



FACULTY OF  
BUSINESS &  
ECONOMICS

# Melbourne Institute Working Paper Series

## Working Paper No. 3/14

Identifying Tax Implicit Equivalence Scales

*Justin van de Ven, Nicolas Herault and Francisco Azpitarte*

# **Identifying Tax Implicit Equivalence Scales\***

**Justin van de Ven<sup>†‡</sup>, Nicolas Herault<sup>†</sup> and Francisco Azpitarte<sup>†§</sup>**

<sup>†</sup>**Melbourne Institute of Applied Economic and Social Research,  
The University of Melbourne**

<sup>‡</sup>**National Institute of Economic and Social Research**

<sup>§</sup>**Brotherhood of St Laurence**

**Melbourne Institute Working Paper No. 3/14**

**ISSN 1328-4991 (Print)**

**ISSN 1447-5863 (Online)**

**ISBN 978-0-7340-4342-9**

**March 2014**

\* Francisco Azpitarte would like to acknowledge the financial support from the Spanish Ministerio de Ciencia e Innovación (grants ECO2008-03484-C0201/ECON and ECO2010-21668-C03-03) and the Xunta de Galicia (10SEC300023PR). Correspondence to Justin van de Ven, <justin.van@unimelb.edu.au>.

**Melbourne Institute of Applied Economic and Social Research**

**The University of Melbourne**

**Victoria 3010 Australia**

**Telephone (03) 8344 2100**

**Fax (03) 8344 2111**

**Email** melb-inst@unimelb.edu.au

**WWW Address** <http://www.melbourneinstitute.com>

## **Abstract**

This paper describes a simple and tractable method for identifying equivalence scales that reflect the value judgements implicit in a tax and benefits system. The approach depends upon two assumptions that are standard in the literature concerned with inequality and tax progressivity, in addition to a functional description for transfer payments that can be estimated using common micro-data sources. 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 for the UK vary positively with tax unit size and are decreasing in gross earnings, reflecting recent econometric estimates based on consumption data. We conclude by discussing a range of potential applications for the proposed tax implicit scales.

**JEL classification:** D31, H23, I38

**Keywords:** Equivalence scale, taxation, base dependence

# 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 transfer system of alternative tax units, and a useful statistic to control for tax unit heterogeneity when conducting distributional analyses.

Most empirically evaluated equivalence scales are based on consumer demand theory.<sup>1</sup> 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 analysis”, 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.<sup>2</sup> 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. This may be due to a commonly held perception that “income taxes are not typically coherent with equivalence scales” (Lambert, 1993, p. 364). Yet, tax and transfer systems translate

---

<sup>1</sup>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).

<sup>2</sup>The modified OECD scale is based upon “expert opinion”; see Orshansky (1965) for a comparable scale also based on expert opinion.

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 households in Indonesia.<sup>3</sup>

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.<sup>4</sup>

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 analytical assumptions and a functional description for transfer payments.<sup>5</sup> The assumptions upon which our identification approach is based are common, if implicit, in empirical studies of inequality and tax progressivity. 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 Current

---

<sup>3</sup>See also Lall et al. (2012) for equivalence scales implicit in a housing subsidy in South Africa.

<sup>4</sup>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).

<sup>5</sup>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)

Population Survey in the US, the Family Resources Survey in the UK, the Survey of Income and Housing Costs in Australia).

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 identify tax implicit equivalence scales based on two assumptions:

1. Two tax units with the same equivalised post-tax and benefit incomes can be interpreted as being ‘equally well off’ (enjoy the same utility)
2. If two individuals would be equally well off given their pre-tax incomes in the absence of a tax, they should also be equally well off if there is a tax.

The first assumption ensures that the equivalence scale can be used to discount the incomes of any two tax units to a comparable basis. The second assumption is a variant of the principle of horizontal equity suggested by Feldstein (1976, p. 83), where we have inserted the term “given their pre-tax incomes” to facilitate evaluation of the principle using observable data. Horizontal equity is widely accepted as one of the core principles of distributive justice underlying the design of tax and transfer policies. The tax implicit scales that we identify are those that are necessary to ensure that an observed transfer system satisfies this principle.

Our analytical approach is closely related to the recent study by Bourguignon & Spadaro (2012). Bourguignon & Spadaro (2012) seek to identify the properties of “the social welfare function that makes optimal the actual marginal tax rate schedule that corresponds to the redistribution system actually in place” (p.76). This then permits consideration of “whether the social welfare function implied by the actual redistribution schedule is in some sense ‘reasonable’” (p.76). In a similar vein we seek to identify the properties of the tax implicit equivalence scale that are necessary to ensure that the tax schedule satisfies the basic condition of horizontal equity. It is then possible to consider whether the equivalence scales required to satisfy this condition are “in some sense ‘reasonable’”.

Denote the gross (pre-tax and benefit) income of tax unit  $i$  by  $x_i$ , and disposable (post-tax and benefit) income by  $y_i$ . Gross and disposable incomes are related through the unit's (net) tax burden,  $t_i$ ;  $y_i = x_i - t_i$ . Consider two tax units,  $i$  and  $j$ , which differ in their respective demographic compositions. The equivalence scale that transforms tax unit  $i$ 's income so that it is comparable with that of tax unit  $j$  is  $a_i$ . Then, if units  $i$  and  $j$  are equally well off, assumption 1 requires:

$$\frac{y_i}{a_i} = y_j \quad (1)$$

Given equation 1, assumption 2 will only hold if:

$$\frac{x_i}{a_i} = x_j \quad (2)$$

Dividing equation 2 by equation 1, and rearranging we obtain:

$$\frac{t_i}{x_i} = \frac{t_j}{x_j} \quad (3)$$

Hence, assumptions 1 and 2 imply that any two tax units that can be treated as equals will be subject to the same (observable) average tax rates. This condition will uniquely identify the tax implicit equivalence scale, so long as at least one population subgroup is subject to average tax rates that vary strictly monotonically with gross income and span the feasible domain.<sup>6</sup>

Suppose, for example, that the average tax rate is strictly increasing in gross income for tax unit  $j$ , with a range  $(-\infty, t_{\max})$ , where  $t_{\max}$  is an asymptote upper bound on the average tax rates to which all tax units are subject. Then a unique tax implicit scale can be calculated for all other tax units, with reference to the tax schedule for unit  $j$ . Specifically, the equivalence scale of tax unit  $i$  with gross income,  $x_i$ , can be obtained by taking the ratio of incomes that equates their average tax rates:<sup>7</sup>

$$\frac{t_i}{x_i} = \frac{t_j}{x_j} \implies a_i(x_i) = \frac{x_i}{x_j} \quad (4)$$

In equation 4 the equivalence scale is defined as a function of gross income, which recognises that tax implicit equivalence scales will often fail to satisfy the condition

---

<sup>6</sup>Average tax rates are usually increasing in gross income. Where strict monotonicity does not hold for at least one population subgroup, then additional assumptions to those described here are required for identification of a tax implicit equivalence scale.

<sup>7</sup>Our approach consequently displays parallels with the matching estimator for equivalence scales proposed by Szulc (2009), in that it focuses on pairing households of different compositions that are equally well off. Our approach differs from Szulc's in that it does not rely on consumption data and it does not require any econometric estimation.

of base independence.<sup>8</sup> As noted by Seneca and Taussig (1971, p. 255), “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”.

### 3 Tax Implicit Equivalence Scales for the UK

The method for identifying tax implicit equivalence scales that is set out in this paper requires disposable 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.<sup>9</sup> 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 of hours.<sup>10</sup>

The TBMTs report the relationship between gross earnings and disposable 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.<sup>11</sup> A single adult without dependent children was adopted

---

<sup>8</sup>Base independence (Lewbel, 1989, and Blundell and Lewbel, 1991) requires the equivalence scale to be unaffected by the level of utility. This requirement is referred to as ‘equivalence scale exactness’ by Blackorby & Donaldson (1993).

<sup>9</sup>The TBMTs were produced annually from 1996 to 2009; see DWP (2009) for details.

<sup>10</sup><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.

<sup>11</sup>The spreadsheet was used to calculate, for each tax unit, disposable before housing costs income for values of gross earnings increasing at £1 per week increments from £0 to £1200 per week. The average tax rate associated with each evaluated measure of disposable income was then calculated. The ‘VLOOKUP’ Excel search routine was used to identify, for each measure of gross earnings and for each

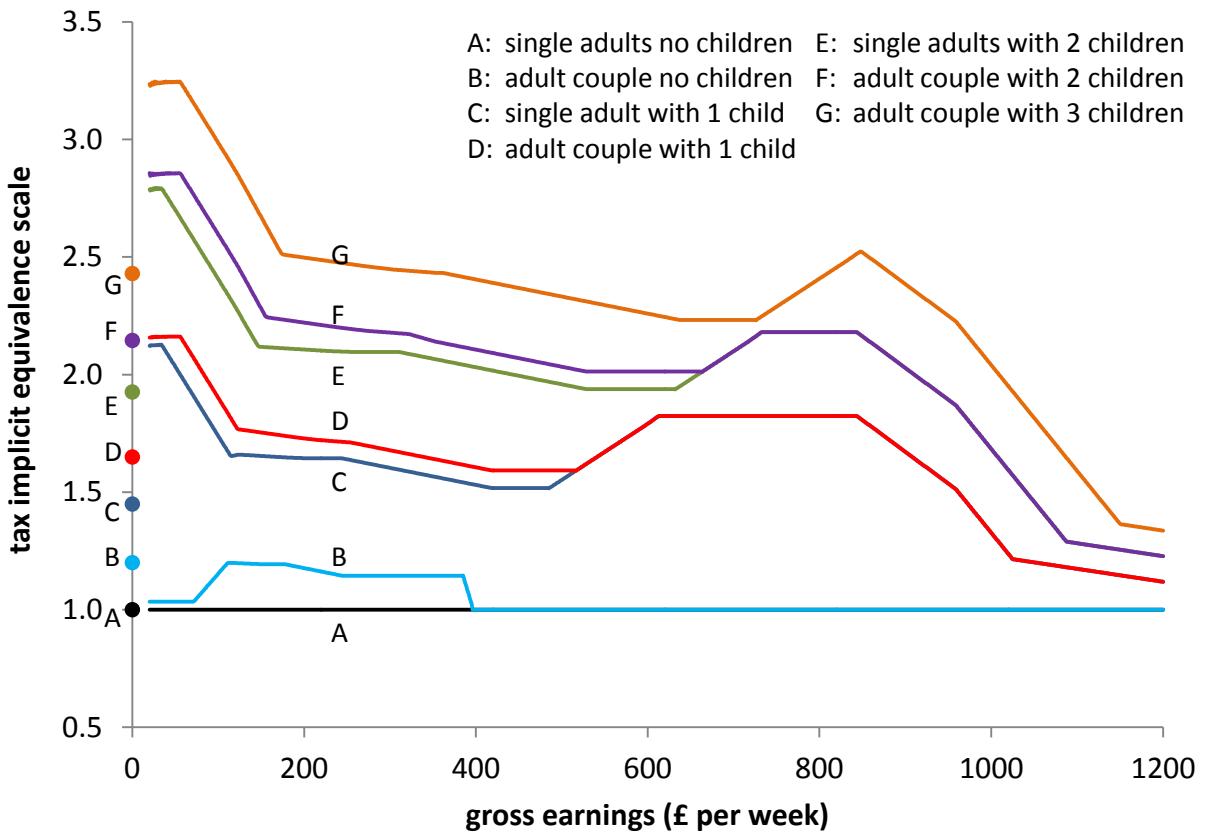


Figure 1: Tax implicit equivalence scales of selected family types evaluated for the UK transfer system applied in April 2009

as the reference group for analysis, noting that the average tax rates of all tax unit types are strictly increasing over the considered range of gross earnings. 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 gross earnings, 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

---

tax unit, the measure of gross earnings for single adults that equated the respective average tax rates. The tax implicit equivalence scale relevant for any combination of gross earnings and tax unit was then calculated as the ratio of gross earnings of the respective tax unit to the gross earnings of single adults that equated their average tax rates.

in the determination of the income support payments to unemployed households. In 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.

Figure 1 also indicates that the tax implicit equivalence scales display a great deal of variation with gross earnings. In the case of couples without dependent children, the tax implicit scale falls from a value of 1.2 at zero gross earnings to a value that approximates 1.0 at very low earnings, 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.<sup>12</sup> The adjustment made for the second adult is then approximately stable, before being withdrawn fully at gross earnings of £400 per week, which is equal to median earnings.<sup>13</sup> 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 gross earnings 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 gross earnings 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 disposable 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 gross earnings, 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

---

<sup>12</sup>The national minimum wage for the UK of someone aged 21 or over in 2009 was £5.73 per hour.

<sup>13</sup>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.

gross earnings 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 for the UK vary positively with tax unit size and are decreasing in gross earnings, 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 relaxes the assumption of base independence for equivalence scales in context of estimation approaches based on consumption data (e.g. Donaldson and Pendakur, 2003, Koulovatianos *et al.*, 2005, and de Ree *et al.*, 2013).

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. This is not to suggest that the tax implicit equivalence scales described here should be understood to reflect the value judgements of a social planner. As Atkinson and Stiglitz (1980, p. 9) warn, “Tax and expenditure policy may be designed more with a view to electoral success, or the goals of an established bureaucracy, than to social welfare maximisation.” We also do not suggest that such scales can be taken to represent 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). Nevertheless, given the importance of transfer policy in people’s everyday lives, the value judgements that *are* implicit in the prevailing transfer system represent a focus of concern, regardless of *how* those value judgements came to be made. We envisage two alternative uses for such scales: one in which the relativities represented by the scales are the focus of interest, and another in which the scales are used to control for aspects of tax unit heterogeneity that are not the focus of concern. We discuss each of these potential uses in turn.

Tax implicit equivalence scales provide a transparent measure of the value judgements described by transfer policy. This is useful because the complexity and fragmented na-

ture of many transfer systems obfuscate the relative treatment of alternative tax units. This lack of clarity increases the potential for policies that fail to reflect popular perceptions concerning relative needs. By clarifying the relativities implicit in transfer policy, it may be possible to identify whether and in what ways existing transfer systems contradict commonly held value judgements, thereby supporting associated policy reform.

Comparing tax implicit scales through time could provide an interesting description of changing social value judgements (even if implicit) within a given country. Comparing scales across tax jurisdictions could provide useful detail concerning tax incentives for migration, particularly relevant in context of weak migratory controls (as within the European Union or between US states). Similarly, 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.

One of the most common uses for equivalence scales is as a control to aid comparisons of income or consumption between heterogeneous tax units. The value judgements implicit in transfer policy present a defensible, observable, and objective source for defining adjustments between heterogeneous tax units. A key problem when seeking to identify any equivalence scale, for example, concerns the nature of the functional form to assume. This is resolved in context of tax implicit scales, which depend upon the (observable) set of factors that are considered in the evaluation of net transfer payments.<sup>14</sup>

Furthermore, as tax implicit scales are based on different underlying assumptions and data sources to those that are more commonly considered in the literature, they are not subject to the same critiques, and therefore present a useful candidate for associated sensitivity analysis. In some contexts tax implicit equivalence scales may also provide conceptual advantages, relative to alternative identification approaches. Distributional analyses of re-ranking, for example, explore the extent to which progressivity of a transfer

---

<sup>14</sup>Note, however, that this feature of tax implicit scales does have drawbacks. Most modern tax and benefit systems are fiendishly complex, and this complexity has the potential to feed into the specification of a tax implicit equivalence scale. Such complexity is likely to obscure the value judgements implied by the tax implicit scales, hampering associated analysis. The question of how much of the complexity of a transfer system to include when evaluating a tax implicit scale will ultimately depend upon the purpose(s) of the intended analysis.

system is damped by changes in the rank-order of individuals from the pre- to the post-tax and benefit income distributions.<sup>15</sup> 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 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.<sup>16</sup>

## References

- Aronson, J. R., Johnson, P. & Lambert, P. J. (1994), ‘Redistributive effect and unequal income tax treatment’, *The Economic Journal* **104**, 262–270.
- Atkinson, A. B. & Stiglitz, J. E. (1980), *Lectures on Public Economics*, McGraw-Hill, Singapore.
- Blackorby, C. & Donaldson, D. (1993), ‘Adult-equivalence scales and the economic implementation of interpersonal comparisons of well-being’, *Social Choice and Welfare* **10**, 335–361.
- Blundell, R. & Lewbel, A. (1991), ‘The information content of equivalence scales’, *Journal of Econometrics* **50**, 49–68.
- Bourguignon, F. & Spadaro, A. (2012), ‘Tax-benefit revealed social preferences’, *Journal of Economic Inequality* **10**, 75–108.
- Coulter, F. A. E., Cowell, F. A. & Jenkins, S. P. (1992), ‘Differences in needs and assessment of income distributions’, *Bulletin of Economic Research* **44**, 77–124.
- de Ree, J., Alessie, R. & Pradhan, M. (2013), ‘The price and utility dependence of equivalence scales: Evidence from Indonesia’, *Journal of Public Economics* **97**, 272–281.

<sup>15</sup> See, for example, Ebert & Lambert (2004), van de Ven et al. (2001), Aronson et al. (1994), Jenkins (1988).

<sup>16</sup> van de Ven & Creedy (2005) explore the relationship between tax implicit equivalence scales and measures of horizontal inequity.

- Deaton, A. & Muellbauer, J. (1980), *Economics and Consumer Behavior*, Cambridge University Press, Cambridge.
- Donaldson, D. & Pendakur, K. (2003), ‘Equivalent-expenditure functions and expenditure-dependent equivalence scales’, *Journal of Public Economics* **88**, 175–208.
- DWP (2009), Tax Benefit Model Tables April 2009. ISSN 1741-5896.
- Ebert, U. & Lambert, P. J. (2004), ‘Horizontal equity and progression when equivalence scales are not constant’, *Public Finance Review* **32**, 426–440.
- Feldstein, M. S. (1976), ‘On the theory of tax re-form’, *Journal of Public Economics* **6**, 77–104.
- Hagenaars, A., Vos, K. D. & Zaidi, A. (1994), *Poverty Statistics in the Late 1980s: Research based on micro-data*, Eurostat, Luxembourg.
- Hirsch, D. (2013), *A Minimum Income Standard for the UK in 2013*, Joseph Rowntree Foundation, York.
- HMSO (1978), Report of the Royal Commission on the Distribution of Income and Wealth. Report No. 6, Lower Incomes, Cmnd 7175.
- Jenkins, S. P. (1988), ‘Reranking and the analysis of the income distribution’, *Scottish Journal of Political Economy* **24**, 65–76.
- Koulovatianos, C., Schröder, C. & Schmidt, U. (2005), ‘On the income dependence of equivalence scales’, *Journal of Public Economics* **89**, 967–996.
- Lall, S. V., van den Brink, R., Dasgupta, B. & Leresche, K. M. (2012), Shelter from the storm - but disconnected from jobs. World Bank Policy Research Working Paper 6173.
- Lambert, P. J. (1993), ‘Inequality reduction through the income tax’, *Economica* **60**, 357–365.
- Lambert, P. J. (2004), Equivalence scales, horizontal equity and horizontal inequity, in C. Dagum & G. Ferrari, eds, ‘Household Behaviour, Equivalence Scales, Welfare and Poverty’, Physica-Verlag, New York.

- Lewbel, A. (1989), 'Household equivalence scales and welfare comparisons', *Journal of Public Economics* **39**, 377–391.
- Muellbauer, J. (1975), 'The cost of living and taste and quality change', *Journal of Economic Theory* **10**, 269–283.
- Muellbauer, J. & van de Ven, J. (2003), Equivalence scales and taxation: A simulation analysis, in C. Dagum & G. Ferrari, eds, 'Household behaviour, equivalence scales, welfare and poverty', Physica-Verlag, Heidelberg.
- Muellbauer, J. & van de Ven, J. (2004), Estimating Equivalence Scales for Tax and Benefits Systems. NIESR Working Paper 229.
- Olken, B. A. (2005), 'Revealed community equivalence scales', *Journal of Public Economics* **89**, 545–566.
- Orshansky, M. (1965), 'Counting the Poor: Another look at the poverty profile', *Social Security Bulletin* **28**, 3–29.
- Pollak, R. A. & Wales, T. J. (1979), 'Welfare comparisons and equivalence scales', *American Economic Review* **69**, 216–221.
- Seneca, J. J. & Taussig, M. K. (1971), 'Family equivalence scales and personal income tax exemptions for children', *Review of Economics and Statistics* **53**, 253–262.
- Stewart, M. B. (2009), 'The estimation of pensioner equivalence scales using subjective data', *Review of Income and Wealth* **55**, 907–929.
- Storms, B. T., Goedemé, T., van den Bosch, K. & Devuyst, K. (2013), Towards a common framework for developing cross-nationally comparable reference budgets in Europe. ImPRovE Methodological Paper 13/02.
- Szulc, A. (2009), 'A matching estimator the of household equivalence scales', *Economic Letters* **103**, 81–83.
- van de Ven, J. & Creedy, J. (2005), 'Taxation, reranking and equivalence scales', *Bulletin of Economic Research* **57**, 13–36.
- van de Ven, J., Creedy, J. & Lambert, P. (2001), 'Close equals and calculation of the vertical, horizontal and reranking effects of taxation', *Oxford Bulletin of Economics and Statistics* **63**, 381–394.