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IS THERE BIAS IN COMPUTING HOUSEHOLD EQUIVALENCE SCALES?

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Household equivalence scales are often used to help perform welfare comparisons across households with different demographic composition. Abstracting from the problems of value judgments and ethical standards, the use of equivalence scales to perform welfare comparisons still faces several measurement problems, namely the identification problem and the endogeneity problem. This paper introduces and estimates an unconditional demand system that simultaneously addresses these two problems. By explicitly considering the demand for leisure, and the fact the household can choose some of its demographic characteristics, we deal with the endogeneity problem and obtain consistent estimates. We identify unconditional equivalence scales by estimating the demand for endogenous demographic variables along with the demand for leisure and consumer goods. More general equivalence scales allowing for better comparability are estimated and used for welfare comparisons.

1. INTRODUCTION

Whether the issue is the measurement of inequality, the definition of the poverty line for households with different demographic profiles, or other aspects of social policy, welfare comparisons across households are often required. Household equivalence scales (ES) are one of the devices used to help address these issues, permitting the conversion of an actual economy into an "as if" economy of identical single adults (Blackorby and Donaldson, 1991). The empirical use of equivalent scales has faced two significant problems: the problem of the *identification* of the scales using data on observable household behavior; and the econometric implications of *endogeneity* of some of the socio-demographic variables (such as family size) which can adversely affect the validity of the scale estimates.

This paper introduces and estimates an unconditional demand system that simultaneously addresses these two problems. First, by explicitly considering that households can choose some of their demographic characteristics, we deal with

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the endogeneity problem and obtain consistent parameter estimates. Second, we identify unconditional equivalence scales by estimating the demand for the endogenous demographic variable (the number of children) along with the demand for leisure and consumer goods. This joint analysis appears particularly relevant since strong interactions likely exist between leisure decisions, consumption decisions, and the number of children in the household. It provides useful insights into the household preference structure. In particular, the simultaneous analysis of demographic choice, leisure, and consumption choice helps the identification and evaluation of welfare measurements across households. This is illustrated in an empirical application using the 1986–90 consumer expenditure survey of the U.S. Bureau of Labor Statistics. More general equivalence scales allowing for better comparability are estimated and used for welfare comparisons.

The paper is organized as follows. Section 2 presents the problems associated with the use of equivalence scales in inter-household welfare analysis. Section 3 introduces the theoretical model. Section 4 summarizes the estimation methodology and Section 5 presents the empirical model. Section 6 displays the results and Section 7 presents the conclusions.

2. Equivalence Scales and Related Problems

Abstracting from the problems of value judgments and ethical standards, the use of equivalence scales to perform welfare comparisons across households still faces several measurement problems. This section discusses two of the problems associated with the construction and use of household equivalence scales: the identification problem and the endogeneity problem.

2.1. *The Identification Problem*

Pollak and Wales (1979) were the first to point out that only *conditional household preferences* can be inferred from observed demand behavior, where "conditional" means for a given socio-demographic profile. Yet, welfare comparisons across households require *unconditional preferences*. This can be seen by comparing households with different numbers of children, with the possibility that each household may have different preferences toward children. If we make welfare comparisons based on equivalence scales that are computed conditional on a predetermined demographic profile, potential differences in utility due to different demographic composition of households are neglected.

Borrowing from Van Praag's (1991) terminology, consider that household utility has two dimensions: an *horizontal* one reflecting the quantity q of consumer goods, and a *vertical* one corresponding to the demographic (d) composition of the household (Figure 1). Observed demands represent preferences conditional on the demographic composition d so they can only identify the *horizontal dimension of utility*. To illustrate, consider a conditional preference ordering, $U(q \mid d)$ that rationalizes observable household demand for consumer goods q. The class of transformations $V(q, d) = F[U(q \mid d), d]$, with F strictly increasing in U, will relabel the indifference curve on the q–d space. Different functional forms for F correspond to changes of the *vertical dimension of utility* that do not change its *horizontal dimension*.

To see that, let p denote the vector of market prices for the consumer goods q, and u be some household utility level. In terms of the cost function, this means that conditional Hicksian household demand of the form $q(p, u|d)$ can arise either from a cost function of the type $C(p, u|d) = \min_q [p^T q | U(q|d) \geq u]$, or from a cost function given by $\bar{C}(p, u, d) = \min_q [p^T q | F(U(q|d), d) \geq u]$. In conditional models where only the quantities of market goods are the object of choice, the empirical distinction between these two cost functions is not possible.

This suggests that the recovery of unconditional equivalence scales requires the construction of models where both market goods and demographic composition are objects of choice. As an example, consider the *conditional household equivalence scales* comparing two demographic profiles d^h and d^0:

$$\mathrm{ES}^c(p, u|d^h, d^0) = C(p, u|d^h)/C(p, u|d^0),$$

for all u in $\Re$. However, under the preference structure $V(q, d) = F[U(q|d), d]$, the true *unconditional household equivalence scales* take the form:

$$\mathrm{ES}^u(p, u, d^h, d^0) = C(p, F(u, d^h), d^h)/C(p, F(u, d^0), d^0),$$

for all u in $\Re$. Note that ES^u allows for different households to enjoy different utilities from different demographic compositions. Only if the function $F(U, d)$ is independent of d is there no identification problem for the scales. Otherwise, the true schedule of equivalence scales cannot be econometrically identified from observed consumption goods q.

Consider Figure 1, where the observed consumption of family A is given by point A. Similarly, family B consumes the quantities associated with point B. According to the observed patterns of consumption, these two families enjoy the same utility. However, because they obtain different utilities, respectively A' and B', from their demographic composition, their true utility levels are different. The unconditional ordering captures the individual's preferences between *situations* (Pollak, 1991) in which only the demographic composition, or other attributes change. Thus utility differences cannot be recovered from observations on which only consumer goods are considered objects of choice.

One way to avoid the identification problem is to use a *conditional cost function* (e.g. a demographically augmented Barten scaled cost function) to calculate the associated equivalent scales. This is equivalent to imposing restrictions on household preferences such that the function F satisfies $F(U, d) = F(U)$. For example, the traditional literature implicitly assumes that the utility of having children (or other demographic attributes) is constant across families (e.g. Jorgenson and Slesnick, 1987). In this case, unconditional equivalence scales can be identified from conditional choices. However, the assumption that $F(U, d)$ is independent of d appears rather strong. If such an assumption is not satisfied, then the use of conditional equivalence scales would lead to misleading welfare comparisons across households.

The research question for welfare analysis is whether it is possible for the analyst to estimate unconditional household equivalence scales (rather than conditional ones). If the demographic variables d are not object of choice, additional psychometric data on attained utility levels are needed, since no revealed preference analysis for d is possible. However, if some socio-demographic variables (e.g.

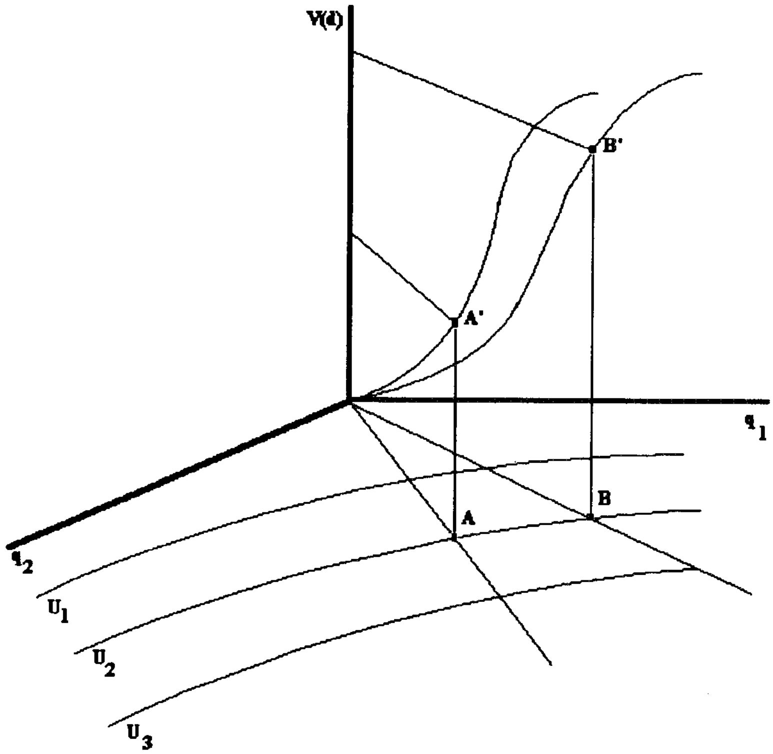

Figure 1: The Vertical and Horizontal Dimension of Utility

family size) are objects of choice, then analyzing such decisions can provide useful insights into the household preference structure $F(U, d)$ and its welfare implications. However this requires the *joint* estimation of consumer demand for q and of the demographic variables subject to choice.

2.2. *The Endogeneity Problem*

In the estimation of household equivalence scales, the issue of treating some demographic variables as endogenous to the household raises an econometric issue. Such endogeneity means that the parameter estimates of traditional demand functions (conditional on a demographic profile) are subject to simultaneous equation bias. Similar arguments apply to the labor/leisure choice. As a result, the estimation of a demand system that considers only consumer goods might be limited in scope and realism. And the resulting parameter estimates might not even be consistent because of the simultaneity problem (Browning and Meghir, 1991).

For our purpose, we will consider the joint estimation of consumer demand, leisure choice, and family size. This requires addressing the econometric issue raised by endogeneity. It implies the need to use an estimation method that deals directly with the simultaneity of the decisions analyzed.

3. THE MODEL

3.1. *Theoretical Background*

Most empirical investigations of household demand in the literature focus on the demand for consumer goods (e.g. Pollak and Wales, 1981). Yet, the consumption decision likely interacts with the labor-leisure decision, and with fecundity choice influencing the number of children. This section introduces a model that simultaneously considers household choice over goods and leisure. Perhaps more importantly, it also analyzes jointly the utility that parents enjoy from children, thus allowing to model the fecundity choice.[1] This joint analysis appears particularly relevant since strong interactions likely exist between the number of children, leisure decisions, and consumption decisions.

It is undeniable that "the adult may derive utility from the child in the same way that he/she derives utility from other possessions, and his/her choice to have the child and expend resources on the child are simply part of his/her own utility maximizing strategy" (Lazear and Michael, 1980: 55). A utility function of the family that does not incorporate this assumption will likely be inappropriate and the distribution of household expenditures will not be a valid welfare measure.

In the short run, family size could possibly be taken as fixed. However, in the longer run, it is typically a subject of choice as the household can take steps that affect the number of children. Assume that households behave as if they have a neoclassical utility function, where the utility that parents enjoy from children is an argument. To some extent, children can be considered a durable and irreversible good. In this framework it makes sense to consider that, in each period, it is likely that the household might be better off if they could adjust for the supply of children. Let k be the *actual* number of children in the household. This supply is fixed in each period of the analysis. Now, let k^* define the number of children that the family would "demand" in each period if the fecundity choice as unrestricted, and without adjustment costs. Therefore, k^* corresponds to the household's *desired* number of children. k^* may differ from one period to the next, as other variables change (income, costs of children, etc.). The difference between k and k^* can be interpreted as an indication of whether the parents think of their children as a curse ($k^* < k$), or as a blessing ($k^* > k$).

We propose a model that represents the determination of k^*. Assume that, given the time and budget constraints in the household, the parents combine inputs (leisure and market goods) to maximize the value of the presence of children in the household. Each family may have different *intensities* of enjoyment from their children. Household behavior is assumed consistent with the following optimization problem:

$$\max_{q,\, k^*} \{U(q, \vartheta(k^*, k) | d) : p^T q \leq M\},$$

where q is the vector of consumer goods (including leisure), p is the price vector for q, M denotes household income, d is a vector of demographic variables other

[1]For a full presentation and derivation of the model see Ferreira (1992), Chapter 3.

than k, and $\vartheta(k^*, k)$ measures the *pure* utility from children.[2] The solution to the above optimization problem gives the optimal *desired* number of children $k^* = f(p, M|d)$. In this context, the optimal utility function of the household can be expressed as a function of p, M, d and k.

The above model assumes that choosing k^* is motivated by the utility that parents enjoy from children. It assumes that it is possible to separate the *pure* utility that the household enjoys from children from the utility derived from the consumption of all other goods.

The introduction of demographic variables into the utility function captures the differences in behavior and utility due to different demographic composition, including the actual number of children in the household. However, this information does not tell us how parents feel about their children. To complement the information already contained in the demographic composition of the household, we need a measure of how far the parents are from the optimal solution, k^*. We assume that $\vartheta(\cdot) = \exp((k^*/(k+1))$ captures parents' feelings about children. This choice of the exponential function is essentially a matter of empirical simplicity and tractability.

Let $\phi(u^*) = U(\cdot)$ represent the *unconditional* level of utility. Taking into consideration the utility enjoyed from the children, we can write $\phi(u^*) = \phi(u)\vartheta(k^*, k)$, where $\phi(u)$ is the *conditional* level of utility, and $\vartheta(k^*, k)$ is the "pure utility" derived from the children present in the household. This specification yields testable implications for observed demand behavior.

Given additional assumptions, one can capture how parents feel about the children they have from their observed behavior. Denote the household cost function by $C(\phi(u^*), p|d)$, where $\phi(u^*)$ is a "scaled up" transform of $\phi(u)$ (since $\vartheta(k^*, k)$ is strictly positive). This is what we term the *unconditional* cost function, in contrast with $C(u, p|d, k)$ which is *conditional* on all elements of the demographic profile (including family size).

3.2. *Empirical Specification*

In order to maintain theoretical plausibility of the transformed demand system, Lewbel's (1985) modifying technique to incorporate demographic variables in a demand system will be used. In all cases, the basic demand system is the *Almost Ideal Demand System* (AIDS) model proposed by Deaton and Muellbauer (1980).

In this study the demographic variable "number of children in the household" is central to the analysis as it is treated as an endogenous decision variable. Lewbel's procedure, by constructing adequate modifying functions, produces the *Shifting Reverse Gorman* (SRG) model which nests Barten Scaling, Share Translating, and Parameter Shifting.[3] Since it allows for a complete, articulate, and exhaustive pattern of interactions between price, income and demographic variables, it

[2]The vector q of consumer goods implicitly includes leisure, which has the wage rate as opportunity cost. In this context, the income variable M should therefore be interpreted to be Becker's "full income".

[3]A slightly different version of this model was first introduced by Ferreira and Perali (1992) with the name of Extended Barten–Gorman model.

is an appropriate way to introduce the demographic variables into the demand model. The *translating* technique captures the effects of children on basic needs. *Scaling* considers the fact that children affect perception of tastes or wants. The dependence of the income parameters (*shifting*) on the number of children allows deriving profile specific income elasticities, as well as allowing for interactions between income and demographic variables. The specification of the empirical SRG-AIDS model, can be written in budget shares $w_i = p_i q_i / M$ as:

$$(1) \qquad w_i = \alpha_i + t_i(d) + \Sigma_j \gamma_{ij} \ln(p_j^*) + \beta_i(d)[\ln(y^* - \ln(P)] + B(p, d)[\partial \ln(\vartheta(k^*)/\partial k^*][\partial k^*/\partial \ln(p_i)], \qquad i = 1, \ldots, n,$$

where $\ln(y^*) = \ln(M) - \Sigma_j t_j(d) \ln(p_j^*)$ defines the translating function specific to the i-th commodity, $\ln(P) = \Sigma_j \alpha_j(d) \ln(p_j^*) - 0.5\, \Sigma_i \Sigma_j \gamma_{ij} \ln(p_i^*) \ln(p_j^*)$, $m_i(d)$ is the scaling function specific to the i-th commodity, $B(p, d) = \Pi_j p_j^{\beta_j(d)}$, and $p_j^* = p_j m_j$ are the Barten scaled prices.[4]

The derivation of the shares, given the presence of k^* (which is intrinsically unobservable) requires some additional assumptions. To generate the link between the *actual* number of children in the household, and the *desired* number of children, the latent variable of interest, we assume that $k = k^* + \varsigma$, where ς is a random variable with mean zero. Then the difference between k^* and k may be seen as a "noise" arising from the fact that children are typically chosen under less than perfectly controllable conditions. Given that $E[\varsigma | x] = 0$, then $k^* = E[k|x]$, where x represents a set of exogenous variables, that may include p, M, and exogenous demographic factors in d. Now, let $k = f(x^T \xi) + \varsigma$, where k has a Poisson distribution, conditional on x. It follows that $\partial k^*/\partial \ln(p_i) = \partial k/\partial \ln(p_i)$. We further assume that $f(x^T \xi)$ is such that $E(k|x) = \exp(x^T \xi)$.

The derived shares in (1) are then given by:

$$(2) \qquad w_i = \alpha_i + t_i(d) + \Sigma_j \gamma_{ij} \ln(p_j^*) + \beta_i(d)[\ln(y^*) - \ln(P)] + B(p, d)\xi_i k^*/(k+1), \qquad i = 1, \ldots, n.$$

If the share equations for the SRG-AIDS model are generated under utility maximization, then the partial set of integrability conditions of the demand system can be specified: $\Sigma_i \gamma_{ij} = 0$ (homogeneity), and $\gamma_{ij} = \gamma_{ji}$ (symmetry). Adding up requires $\Sigma_i \alpha_i = 1$, and $\Sigma_i \gamma_{ij} = \Sigma_i \beta_i(d) = \Sigma_i \xi_i = 0$. To guarantee that the modified cost function is theoretically consistent, the condition $\Sigma_i t_i(d) = \Sigma_i m_i(d) = 0$ is also imposed. This set of additional constraints is sufficient to guarantee that the parameters in the Barten and translating functions are identified (see Ferreira and Perali, 1992).

If the integrability conditions are not rejected, we can recover the AIDS indirect utility (or cost) function which provides a direct measure of utility. The measure is obtained by setting the indirect utility function equal to $\phi(u)\vartheta(k^*, k)$. Assuming that the utility that parents enjoy from children is equal to $\vartheta(k^*, k)$ is a testable restriction. An alternative specification for the dependence of the cost function on k^* would lead to different demand behavior.

[4]See Ferreira (1992) for a derivation of the model.

4. Specification and Estimation Methodology for a Complete Demand System

For the consumption-leisure choice problem, we use a complete system of demand equations which relates an exhaustive set of expenditures to all prices, income, and demographic variables. The fertility choice is modeled simultaneously with the consumption-leisure choice.

The stochastic specification of our demand system in (2) is obtained by adding a disturbance to each share equation. The errors across equations are assumed to be normally distributed, uncorrelated across households and have a constant covariance matrix. Except for the number of children in the household (k), we assume that all variables affecting demand are exogenously determined.

Specify the complete system of demand equations in (2) as:

$$k_h = k_h^* + \varsigma_h = f_h(x^T\xi) + \varsigma_h, \tag{3a}$$

$$w_{ih} = f_{i1}(x_h, \theta_i) + f_{i2}(k_h^*, \theta_i) + \varepsilon_{ih}, \tag{3b}$$

for $i=1, \ldots, n$, and $h=1, \ldots, H$, where n is the number of consumer goods and H is the number of households. In equation (3), x is a vector of explanatory variables (income, prices, and demographic variables), θ_i is a vector of unknown parameters to be estimated, and ε_{ih} and ς_h are unobserved random disturbances. Let $\varepsilon_h = [\varepsilon_{1h}, \varepsilon_{2h}, \ldots, \varepsilon_{nh}]$, and $\varepsilon = [\varepsilon_1, \varepsilon_2, \ldots, \varepsilon_H]$. Then $E[\varepsilon^T\varepsilon] = \Sigma \otimes I$, where $\otimes$ is the Kronecker product, Σ is the $(n \times n)$ positive definite covariance matrix where $E(\varepsilon_{ih}\varepsilon_{jr})$ equals to σ_{ij} for $h=r$, and equals zero otherwise.

Note that the likelihood function of the full system includes both continuous and discrete variables. Therefore, straight maximization of the likelihood function is cumbersome. To avoid this problem, we use a two-step maximum likelihood estimation approach to the system (3). First, we estimate equation (3a) by maximum likelihood from a Poisson regression model ($L_1(\xi)$), and obtain the predicted values for the number of children k.[5] If the expectation of k, conditional on the set of exogenous variables is well specified, the Poisson regression will provide consistent estimates of the first set of equations (3a). Second, the likelihood function for (3b) can be written as $L_2(y, \xi, \theta)$, where ξ are the parameters estimated in the first step. Estimation of $L_2(y, \xi, \theta)$ will provide consistent estimates of θ, the parameters associated with the demand equations (3b).[6] Under some regularity conditions discussed in Murphy and Topel (1985), this two-step method provides consistent estimates of all the behavioral parameters. However, the method in general provides biased estimates of the standard errors of the demand parameters. In this context, appropriate corrections need to be implemented to obtain consistent estimates of the standard errors (see Murphy and Topel, 1985).

[5]Given the nature of the variable number of children, alternative models such as the Probit, ordered Probit, multinomial Logit, or negative binomial model type I or type II could have been used (Cameron and Trivedi, 1986: 33). We used likelihood ratio tests, as well as Lagrange multiplier tests and we did not reject the hypothesis that the data would follow a Poisson distribution. For example, the tests clearly rejected the hypothesis that the children variable would follow a multinomial Logit distribution. (See Ferreira, 1992 for a more detailed discussion).

[6]The concentrated likelihood for the second step estimation is given by $L_2 = -H \ln |\Sigma|$ *where* Σ is the covariance matrix, and H is the number of households in the sample. This is the likelihood function of a Seemingly Unrelated Regression (SUR) model.

5. Estimation

5.1. *The Data*

The expenditure data used in this analysis are from the quarterly interviews of the Bureau of Labor Statistics 1986–88 Continuing Consumer Expenditure Survey (CCES). The interview part of the CCES is a nationally representative survey comprised of a panel of approximately 5,000 households. The expenditures of consumer units are obtained in four consecutive interviews, conducted every three months. For each household, a weighted price index for each of the expenditure categories included in the model was computed.[7]

The sample consists of married households living in urban areas in the North-Central region, that answered at least 2 out of four interviews, where neither the wife, nor the husband are older than 65, and both of them are in the labor force.[8] The final data set contains 693 households. Thus, the results are only valid for this specific population.

5.2. *First Step: Modeling Family Size*

Modeling the variable "number of children" requires recognizing that the behavioral response is not continuous. This implies that the usual Gaussian model may not be a good approximation to the true statistical model generating the data.

We assume that, conditional on a set of exogenous regressors, the H observations on k were independently drawn from a Poisson distributions with mean given by $k_h^* = \exp(x^T \xi)$. The use of the exponential function ensures the non-negativity of the predicted values of k_h. If the Poisson model is correctly specified, the maximum likelihood estimate of ξ is strongly consistent and satisfies $n^{1/2}(\xi - \xi) \rightarrow N(0, F^{-1})$, where $F = E[x^T x k_h^*]$.

The set of regressors included in the family size model are: logarithm of the hourly female wage rate, logarithm of the male hourly wage rate, the logarithm of the food price, the logarithm of the house price, female race, female age and its square, welfare payments, housing tenure status, female and male work, male occupation, female education, logarithm of total expenditure on goods and leisure, per capita housing expenditures, per capita number of rooms, and interaction between age and female education. A likelihood ratio test of the overall significance of the parameters (LR = 535.72) indicates that the model has some explanatory power.

We tested the adequacy of the Poisson model vis-à-vis other possible specifications using the set of score tests, and regression based tests discussed in Cameron and Trivedi (1986). The sample results indicate that the conditional variance of the number of children in the household is not bigger than the conditional mean.

[7] Details in the construction of the price variables, including wages, or other information on the data are documented in Ferreira (1992).

[8] One reason to consider only households where both parents work is that we do not believe that the same utility maximizing behavior model applies to people that work, and people that do not work.

5.3. *Second Step: System Estimation*

Stacking the variables and the equations, the model in (3b) can be written as $w = f(X, \theta) + \varepsilon$, where $w, f(X, \theta)$, and ε are $(Nh \times 1)$ vectors. Since the Hessian for the full system is *not* block diagonal in ξ and θ, we correct the estimated standard deviations of the second-step parameters using the results obtained in the first-step estimation, as proposed by Murphy and Topel (1985).

This system of equations is formed by the budget shares for food, housing, male leisure, female leisure, and other expenditures. Other expenditures include education, transportation, health, personal care, alcoholic beverages, cigarettes, and entertainment. The relevant demographic variables included are: number of children present in the household, percentage of children between the ages of 0–5, percentage of the children between the ages of 6–17, and average age of children younger than 18 years old. These "child" demographic variables are needed to parsimoniously capture the effect of number and spacing of children on demand for market goods and labor supply. Also included are: male age, male and female education, male race, and the number of adults present in the household.

The set of demographic variables used for the scaling, translating, and shifting functions is not the same. The partitioning was done *a priori* and justified on behavioral concerns. The number of children present in the household was the only demographic variable included in all three demographic specifications, because of its importance in this study.

Following the indications of earlier studies (e.g. Pollak and Wales, 1981), it is possible to express the SRG model in a parsimonious way. The demographic specifications are as follows: $m_i(d) = v_i \Sigma_r \delta_{ir} d_r$, $t_i(d) = (1 - v_i) \Sigma_r \delta_{ir} d_r$ for some constant v_i, and $\beta_i(d) = \beta_i + \Sigma_r \beta_{ir} d_r$. The vector of disturbances is linearly dependent, because the adding-up property was imposed. Thus, the full system of share equations has a singular covariance matrix. The system is therefore estimated after dropping one equation.

The R^2s for each estimated equation are 0.38, 0.16, 0.81, 0.84, and 0.16, respectively for food, housing, male leisure, female leisure, and other expenditures. The values of the likelihood functions for the full model and for the restricted model (only constants) are respectively 520.6 and 451.1. Hence, a likelihood ratio test of the model, against the restricted model, clearly indicates that the model has explanatory power.

6. The Results

6.1. *In Search of the True Equivalence Scale*

In the framework of the Shifting Reverse Gorman model, the *unconditional equivalence scale* can be written as:

$$\mathrm{ES}^u(d^h, d^0, p, u) = \left[\frac{\vartheta(k_h^*, k_h)}{\vartheta(k_0^*, k_0)} \phi(u) \right]^{B(p,d^h) - B(p,d^0)}.$$

Note that the above equivalence scales, in general, depend on the reference utility level u. A special case includes the situation in which the scales are Independent of Base (IB) utility u: the IB property. The Wald Test for the IB property

(Test = 56.99, $\chi^2 = 36.41$) fails to accept that the IB property holds in this data. Thus, the computed scales are dependent on the utility level chosen for the reference family. To circumvent this problem, all the scales are computed for the utility level implicit in the official poverty line. In this case the equivalence scales are the ratio of the poverty line for the household under analysis to the poverty line for the reference household, holding prices constant (Blackorby and Donaldson, 1991).

TABLE 1

SELECTED EQUIVALENCE SCALES

Family Size	(1)	(2)	(3)	(4)	(5)	Model
Two adults	100	100	100	100	100	100
Two adults + 1 child	121	111	112	118	100	113.1*
						(0.111)
Two adults + 2 children	140	119	124	152	100	121.7*
						(0.094)
Two adults + 3 children	160	126	132	180	101	127.8*
						(0.308)

Source: Scales in (1) are from Lazear and Michael (1988), in (2) from Blaylock (1990), and in (3) from Danzinger *et al.* (1984). (4) displays the equivalence scale implicit in the official poverty line for the years of 1986–87, and (5) the purely expenditure based equivalence scales. Model reports the equivalence scales estimated in this study.

* Different from zero at the 5% significance level. Standard deviations are presented inside parentheses.

Some household equivalence scales previously computed in the literature are presented in Table 1, along with two sets of equivalence scales estimated in this study, depending on whether we assumed (hereafter Model) or not the endogenous children decision (column (5) of Table 1). The scales are computed at the means of the data, except for the number of members in the household which was set equal to two. The purely expenditure based equivalence scales are flat, indicating that the household costs are almost invariant to family size. These estimates look too extreme and unrealistic.[9] The Model's scales are similar to those in Blaylock (1990), and in Danzinger *et al.* (1984) (columns (2) and (3) of Table 1). The Danzinger *et al.* scales were computed using an "income evaluation question" of the type "what household income would you consider, in your circumstances to be a good (or bad) income?" These questions allow the construction of an *unconditional* cost function, since the question enables one to infer how the household feels about its actual family size. The fact that the estimated equivalence scales in our model give results very similar to Danzinger's is an indication that, with the available data and a different approach one might be able to infer how parents feel about their children (or equivalently capture part of the vertical/pure dimension of utility). What is needed is an extension of the empirical approach to include this fact.

Another important point concerns the comparison of the aggregate equivalence scales from the model estimated in this work, and the aggregate equivalence

[9]The rest of the paper discusses only the Model's results. Further results on the purely expenditure based equivalence scales can be found in Ferreira (1992).

scales implicit in the poverty line. Note that the "official" equivalence scales are always higher than those estimated in our model. If it is true that parents derive pure utility from children, then what they need to reach the same welfare level is less than what the "official" equivalence scale indicates. In this event, the "official" equivalence scale, which does not take into account that children are a choice and yield utility, may be distorting the choices, leading families to have a higher number of children that they would have had otherwise. Note this inference does not state that the incomes implicit in the poverty line are enough to reach adequate standard of living. Rather, the increase in income necessary to achieve the "same welfare" level in the official poverty line might be overstated.

6.2. *The Distribution of Welfare*

Since the price of time is quite different across families, and is likely to be related to the number of children in the household, equivalence scales, computed at the means of all variables may be misleading. This section presents the distribution of welfare, using the scales computed at each family's specific demographic composition.

The family income was deflated by the different estimated equivalence scales. This income distribution is a distribution of welfare, since all households are now "fully" equivalent.

Adjusting households by different equivalence scales will lead to different measures of inequality in the distribution of welfare. Using the equivalence scales computed in this work (Model) and the equivalence scale implicit in the poverty line (Official), different measures of "deflated" income were calculated. We also computed the distribution of the income per capita (Per Capita). The series labeled as Income represents the distribution of family income.

The resulting series of deflated incomes were used to compute the density function of welfare for the sample (Figure 2).[10] Based on these distributions, one can infer about the distribution of welfare.

Several comments are in order. The welfare distribution in Model and Official is more concentrated (smaller variance). Model and Official income yield similar distributions of welfare. Model and Official have a similar upper tail. The remaining models yield a "fat" upper tail. The per-capita income yields the highest concentration of low levels of welfare. Lastly, one important point to keep in mind is that the official ES yields a more "optimistic" distribution of welfare than the one using the unconditional ES estimated in this work. Table 2 summarizes information on the several distributions of welfare [see Lambert (1989) for a review of the several estimated coefficients].

According to the results in Table 2, the equivalence scale estimated in Model generates a less "egalitarian" distribution of welfare than the one implicit in the official poverty line; the purely expenditure-based equivalence scales yields the most egalitarian distribution of welfare. The Gini coefficient indicates that the

[10] The density function was estimated using non-parametric techniques. The Gaussian kernel was used. The value of the bandwidth selected is the optimal value for a Gaussian kernel (Silverman, 1986).

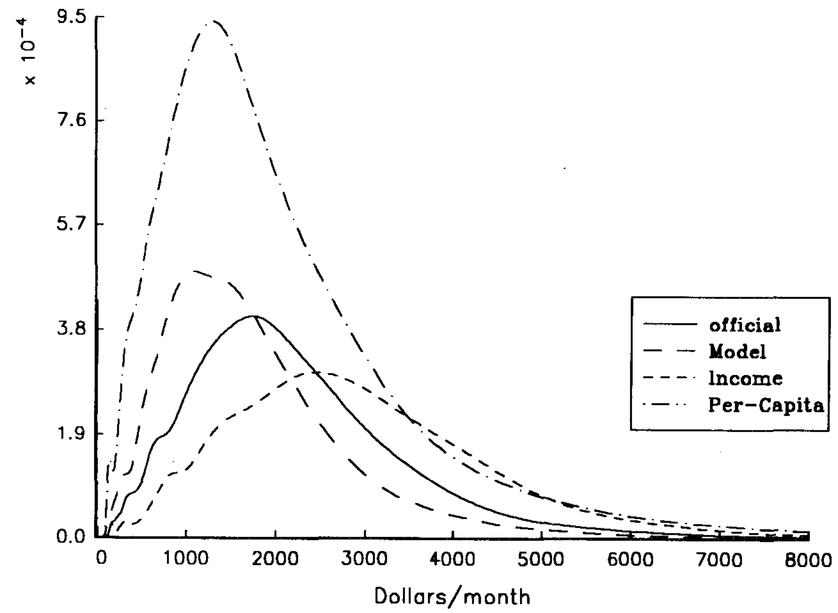

Figure 2: Estimated Density of Deflated Income

TABLE 2

SOME MEASURES ON THE INEQUALITY OF THE WELFARE DISTRIBUTION

	Official	Per Capita	Expenditure*	Model
Mean	2,245.9	954.8	2,575.4	1,771.2
Standard deviation	1,210.4	586.7	965.2	1,016.7
Maximum	8,747.6	3,668.7	8,577.9	7,093.8
Gini	0.287	0.321	0.201	0.303
Coefficient of variation	0.539	0.614	0.375	0.574
Theil	0.127	0.156	0.066	0.139
Asymmetry	1.309	1.479	1.091	1.431

* Purely expenditure based equivalence scales.

per-capita income distribution has the highest asymmetry in the distribution of welfare.

6.3. *Identifying the Poor*

An interesting comparison is the identification of the differences in the "population" in poverty using the ES's estimated in this study, and the official ES implicit in the poverty line. The results are displayed in Table 3. Note that the objective of this section is not to measure poverty, which would take us too far away from the scope of this work, but just to assess whether or not some specific demographic groups are hurt more by the official equivalence scale. To accomplish this goal we just count (head count measure) the number of families whose deflated income is below the poverty line income (Table 3).

TABLE 3

IDENTIFYING THE POOR

	Sample	Below Poverty Line	
		Official	Model
Number of households	693	37	56
Number of people	2,416	155	239
Number of children	1,026	81	84
Number of members	1,390	74	115
Average age of male	39.4	36.2	35.3
Average number of children	1.48	2.19	1.51
Average family size	3.48	4.18	3.54
Percentage of people in poverty	--	5.34	8.12

The unconditional equivalence scales produce a higher percentage of families living in poverty than does the official ES. Using the official ES, the average number of children living in families in poverty is higher than using the unconditional equivalence scales. Since the official ES does not take into account the utility parents may enjoy from their children, it overstates the income needed by large families to reach the same welfare level. The conclusion is that the demographic structure of people in poverty is quite dissimilar depending on which equivalence scale is used. The major differences occur in the average family size and the average number of children present in the household. Characteristics such as age, and education are similar whether using ES or the official equivalence scale. According to the equivalence scales implicit in the poverty line, the average number of children living in families in poverty is 2.2, while according to ES this number is 1.5. This result comes as no surprise given the conclusion that the official ES overstates the "welfare costs" of family size. As stated previously, since the official ES does not take into account that parents may enjoy utility from their children, it inflates the number of children living in families in poverty (see Ferreira *op. cit.* for more detailed results).

7. CONCLUSIONS

The objective of this study is to conduct welfare comparisons across households with different demographic profiles. Standard economic theory suggests the use of household equivalence scales to account for these differences, but a controversy exists concerning the appropriateness of the traditional approach which does not account for the feelings of parents toward children. This research estimates a model that simultaneously considers the choice of goods, and explicitly takes into account that parents may enjoy "pure" utility from their children.

The official poverty line is the basis for eligibility in many welfare programs. Small changes in the method to compute the poverty lines, and thus to deflate income, can result in fairly large changes in which households are eligible for welfare programs. If it is true that parents derive "pure utility" from their children, then our study indicates that the income required to reach the same welfare level as a childless couple is less than official estimates. Thus, equivalence scales implicit in the official poverty line will likely overstate the levels of required compensation for families with strong preferences for children.

If programs such as the WIC and AFDC do not explicitly take into account the utility that parents enjoy from children, it may induce low-income families to have more children than they would have had otherwise, because of "spuriously" low children costs. In fact, empirical evidence suggests that low-income families have more children than the middle and high income families. This may be exacerbated by a "price distortion" that overcompensates families beyond the true "cost of children."

If eligibility for these welfare programs were to be based on a revised poverty line that would take into account that parents enjoy "pure utility" from their children, in the long run we could expect choices to start responding to different incentives. This could definitely have an impact on the characteristics of poverty. We would expect those smaller number of families living in poverty to have, on average fewer, children and smaller sizes. However, ceteris paribus, one could expect inequality to rise, if the benchmark poverty line were not to change in real terms. If it is true that now we are overcompensating poor families for the costs of an additional child, those families would be receiving less, widening the gap between households.

In this research an attempt has been made to bridge the gap between the theory and what can be empirically obtained from the available data. This new approach to computing unconditional equivalence scales is far from comprehensive. Nevertheless, this work can be seen as a first step toward a more acceptable way of computing equivalence scales and making welfare comparisons. The use of inappropriate equivalence scales may result in policy recommendations that are misleading. Equivalence scales embedding fewer assumptions may result in a reassessment of results on policy matters such as the incidence of poverty, distribution of income, and eligibility for welfare programs.

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