The Influence of Household Composition on Household Expenditure Patterns: Assessing the Equivalence Scale determining eligibility for the General Medical Services Scheme in Ireland.

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Abstract

This paper presents an empirical study of the effects of household composition on household consumption patterns. Equivalence scales using the Engel food share method and the Rothbarth adult good method are constructed incorporating the effects of household demographics using cross sectional data from the Irish Household Budget Survey 1999-2000. Eligibility for the General Medical Services (GMS) Scheme in Ireland is means tested. This study compares the equivalence scale implied by the means test with the equivalence scale generated by the Engel and Rothbarth methods This paper finds that the weekly expenditure of a married one-child household is 44% higher than that of single adult household using the Engel method and is 41% higher using the Rothbarth method, while for GMS eligibility the weekly expenditure of a married one-child household is deemed to be 62% higher than that of single adult household.

1: Introduction.

Equivalence scales indicate how much income a household with certain characteristics require so that they are able to achieve the same welfare as some base or reference household with varying demographic compositions (Klauvs, 1999; Donalson and Pendakur, 2000). Definition of such scales is important to the study of income distribution, as well as to the formation of public policies regarding the appropriate size of transfer payments, such as, child or medical support awards (Nelson, 1992).

A key element in providing greater access to health care in Ireland is the General Medical Services (GMS) scheme, which entitles low-income earners to receive health services free of charge. Approximately one third of the Irish population have GMS eligibility. Under the Health Act 1970, GMS eligibility is based on a notion of 'hardship', which is defined by income guidelines that are used as a means test to determine eligibility. These income guidelines are based on implicit

equivalence scales. However, no clear justification has ever been provided by the Department of Health and Children as to how the implicit equivalence scale identifying the income thresholds determining eligibility is derived (Nolan and Russell, 2001).

There is also no justification given as to why the Irish GMS implicit scale and the unemployment benefit scale in Ireland both differ from each other. The GMS and the unemployment benefit scale identify the ratio of an adult to a child as being; 1 : 0.18 and 1 : 0.12 respectively. Since all these scales are meant to accomplish the same end, that is, to allow welfare comparisons among households with varying demographic compositions it is surprising that they are both different from each other.

Two of the most popular methods within the observed demand approach for constructing equivalence scales are the Engel (1895) and Rothbarth (1943) methods. Engel (1895) is based on the identifying assumption that the share of the budget devoted to food expenditure correctly indicates welfare between households of differing demographic compositions (Deaton, 1997). According to Rothbarth (1943) two households with the same number of adults who spend the same amount of their budget on adult goods are equally well off. This paper estimates equivalence scales using both the Engel (1895) and Rothbarth (1943) methods on the same data set, the Irish Household Budget Survey 1999-2000, using the same structure of demand equations, so that the differences in the size of the estimated scales cannot be attributed to incompatible demand structures. These derived equivalence scales are then compared to the current implicit equivalence scale determining GMS eligibility to identify whether the implicit scale reflects the objective of what the Engel and Rothbarth equivalence scales are meant to accomplish.

The rest of the paper is presented as follows. Section II presents the theory of equivalence scales estimated from observed behaviour. Section III describes the Engel (1895) and Rothbarth (1943) methods for determining equivalence scales. Section IV identifies and describes the data and empirical results, it discusses the equivalence scales constructed from the estimation of the Engel and the Rothbarth methods and also compares the derived and implicit scales. Section V concludes the paper.

2: The Theory of Equivalence Scales

(a) Approaches for constructing Equivalence Scales

Equivalence scales indicate how much income a household with certain characteristics require so they are able to achieve the same welfare as some base or reference household with varying demographic compositions (Donaldson and Pendakur, 2000; Klavus, 1999). According to Tsakloglou (1991) there are three main approaches to the construction of equivalence scales:

- The first uses nutritional needs of different gender-age groups to determine them (see for example, Visaria, 1980).

However, 'needs' are usually regarded as a social rather than a physiological concept. Further, even if the physiological approach was accepted, the estimated scales are likely to vary considerably over time and across regions, since nutritional needs depend on climate, environment, health, work habits and so on (Tsakloglou, 1991).

- The second approach relies on the use of survey questionnaires directly asking households questions about preferences or hypothetical choices (Kapteyn and Van Pragg, 1976; Goedhart *et al*, 1977).

According to Tsakloglou (1991), this approach introduces a very strong subjective element in the construction of equivalence scales. The subjective methodology

conducted in a well known study by Kapteyn and Van Pragg (1976) derives scales from the evaluation of respondents, where respondents must specify a utility level corresponding to given income levels. Respondents state the income levels that they associate with a corresponding specific utility level, such as states of 'very bad,' 'bad', 'good,' and 'very good'. However the phenomenon that Kapteyn and Van Pragg (1976) referred to as 'preference drift' can occur. This is due to the fact that specifying utility levels leads to a significant correlation between stated income levels and the real income of respondents (Schroder and Schmidt 1992).

- The third approach advocates the estimation of equivalence scales from observed expenditure patterns of households (Jones and O'Donnell, 1995; Deaton and Muellbauer, 1986; Beneito, 2003).

This consumption-oriented approach, which is the most popular and least problematic technique, derives preferences from demand behaviour. The estimates found in this paper of equivalence scales for households with differing demographic compositions are based on this approach. Consumption equivalence scales are intended to measure the relative levels of expenditure needed by households of varying sizes and compositions to attain a comparable standard of living. Thus it is supposed that the well being of a household at any given level of income will be an inverse function of the household size.

According to Tsakloglou (1991) and Deaton (1997) formally the models of equivalence scales derived from observed behaviour assume that the direct utility function of household *i* is given by:

$$u_i = u_i(q_i, z_i) \tag{1}$$

Where u is utility of household *i*, q the vector of commodities consumed by household *i* and z is the vector of household demographic characteristics.

Associated with this utility function is a cost function giving the minimum level of expenditure, X_i, required for household *i* to reach utility level u_i, at prices p_i when z_i is given.

$$c_i(u_i, p_i, z_i) = X_i \tag{2}$$

A reference price vector p_o and a reference utility level u_o can be selected. The cost function of household *i* can be divided by the cost function of the reference household *o* to derive the equivalence scale.

$$m_i = c_i(u_o, p_o, z_i) / c_o(u_o, p_o, z_o) \tag{3}$$

Where m_i is the equivalence scale.

In the simplest case, z_o would represent a single adult household z_i a married couple. Using the pre-married utility level and current prices as base, the excess of equation (3) over unity would be the cost of being married as a ratio of total household expenditure. Alternatively, a consumer's surplus analogy could be followed and measure not the equivalence scale which is an index number, but the cost of being married, which corresponds to a consumers' surplus measure. This is the cost difference in household characteristics (D_i), which would be the amount of money necessary to restore the original welfare level .

$$D_i = c_i(u_o, p_o, z_i) - c_o(u_o, p_o, z_o) \tag{4}$$

The equations above involve direct utility, which is unobservable but associated with them is a system of demand equations linking commodity expenditures to total expenditure, prices and demographic characteristics (Tsakloglou, 1991).

Using Shepherd's Lemma, the Hicksian (compensated) demand functions of good *j* can be estimated:

$$\frac{p_j q_j \partial c_i(u_i, p_i, z_i)}{\partial \ln p_i} \tag{5}$$

Where p_j is the price of good *j*, q_j is the quantity purchased by household *i* of good *j*. Then substituting indirect $v_i(X_i, p_i, z_i)$ for the direct utility $u_i(q_i, z_i)$ of household *i* the Marshallian demand function can be derived:

$$p_j q_j = \frac{\partial c_i\left[v_i(X_i, p_i, z_i), p_i, z_i\right]}{\partial \ln p_i} = f(X_i, p_i, z_i) \tag{6}$$

whose components are observable. Thus it is possible to recover equivalence scales from standard demand systems analysis.

This procedure for identifying equivalence scales was strongly criticised by Pollak and Wales (1979, 1981). It has been argued that, although constructing equivalence scales from observed behaviour is useful for applied demand analysis, it cannot be used for welfare comparisons. Systems of demand equations can only identify 'conditional' preferences and the corresponding cost functions (Jones and O'Donnell, 1995) whereas, 'unconditional', or long run equivalence scales are required for welfare comparisons. However, Jones and O'Donnell (1995) point out that despite this identification problem, observed demands may be used to identify the partial welfare effects of demographic characteristics. Also using observed household expenditure data is the least problematic of the three existing approaches for the construction of equivalence scales.

Pollak and Wales (1979) also argued that equivalence scales in general. are not necessary to determine the cost of a child. Assuming a perfectly contraceptive society whereby it is possible for individuals to deliberately choose family size, it could be considered that children contribute to, rather diminish the welfare of their parents. However, it could also be said that even though individuals may be able to choose to have a children, children cannot decide to be born and if equivalence scales were not used to determine the cost of a child it would be the welfare of children that would suffer.

The search for the best method to estimate consumption based equivalence scales has spawned a large literature (Bradbury, 1994; Gan and Vernon, 2003). Methods include, Engel (1895), Rothbarth (1943), Prais and Houthakker (1955), Barten (1964), Gorman (1975), Muellbauer (1975b), Pollak and Wales (1976), Ray (1983), Kakwani (1977). Several of the methods which may be used to determine an equivalence scales require the estimation of a complete system of demand equations from many Household Expenditure Surveys so that there is sufficient price variation (Prais and Hothakker,1955; Barten,1964; Gorman, 1975; Muellbauer, 1975b; Pollak and Wales, 1976; Ray, 1983) while some others require the estimation of a single equation (Engel,1895; Rothbarth,1943; Kakwani, 1977). The task of this paper is to estimate the Engel and Rothbarth methods. The theories underlying these two methods are discussed in parts (b) and (c) respectively. The other existing techniques for determining an equivalence scale, which are not estimated in this paper, are briefly discussed in part (d) of this section.

(b) The Engel Method

According to Beneito (2003) the use of cross sectional survey data in the estimation of systems of demand equations partly simplifies the task of choosing the method to estimate equivalence scales. Cross-sectional data transforms the relationship between consumption income and prices into the well-known consumption – income (or Engel) relationship. The estimation of the Engel

relationship from cross-sectional data, has been paid considerable attention in previous literature (Blundell and Ray, 1984; Giles and Hampton, 1985; Lee and Brown, 1986; Sawtelle, 1993; Beneito, 2003).

The Engel (1895) method is based on the identifying assumption that the share of the budget devoted to food expenditure correctly identifies welfare between households of differing demographic composition. Engel (1895) pointed out two issues:

- Firstly, that richer household devote a lower proportion of their total expenditure to food than poorer households.
- Secondly, the average propensity of smaller households to consume food is lower than that of larger households when they are at the same level of total expenditure.

As a result, the share of food expenditure in total expenditure can be considered as an inverse indicator of welfare and hence, two households, with the same food share are assumed to enjoy the same level of welfare irrespective of differences in size, composition and total expenditures (Tsakloglou, 1991). Figure 1, in the Appendix illustrates the standard diagram for the Engel method.

On the vertical axis the food share is plotted and on the horizontal axis total household expenditure. Engel's Law states that for any given household composition, there is a negative relationship between the food share and total expenditure. Two curves are contained in Figure 1, one for a small family, AB, and one for a larger family, A'B'.

At the same level of total outlay, the large family spends a larger share of its budget on food, so that its curve lies above and to the right of that for the small family. Starting from some reference point on the curve for the small family, say combination x_o and w_f^o as illustrated, the amount of total expenditure that the large household would require to be as well-off as the smaller family with x_o can be calculated. In the diagram, the large family has a budget share w_f^o at x_1 so that, by the assumption, it requires x_1 to compensate it for its larger family size. If, for example, the larger family is a married couple and the smaller family is a single adult, the cost being married is $(x_1 - x_0)$ and the equivalence scale, that is, the cost of being married relative to a single adult is: $(x_1 - x_0) / x_0$.

Underlying the Engel methodology are two empirical regularities and one assertion.

- The first regularity is Engel's Law itself, that the share of food in the budget declines as income or total outlay increases.
- The second regularity is that, with resources held constant, the food share increases with the number of children (Deaton and Muellbauer, 1986).

The assertion that Engel (1857) made is that the food share is a good indicator of welfare. More precisely, ranking households (inversely) according to their food shares is equivalent to ranking them in terms of well-being. It is important to note that this is indeed an assertion, and not an implication of the two empirical regularities (Deaton, 1997). Since food is so important in the budgets of poor household's, the assertion that the food share indicates welfare has a superficial plausibility (Deaton *et al*, 1989). Food is the first necessity and at least among the very poor, it can probably do a good job of assessing welfare by checking whether people have enough to eat. However, according to Deaton (1997), this claim needs to be argued and the primacy of food is not by itself enough to establish Engel's assertion.

(c) The Rothbarth method

According to Rothbarth (1943), goods and services consumed by a household can be divided into 2 groups:

- Those consumed exclusively by adults ('adult goods').
- Those which are usually consumed jointly by adults and children ('other goods').

The concept of demographic separability as proposed by Deaton *et al* (1989) is an essential precondition for estimating the Rothbarth (1943) method. Deaton *et al* (1989) formalised the idea that some commodities are more closely connected than others with specific age groups in the household, that is, certain goods are demographically separable. Baby clothes, are worn by babies, while alcoholic drinks are consumed by adults. The presence of children is assumed to affect the total expenditure on adult goods only through income-like effects and not through substitution effects, so that if the correct compensation for child costs were to be paid, expenditure on adult goods would be unaltered by changes in the number of children (Deaton and Muellbauer, 1986). While the Engel method works by calculating the amount of money that would restore the foodshare to its previous level, the Rothbarth method calculates the sum of money that would restore the level of expenditure on adult goods.

The procedure for calculating the Rothbarth measure is similar to that for calculating the Engel scale eventhough a different indicator of welfare is being used, expenditure on adult goods rather than the food share (Tsakloglou, 1991). Figure 2 in the Appendix illustrates the Rothbarth method for determining equivalence scales. Figure 1 (which illustrates the Engel method for determining equivalent scales), corresponds to Figure 2, however, instead of the food share, expenditure on adult goods is plotted against total outlay. The larger household spends less on adult goods at the same level of total outlay, so that, if the original x_o is picked as the reference outlay for the small household, the cost of being married is once again $(x_1 - x_0)$ and the equivalence scale, that is, the cost of being married relative to a single adult is: $(x_1 - x_0) / x_0$.

Rothbarth (1943) used a very broad selection of adult goods, including virtually all luxuries and savings. Subsequent studies have used a much narrower definition of adult goods, often confined to such items as alcohol and tobacco (Deaton and Muellbauer, 1986). However, this narrow definition can cause problems since neither category have been typically very responsive to changes in income so that the income effects required to measure the compensation would be harder to establish (Cramer, 1969).

This method was originally described as the 'Generalised Translation' method and was then referred to as the Rothbarth method after his 1943 paper. However, according to Bradbury (1994), Rothbarth in fact did not use 'adult goods' as such for his calculations. Rather he used a concept of 'excess income' as a criterion of the standard of living of the parents. Excess income was defined as the residual after expenditure on rent, rates, state insurance, travel, income tax, food, fuel and clothing.

(d) Other methods for determining equivalence scales.

Other methods of determining equivalence scales are listed in Table 1. One of these methods which has been estimated in previous research is Kakwani's (1977) adaption of the extended linear expenditure system (ELES) of Lluch (1973). The ELES method can be described as a conventional linear expenditure system where

saving is included as a commodity with zero subsistence expenditure (Bradbury, 1994).

Table 1: Methods of Determining Equivalence Scales

Single Equation Methods
• Engel (1895)
• Rothbarth (1943)
• ELES – Kakwani (1977)
Demand Systems Approach
• Prais-Houthakker (1955)
• Barten (1964)
• Gorman (1975)
• Muellbauer (1975b)
• Demographic Translation – Pollak and Wales (1976)
• Price Scaling – Ray (1983)

The ELES method assumes no direct demographic effect upon savings and with this restriction; equivalence scales can be identified from cross-sectional data. Bradbury (1994) describes the ELES method as an application of the Engel method with saving as the numeraire good and could also be interpreted as the Rothbarth method where saving is an adult good. The two main difficulties with this method are that the assumption of no demographic effect on saving is quite restrictive and the measurement of saving from household expenditure surveys is extremely difficult. It is due to these difficulties and the fact that the ELES is very similar to the Engel and Rothbarth methods that it is not estimated in this paper. Friedman (1952) is omitted from Table 1, similar to Muellbauer (1977) since this method is either the same as the Engel method or is inconsistent with optimising behaviour.

Prais-Houthakker (1955), Barten (1964), Gorman (1975), Muellbauer (1975b), Pollak and Wales (1976) and Ray (1983) all constructed equivalence scales from a system of demand equations to ensure a sufficient amount of price variation which is necessary for the estimation of these methods. Since the data used in this paper is cross-sectional it is not possible to use these methods to construct an equivalence scale. The calculation of the demand systems methods requires estimation of a potentially large system of equations and it is not clear what is gained over the much simpler Rothbarth methodology (Deaton, 1997).

3: Empirical Techniques

(a) Estimation of the Engel method

In order to proceed to the estimation of the Engel method for determining equivalence scales a model for the Engel curve, where the dependent variable is the budget share of food has to be selected (Tsakloglou,1991). One equation that frequently has been found to fit the data well is the Working (1943) – Lesser (1963) model, in which the food share is a linear function of the logarithm of total outlay as can be seen below:

$$w_{fi} = \alpha_{0i} + \alpha_{1i} \ln x_i \qquad (7)$$

where w_{fi} = share of the budget spent on food for household *i*
x_i = total outlay of household *i*
$\alpha_{0i}, \alpha_{1i},$ = coefficients to be estimated by the model

Previous studies have focused on aggregation of consumers demand using various demand systems. Deaton and Muellabuer (1980) addressed this concern with a demand that successfully aggregated over consumers – the Almost Ideal Demand System (AIDS). The AIDS model is derived from the consumer cost function corresponding to price-independent, generalised logarithmic (PIGLOG) consumer preferences (Chalfant, 1987). The AIDS model is of comparable generality to the Rotterdam and translog models but has considerable advantages over both.

According to You (2003) modelling the Engel curve in the Working-Lesser format is consistent with the microeconomic theory of the consumption expenditure relationship and can be derived from the linear Almost Ideal Demand System (AIDS) of Deaton and Muellbauer (1980). According to Deaton and Muellbauer (1980) the AIDS functional form is consistent with observed expenditure data.

Beneito (2003) when estimating a complete system of Engel curves for the Spanish economy used the Price Independent Generalised Lineraity (PIGL) family of expenditure functions instead of the AIDS functional form. The PIGL function estimated by Beneito (2003) was non-linear and included a Box – Cox transformation of income as an explanatory variable therby justifying the use of a functional form other than AIDS. The PIGL family of expenditure functions accomplishes the well known aggregation theorems of Muellbauer (1975, 1976) which facilitates the characterisation of goods as luxuries or necessities and moreover under certain general conditions it ensures that the demand functions have the desired theoretical properties and that the expenditure function is concave (Verbeek, 2000).

The first equivalence scale estimated in this paper is constructed using the Engel food share method. This method does not involve estimating a complete system of Engel curves, it requires the estimation of only one Engel curve. The PIGL expenditure functions classification of goods is therefore not necessary and the AIDS model will suffice.

The second equivalence sale is constructed using the Rothbarth method, which begins by estimating a complete system of Engel curves for adult goods, as described below. The PIGL model may be appropriate here, however given that the equivalence scale derived from the Engel and Rothbarth methods will be compared in Section 4 it is better that the same structure of demand equations are used so that the difference in the size of the estimated scales cannot be attributed to incompatible demand structures. Therefore, the AIDS model is also used in the construction of the Rothbarth scale.

This paper estimates the following model for the derivation of the Engel scale

$$w_{fi} = \alpha_{oi} + \alpha_{1i} \ln x_i + \alpha_{2i} z_i + \alpha_{3i} y_i \qquad (8)$$

where w_{fi} = share of the budget spent on food for household *i*
x_i = total outlay of household *I*
z_i = demographic composition of household *i*
y_i = other variables of household *i* listed in Table 2 of Appendix
$\alpha_{0i}, \alpha_{1i}, \alpha_{2i}, \alpha_{3i}$ = coefficients to be estimated by the model

The dependent variable of the equation to be estimated is the budget share (or share of total expenditure) that food accounts for (w_f). The definition of food used in this paper

is the definition followed by the Central Statistics Office in their analysis of the Household Budget Survey 1999-2000.

The aim of this paper is to construct equivalence scales that identify the effects of household composition on household consumption patterns. It is therefore necessary to include household composition (z) as an explanatory variable in the estimation of the Engel curve. The household composition variable consists of nine dummy variables; single adult household aged 14-64, single adult household aged 65 plus, married couple household, married couple household with one child, married couple household with two children, married couple household with three children, married couple household with four or more children, single adult household with children and all other households (for example, people sharing). The reference household will be a single adult household aged 14-64.

In the estimation of an Engel curve one of the most important explanatory variable is purchasing power (Deaton, 1997). This variable is normally defined in one of the two following ways. A first possibility is to consider as a measure of purchasing power the total income of the unit of analysis. A second possibility is to use the total level of expenditure of the unit of analysis as such a measure (Thomas, 1972). According to Beneito (2003) the use of the total level of expenditure as an explanatory variable ensures the fulfilment of the adding up restriction in a system of equations where the dependent variables are defined as shares of the total level of expenditure. In this paper the total level of expenditure (x) will be used as an explanatory variable since income is also considerably affected by measurement errors in survey data.

A number of other explanatory variables (y) aiming to control for socio-demographic factors affecting the food consumption patterns of the household have also been included similar to Tsakloglou (1991) and Deaton and Muellbauer (1986). These variables include; social class, education level, housing tenure, working status, location, social group, the quarter in which the survey was conducted, number of males and females in the household and whether a member of the household was permanently incapacitated for work.

Subsequent to the estimation of the Engel curve, the Engel equivalence scale can be constructed by equating the food share of the reference household with the food share of the household under examination.

(b) Estimation of the Rothbarth Method

The first step to estimate the Rothbarth (1943) method is to select a group of 'adult goods' or demographically separable goods in the terminology of Deaton *et al* (1989). Adult goods are goods that are independent of the demographic characteristics of children, that is, children have income but not substitution effects on them. The existence of adult goods is a necessary but not sufficient condition for the justification of the Rothbarth method (Deaton and Muellbauer, 1986). To begin the procedure of identifying adult goods a list of potential adult goods must be selected. To decide whether a potential adult good is actually an adult good, the expenditure on it can be regressed on the total expenditure of all potential adult goods selected, the demographic variables (z) and on the set of other variables (y). Similar to Deaton et al (1989) and Tsakloglou (1991) the following linear model was adopted.

$$p_{ji}q_{ji} = \beta_{0i} + \beta_{1i} \ln x_{Ai} + \beta_{2i}z_i + \beta_{3i}y_i \qquad (9)$$

where: $p_{ji}q_{ji}$ = expenditure on the particular potential adult good

x_{Ai} = total expenditure on all potential adult goods

z_i = demographic composition of household *i*

y_i = other variables of household *i* listed in Table 2 of Appendix

$\beta_{0i}, \beta_{1i}, \beta_{2i}, \beta_{3i}$ = coefficients to be estimated by the model

Since $x_{Ai} = \sum_{j...1}^{n} p_{ji} q_{ji}$ it is likely that x_{Ai} will not be independent of the error term of (12) for each commodity. For this reason equation (12) has been estimated similar to Deaton *et al* (1989) and Tsakloglou (1991) by using Instrumental Variables instead of Ordinary Least Squares with total expenditure as the instrument for the expenditure on adult goods. The restrictions that the marginal propensity to spend on adult goods out of x_{Ai} is equal to one ($\sum_i \beta_{1i} = 1$) was imposed across equations.

Subsequent to the estimation of the subsystem of equation (9) an F-test is conducted of the hypothesis that the child demographic variables are jointly insignificant and therefore the commodity should be classified as an adult good. On the basis of the results from the F-tests, the non-adult goods are excluded from the group of adult goods. The subsystem is then re-estimated using the remaining subgroups of goods and the new definition of expenditure on adult goods to confirm that these commodities are adult goods. The Engel curves for the budget share of the confirmed adult goods are then estimated using equation (10), which involves the same estimation procedure as equation (8).

$$w_{Ai} = \alpha_{oi} + \alpha_{1i} \ln x_i + \alpha_{2i} z_i + \alpha_{3i} y_i \qquad (10)$$

where w_{Ai} = share of the budget spent on food for household *i*

x_i = total outlay of household *I*

z_i = demographic composition of household *i*

y_i = other variables of household *i* listed in Table 2 of Appendix

$\alpha_{0i}, \alpha_{1i}, \alpha_{2i}, \alpha_{3i}$ = coefficients to be estimated by the model

The Rothbarth equivalence scale is derived from the results of equation (8). The right hand side of equation (8), multiplied by x_i yields an estimate of expenditure on adult goods. This according to Rothbarth, is monotonically related to adult welfare (Deaton *et al*, 1989). Following Deaton et al (1989) and Tsakloglou (1991) a base household is then selected, which is a single adult for this study, total expenditure x_0 (reference total expenditure) and sample mean characteristics. The predicted expenditure on adult goods x^o_A can be calculated for this base household. For some other household, a married couple for example, the value of total expenditure, x_1, that would generate x^o_A is calculated. The cost of household with a composition different to that of the base household is then $(x_1 - x_0)$. A married couple is equivalent to $(x_1 - x_0)/x_0$ of a single adult.

4:Data and Empirical Results

(a) The data

The data used in this paper comes from the Irish Household Budget Survey, which was conducted, between June 1999 and July 2000. A total of 7644 sample households co-operated in this large scale national survey. The maintenance of a detailed diary of household expenditure over a two-week period by the surveyed households is the main distinguishing feature of the Household Budget Survey. Detailed information is also collected on all sources of household income and a range of household facilities**.**

(b) Results from the estimation of the Engel method

Descriptive statistics of the household composition variable, which is required for the construction of both the Engel and Rothbarth equivalence scales, are displayed in Table 2. It is evident from this table that the largest proportion of the sample, that is, 39.32% are in the all other household category, while the married with 4 or more children contains the smallest proportion a mere 1.77% of the sample population. The categories within the household composition variable have been divided into separate variables. The minimum and maximum values of the dummy variables are 0 and 1 respectively, as expected. The reference household for the derivation of the equivalence scale will be the single adult household aged 14-64.

Table 2: Descriptive Statistics for Household Composition

Variable	Description	Percent	Mean	Std error	Min	Max
Single adult 14-64	Single adult aged 14-64 HH	8.97	0.098	0.004	0	1
Single adult 65+	Single adult aged 65+ HH	10.82	0.114	0.004	0	1
Married couple	Married couple HH	18.13	0.159	0.004	0	1
Married 1	Married couple 1 child HH	4.64	0.059	0.003	0	1
Married 2	Married couple 2 child HH	8.58	0.104	0.004	0	1
Married 3	Married couple 3 child HH	4.98	0.063	0.003	0	1
Married 4 or more	Married couple 4+ child HH	1.77	0.032	0.002	0	1
S.A. with children	Single adult with children HH	2.77	0.046	0.003	0	1
All other HH	All other HH	39.32	0.324	0.006	0	1

(Note: Percent = percentage of sample in each category, Mean = weighted mean to allow for sample design and differential response)

Results of the estimation of the Engel equation (8) are reported in Table 3.

Table 3: Engel curve coefficients for the budget share of food

Variable	Coefficient	T Value
Lnhouseexp	-0.131	-39.99
Single adult 65+	-0.004	-0.57
Married couple	0.044	8.12
Married 1	0.048	7.52
Married 2	0.064	9.89
Married 3	0.064	7.50
Married 4 or more	0.057	5.31
S.A. with children	0.024	2.05
All other HH	0.060	9.76

(Base category - single adult 14-64)

The coefficient on the log of total household expenditure is negative, as previous studies have indicated (Deaton and Muellbauer, 1986: Deaton, 1981; Espenshade, 1984; Tsakloglou, 1991). The coefficients of the family composition variable increases from single adult 65+ (household with one adult aged 65 or over) to

married 3 (households whose family composition is a married couple with 3 children). The coefficient on single adult 65+ is negative implying that a single adult aged 65 years or over spends less of their total expenditure on food than a single adult aged between 14 and 64 years. The coefficient on single adult with children is larger than the coefficient single adult 65+ indicating that a single adult with children have heavier food requirements than a single adult. The coefficient on married 4 or more (married couple with 4 or more children) is smaller than the coefficients on married 3 (married couple with 3 children) and married 2 (married with 2 children). This result implies that if Engel's contention that foodshare is an inverse indicator of welfare were to be accepted, larger households behave as if they are better off than smaller households. This result was also found by Subramanian and Deaton (1991) when estimating an Engel curve for India but remains counter intuitive.

(c) Results from the estimation of the Rothbarth method

The results of the estimation of the subsystem of equation (9) are reported in Table 4. Eight potential adult goods are included (the group 'other' contains the following; coffee newspapers, magazines, smoking requisites, legal expenses, gambling, subscriptions, insurance, funeral expenses, licenses and stationary). The final column in Table 4 reports the results of an F-test of the hypothesis that the child demographic variables are jointly insignificant and therefore an adult good. For five subgroups this hypothesis is rejected at the 5% level of significance (alcohol, tobacco, medical care, personal services and transport).

Table 4: Engel curves for the expenditure on eight potential 'adult goods'

Adult good	mps**	R^2	F-test
Meals Out	0.1784295 (21.18)	0.4526	2.31
Alcohol	0.1948794 (17.17)	0.5795	11.14*
Tobacco	0.0072916 (1.81)	0.1803	3.55*
Clothfoot	0.3020715 (19.46)	0.4911	0.69
Med care	0.1044831 (11.06)	0.2723	10.07*
Peronal S	0.0479253 (14.05)	0.3644	6.33*
Transport	0.0678966 (7.78)	0.2652	4.08*
Other	0.0970231 (10.40)	0.2790	2.93

** Hypothesis rejected at the 5% level of significance*
*** $\sum mps = 1$*

On the basis of these results it was decided to exclude these commodities from the group of adult goods. The subsystem was then re-estimated using the remaining subgroups and the new definition of expenditure on adult goods and it was confirmed that these commodities were adult goods. Therefore, the definition of adult goods used for the estimation of the Rothbarth method includes expenditure on Meals Out, Clothing and Footwear, and expenditure on the 'Other' category.

Table 5 reports the estimation results of the Rothbarth equation (10) and are interpreted in the same way as Table 3. The coefficients of the demographic variables turn out to be statistically significant except for the single adult household aged 65 and over. The child demographic variables have the expected signs (negative), indicating that the satisfaction of children's needs requires the reduction of resources available for the purchase of adult goods.

Table 5: Engel curve coefficients for the budget share of adult goods

Variable	Coefficient	T Value
Single adult 65+	0.007	0.91
Married couple	-0.040	-6.91
Married 1	-0.040	-5.62
Married 2	-0.035	-5.46
Married 3	-0.034	-4.14
Married 4 or more	-0.034	-3.56
S.A. with children	-0.052	-6.98
All other HH	-0.036	-5.73

(Base category - single adult 14-64)

(d) Results of the derived equivalence scales using the Engel and Rothbarth methods

Table 6 displays the equivalence scales constructed using the Engel and Rothbarth methods.

Table 6: Engel and Rothbarth equivalence scales

Variable	Engel Scale	Rothbarth scale
Single adult 14-64	1	1
Single adult 65 +	0.969	0.796
Married couple	1.4028	1.0878
Married 1	1.4452	1.4158
Married 2	1.6277	1.3868
Married 3	1.6285	1.6062
Married 4 or more	1.5441	1.6565
S.A. with children	1.2008	1.6412
All other HH	1.5832	1.1747

The weekly expenditure of a married household is 40% higher than that of a single adult household using the Engel method, while it is only 9% higher using the

Rothbarth method. The cost of being married and having one child to a single adult is 44% of the total household expenditure using Engel and the corresponding value is 4% lower than that (41%) using Rothbarth. It seems from the Engel scale of Table 6 that the cost to a single adult of being married and having four or more children is less than the cost of being married and having two or three children. A comparable result is not apparent in the Rothbarth scale, however the Rothbarth scale highlights that the cost of being married and having 2 children is less than the cost of being married and having one child.

The Engel and Rothbarth equivalence scales constructed in this study highlight the conclusion that different consumption patterns of food exist depending on the household's composition. This confirms the general conclusions found in previous studies (Deaton and Muellbauer, 1986; Tsakloglou, 1991; Deaton, 1997; Subramanian and Deaton,1991). However, as also pointed out by Beneito (2003), the wide range of variation obtained in some cases (as an example, household expenditure), suggests the possibility of running separated regressions for households of different levels of income. Previous studies, when calculating the cost of a child, for example, Deaton and Muellbauer, (1986) and Tsakloglou, (1991) proposed that the Engel method overstates whilst the Rothbarth method may understate the 'true' cost of a child and accordingly found that the Rothbarth scale to be lower than the Engel scale this proposition held true for the majority of the variables when the scales were constructed using the reference household of a single adult aged 14-64.

(e) Comparison of derived scales with the implicit scale determining GMS eligibility

The income guidelines and the implicit equivalence determining GMS eligibility are summarised in Table 7, and are revised annually. GMS status is awarded on the grounds that the applicant's income or total family income is below the designated income limits. Since 2001 people aged 70 and over are automatically entitled to a medical card. Table 7 also compares the derived equivalence scales and the implicit GMS scale of the comparable categories. The reference households age categories of the derived scales do not exactly match the reference households age categories of the implicit scale but are close (single adult aged 14-64 as opposed to, single adult aged under 66).

Table 7: Derived and implicit equivalence scales

Category	GMS Income	GMS Scale	Engel	Rothbarth
Single Adult	€132	1	1	1
Married couple	€117	1.44	1.4028	1.0878
Married 1 child	€190.50	1.62	1.4452	1.4158
Married 2 children	€24	1.80	1.6277	1.3868
Married 3 children	€25	1.98	1.6285	1.6062

It can be seen from Table 7 that differences exist between the implicit and derived scales. The implicit scale allows a married couple household to earn a weekly

income which is 44% higher than that of a single adult household and still be eligible for GMS status. This implies that the weekly expenditure of a married couple household is assumed to be 44% higher than that of a single adult. The Engel method would allow the married couple household to earn 40% higher than that of a single adult household, whilst the relevant figure for the Rothbarth method is 8.78%.

The implicit scale allows a married one child household to earn a weekly income which is 18% points higher than that of a married household with no children and still be eligible for GMS status, the corresponding figure for the Engel and Rothbarth method is 4.24% and 32.8%, implying a child cost of 0.04 and 0.328 respectively. The Rothbarth result is not unlike what was found in previous studies. Deaton and Muellbauer (1986) estimated a child cost of 0.24, while Deaton *et al* (1989) estimated it at 0.44. The implicit scale does not allow for economies or indeed diseconomies of scale for households increasing their number of children while it is evident from the derived scales that economies of scales are present when a household increases its size.

5: Conclusion

This paper presents an empirical study of the effects of household composition on household consumption patterns. Equivalence scales using the Engel food share method and the Rothbarth adult good method are constructed incorporating the effects of household demographics using cross sectional data from the Irish Household Budget Survey 1999-2000. An equivalence scale using the Engel (1895) method is estimated by regressing family composition, total household expenditure as well as a number of other explanatory variables on the households budget share of food. The Rothbarth (1943) scale is constructed by estimating the Engel curve for the household's budget share of adult goods that have been tested for demographic separability. This study then compares the equivalence scale implied by the GMS scheme in Ireland with the equivalence scale derived by the Engel and Rothbarth methods.

The relativities contained in the three equivalence scales examined in this paper (Engel, Rothbarth and GMS implicit) are meant to provide a meaningful way to compare across households with different demographic compositions. However, a comparison between the derived and implicit equivalence scales in Table 7 of section 4 highlights numerous anomalies. For example, under the GMS implicit, Engel and the Rothbarth scale the weekly household expenditure of a married couple is deemed to be 44%, 40% and 8% higher than that of a single adult household respectively. This highlights that the equivalence scale implicit in determining GMS eligibility does not match either of the two derived methods.

The use of cross-sectional data coming from surveys, may offer a high number of cases where the expenditure in some of the consumption categories is zero (Beneito, 2003). This issue may not be true for the Engel method since the consumption category focused on is food but would be a great concern of the Rothbarth adult good method . Therefore, there is potential to further the research in this paper by grouping the original individual household observations according to the characteristics of the mainholder of the household. Other possible aspects that could require additional thought would be the use of a functional form other than AIDS and the use of semi-parametric econometrics to estimate within period equivalence scales similar to those estimated by Pendakur (1999) and Stengos *et al* (2003).

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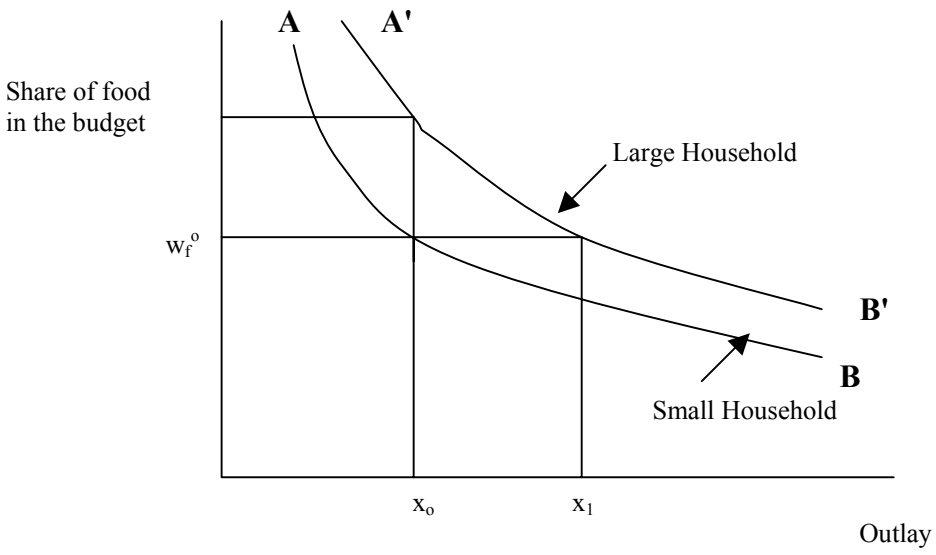
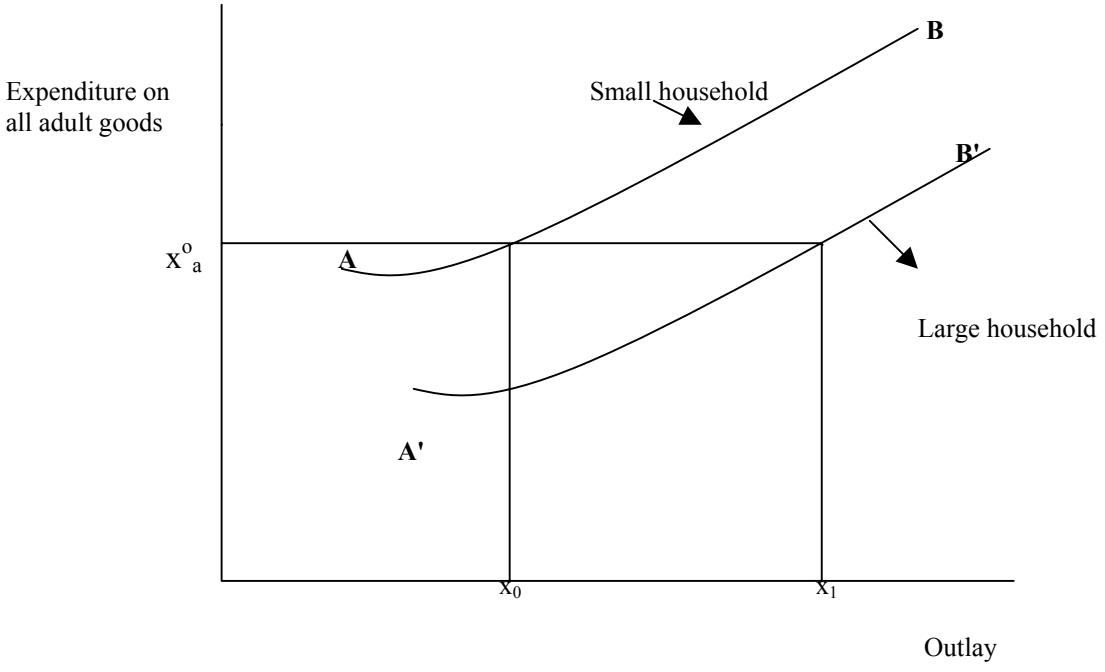
APPENDIX
Figure 1: Engel Method of Equivalence Scale Calculation.



Source: Deaton (1997)

Figure 2: Rothbarth Method of Equivalence Scale Calculation



Deaton (1997)