implicit scales with equivalence scale estimates based on consumer demand theory could provide a useful indication of tax incentives over a broad range of characteristics. If, for example, the tax system made a larger adjustment for young

children than implied by equivalence scales estimated from consumption behaviour, then this could indicate that the transfer system is structured to encourage increased fertility or to alleviate child poverty.

One of the most traditional uses for equivalence scales is as a control to aid comparisons of income or consumption between heterogeneous income/consumption units. In this context equivalence scales are usually designed to adjust income or consumption to a comparable welfare basis, either via estimations based on formal consumer-demand theory, or via expert consensus opinion. As discussed in Section 2, the potential existence of non-welfarist considerations in the design and implementation of tax and transfer policy is likely to drive a wedge between tax implicit equivalence scales and the adjustments necessary to reduce heterogeneous tax units to an equivalent welfare basis. This conjecture seems to be supported by the tax implicit scales that we report for the UK in Section 3, which indicate larger adjustments for children than for adults in contrast to equivalence scales based on alternative analytical approaches.

Nevertheless, we argue that tax implicit equivalence scales remain useful for conducting distributional analyses for (at least) three reasons. First, although tax implicit scales may depend on factors that extend beyond simple welfare comparisons, it is reasonable to expect that a consideration of inter-unit welfare will lie at the heart of any well-designed transfer system.

Secondly, the absence of a generally accepted correct approach for empirically identifying an equivalence scale that is appropriate for making welfare comparisons focusses attention on associated sensitivity analysis. In this regard, the tax implicit equivalence scales that we suggest here have the advantages that they can be objectively observed, and are based on a qualitatively different set of considerations to existing alternatives.

Thirdly, in some contexts using tax implicit scales can help to improve the internal consistency of a distributional analysis. Distributional analyses of re-ranking, for example, explore the extent to which the redistributive effect of a tax system is affected by changes in the rank-order of individuals from the pre- to the post-tax and benefit income distributions.[17] Such studies commonly adjust incomes by an exogenously assumed equivalence scale. Some commentators have subsequently expressed the view that this approach "amounts to "imposing [horizontal inequity] from outside" if the tax is not, in fact, a family income tax designed to be coherent with an equivalence scale – or indeed

[17] See, for example, Ebert & Lambert (2004), van de Ven et al. (2001), Aronson et al. (1994), Jenkins (1988).

if it is and the scale selected by the analyst is not the same as the one being used by the policy maker" (Lambert, 2004, p. 76). Use of tax implicit equivalence scales would help to allay such concerns.

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