Chapter 1

Introduction

Household welfare is of prime importance. Whether the issue is the measurement of inequality, a definition of the poverty line, setting up income maintenance programs or formulation of tax policies, welfare comparisons across households are often required. A good amount of economic research is thus devoted to how household welfare may be measured and compared. Society is, however, made up of households that differ in size, age composition, educational level and other demographic characteristics that make the measurement and comparison of welfare across households a difficult exercise.

Household equivalence scales are popular devices which facilitate the measurement of relative welfare levels. They are numerical estimates that account for differences in the households' demographic variables and show the consumption requirements of one household relative to a base or reference household such that both households are on the same level of welfare. The use of equivalence scales thus enables one to legitimately compare the welfare of two $600 income-per-week households when one consists of, say, a twenty-year old female living alone while the other is composed of a couple with two young children. A comparison of equivalence scales for households with and without children is also a popular means of obtaining some representation of the costs raising children impose on a household. Indeed, it is the use of equivalence scales in income maintenance programs that result in larger benefits accruing to families with more and older children compared to families with fewer and younger children.

There are a large variety of equivalence scales found in the literature and the many issues remaining unresolved in the study area attest to the fact that it is not a simple matter to derive such numerical estimates. In each step in the estimation process - from the definition of the basic welfare concepts to the interpretation of estimated scales - the researcher is required to make crucial assumptions and choice decisions. Unfortunately, there is yet to be a single set of assumptions and decisions that merits universal acceptance and so the debate on which type of equivalence scale can be best used for welfare comparisons goes on. In particular, a crucial issue pertains to whether or not equivalence scales derived from demand data can be used for the purpose. What is not in contention is the fact that there is a great demand for equivalence scale estimates. In the public policy arena, equivalence scales are essential tools for the formulation of tax and transfer policies. Economic research on distributional assessments and poverty analysis cannot be conducted without using equivalence scales. Thus, inspite of the many issues existing in this area of study, research into equivalence scales has continued to flourish. It has, in fact, even become more attractive in recent years because of the growing availability of micro-unit data that can be used in such studies.

The general interest of this work is the comparison of household welfare levels and the underlying premise here is that equivalence scales derived from budget data are regarded as the best instruments through which that objective may be achieved. So, while recognising the importance of particular issues and concerns current in the area, this dissertation primarily aims to contribute to the literature by developing new procedures for estimating equivalence scales from demand data.

1.1 Aims of the Study and Major Contributions

With household welfare as the underlying concern, this dissertation is concerned with exploring alternative approaches towards the estimation of household equivalence scales. A substantial amount of new material is covered particularly with the application of Bayesian techniques to the scale estimation problem.

There are four specific objectives of this study. First, this dissertation seeks to update estimates of equivalence scales for Australia using the 1988-89 Household

Expenditure Survey. Second, this dissertation seeks to improve on some conventional methods of estimating equivalence scales. In particular, we focus on the demand model developed by Lluch (1973) which was extended and estimated by Kakwani (1977) for Australia. Since this method is heavily used by equivalence scale researchers using Australian data[1], this study seeks to improve on Kakwani's procedure by using more general assumptions and developing an easy-to-apply iterative maximum likelihood-based procedure for estimating the scales.

A third objective of this study is to apply Bayesian techniques to the equivalence scale estimation problem. Most estimation procedures in the equivalence scale literature are derived within the sampling theory framework of analysis. Here, we explore the use of Bayesian techniques to estimate scales and show that it is a viable alternative with an intuitively pleasing way of presenting results. Finally, this dissertation develops a model that accounts for the occurrence of "misleading" zero expenditures in survey data and derives a new Bayesian procedure for estimating this model. It will be shown that this model is very difficult to estimate using conventional sampling theory-based techniques but is handled conveniently using the Bayesian approach to estimation.

1.2 Basic Concepts, Scope and Limitations

The underlying concern of this study is the measurement of household welfare. It entails a comparison of differential costs involved in maintaining welfare across different households. Such undertakings almost always involve a number of conceptual and practical difficulties that need to be first addressed.

First of these is the definition of the household. For the purposes of this study, a household is defined as a unit where decisions regarding consumption are collectively made. A common operational definition of a household is a group of people who live together in a single unit and have common eating arrangements. The household is chosen here as the unit of analysis because it is the most convenient one – all individuals belong to a household and the data set used in the empirical

[1]See, for example, Kakwani (1980), Binh and Whiteford (1990) and Bradbury (1994).

applications has the household as its basic sampling unit. The choice of the household is also supported by the data set that we use in the empirical sections of this study. In the text, households are occasionally referred to as families.

A second note pertains to the definition of welfare. In this research, household welfare is defined as the economic agent's material well-being i.e. the capability of the household unit to provide its members with all their physical and socio-economic needs such as food, clothing and shelter. The term welfare in this dissertation is used alternatively with well-being, utility or standard of living. Standard microeconomic theory states that *ceteris paribus*, an economic unit's welfare level is determined by its 'life cycle' or 'permanent' income. Since current consumption is usually considered as a better approximation to life cycle income than current income, it can be justified as a measure of current welfare (Sen 1977). In this work, therefore, consumption is the preferred variable used to measure household welfare.

The problem for the empirical applications is of course that current consumption is not observed: what is available is information on money income and expenditures. As welfare or utility is derived from the consumption of goods and services and there is ample evidence that income is a misleading indicator of household welfare (Slesnick 1994), consumption expenditure data is thus used in the empirical sections of this study.

A third point to note is that by focusing this study over the welfare of households, it is implicitly assumed here that each member of a given household is equally well-off. This equality assumption is obviously incorrect but given the limitations of available data and that, to date, alternative derivations have proved intractable or just as controversial (Coulter, Cowell and Jenkins, 1992), we follow convention and assume that this equality assumption holds throughout this study.

Finally, while it is recognised that intertemporal relationships of variables and parameters are important in empirical demand and welfare analysis, this study limits itself to the application of econometric techniques in a static framework. The static structures analysed here provide a convenient framework for deriving and demonstrating the new techniques. Intertemporal econometric analysis can build on the basic techniques developed and demonstrated in this dissertation.

1.3 Outline of the Study

This dissertation consists of eight separate chapters. In this chapter, Chapter 1, the overall and specific objectives of the study were spelled out and the basic terms and concepts were defined. The chapter also briefly indicates the scope and limitations of the entire study.

Chapter 2 provides a broad overview of selected aspects of research into equivalence scales. The first section defines the analytical framework and gives a short description of the various types of equivalence scales in the literature. The second section presents a critical review of equivalence scale models. This is followed by a discussion of selected issues in the area of equivalence scales research. A final section presents a historical review of various equivalence scales estimated using Australian data. Chapter 3 describes the 1988-89 Australian Household Expenditure Survey which is the data set used in all the empirical applications in this dissertation. Chapter 4 explains the Engel methodology and demonstrates the procedure by estimating new Engel scales for Australia. The empirical results for Australia are compared with those for the Philippines and Thailand which were estimated using a common model specification. Chapter 5 develops an iterative procedure based on maximum likelihood estimation to estimate both commodity-specific and general scales.

In Chapter 6, Bayesian techniques are discussed and employed to arrive at a new procedure for the estimation of equivalence scales. A large portion of the chapter contains detailed derivations of expressions for conditional and posterior probability density functions. Chapter 7 deals with the problem of zero observations that is common in micro-unit data. A model for the occurrence of zero observations due to consumers' infrequency of purchase is developed. Equivalence scales are estimated using a new Bayesian estimation procedure based on this "infrequency of purchase" model. These last two chapters also contain explicit descriptions of how particular numerical algorithms were employed to operationalise the Bayesian procedure. Chapter 8 summarises the work, presents conclusions and indicates some directions for further study.

Chapter 2

Household Equivalence Scales: A Review

The concept and use of household equivalence scales has a long and controversial history in economic and welfare analysis. Equivalence scales have been in existence for more than 100 years now but the debate on how to best estimate them, their validity and their welfare implication are still a subject of intense investigation (Gronau, 1988).

The body of economic literature on equivalence scales is massive and it would be difficult for this study to review all aspects of this rather old and multi-faceted area of economic research. So, rather than provide an exhaustive coverage of previous work, this chapter presents a review of selected aspects of the research area which are deemed directly relevant to all or parts of this dissertation or which provide helpful insights to some of the issues that are current in the area. The aim is to set the scene for the work undertaken in the succeeding chapters of this study.

This chapter therefore consists of the following:

1. an overview of the different types of equivalence scales;
2. an economic-theoretic framework for the discussion of various equivalence scale models;
3. a critical review of the various approaches which have evolved over time for demographically modifying demand functions;

4. a discussion of the "crucial identification problem" affecting equivalence scale estimation; and,

5. a review of empirical results for Australian equivalence scales.

2.1 An Overview of the Different Types of Equivalence Scales

This dissertation is concerned with the estimation of equivalence scales which are derived from the econometric analysis of household expenditure behaviour. These types of scales are calculated based on a "utility" concept and are favourably regarded because they draw on well-developed economic models which link household choices, well-being and composition in a systematic way. They are referred to in this dissertation as econometric equivalence scales. There are however other types of equivalence scales recognised in the economic literature and they are briefly defined below.

A point to note here is that many equivalence scales found in the literature are described with one adult as the unit of reference. These are what are referred to as adult-equivalent scales. The term household equivalence scale is used when the reference unit is chosen to be the two-adult, zero children household (although there is no reason why other households cannot be made a reference unit as well). Adult equivalence scales are used to make comparisons between different types of persons (e.g. adult males, adult females and children of different ages), whereas, household equivalence scales are used to make households of different size and composition comparable. The interest in this work is the estimation of household equivalence scales and, as such, the chosen reference unit in all the empirical applications is the two-adult, zero-children household. Adult-equivalent scales can be easily converted to household equivalent scales by adding up the person-weights for all members of each household and normalising these by the sum of the person-weights for the reference household unit. This effectively sets the scale for the reference household (whatever its composition is) equal to 1.0.

The following overview presents the various types of equivalence scales found

in the economic literature excluding the econometric type scales which are discussed at length in later sections. The following scales are usually presented as adult-equivalent scales in the literature, but because of their links to household equivalence scales as explained above, they need to be briefly explained to put the current work in the proper perspective.

- **Budget standard equivalence scales** are those which are derived by comparing the minimum costs of standard diets and other necessities required by households of different sizes. These standards are prescribed by a panel of nutritionists and/or physiologists. Orshansky (1965) used food expenditure shares (food as prescribed by the US Department of Agriculture economy diet) in her work on US poverty. Visaria (1980) used calorific requirements to estimate equivalence scales for a number of countries in Asia. In the UK, Bradshaw, Mitchell and Morgan (1987) used the budget share of 'necessities' in their estimation. Methodologically, economists dislike this approach because of its prescriptive, non-choice based nature and its implicit identification of welfare with a narrow set of measures of physical well-being (see Atkinson (1975), Nicholson (1976), McClements (1977), Deaton and Muellbauer (1980), Apps and Rees (1996)). As Atkinson (1975) strongly pointed out first, need is a social not a physiological concept.

- **Administrative or social assistance scales** are those that are implicit in the social security and taxation systems of governments. These scales result from the haphazard interaction of pressure group politics, voting and administrative convention. As such, they provide no well-defined foundation on which the validity of the scales can be justified.

- **Pragmatic scales** refer to those equivalence scales that are chosen for their simplicity and ease of use. To these belong per capita scales, weighted or geometric averages of existing scales and scales prescribed by some prestigious international organisations. The Organisation for Economic Cooperation and Development (OECD), for instance, recommends using weights that assign a value of 1.0 for an adult male, 0.7 for an adult female and 0.5 for children. The

main advantages of pragmatic scales are practical ones. They cost nothing to produce and are very easy to apply. The main objection to this type of scales is the obvious absence of a systematic foundation which can form a basis for welfare comparisons (Deaton and Muellbauer, 1980). Coulter, Cowell and Jenkins (1992) also show that these type of scales can have unexpected effects for the conclusions of distributional assessments.

- **Attitudinal scales** are those derived by directly asking households what levels of income or expenditure do they think are associated with different standards of living. The scales are then inferred from the resulting relationship between the respondent's responses and their family composition. This approach was popularised by van Praag and colleagues (the 'Leyden School') and has been experimented with by several researchers (Kapteyn and van Praag (1976), van Praag, Goedhart and Kapteyn (1980), van Praag and van Der Sar (1988), and Saunders, Hallerod and Matheson (1994)). Economists have remained rather uneasy towards the use of such scales particularly in regard to their theoretical assumptions and measurement methods (Coulter, Cowell and Jenkins, 1992).

In this thesis, we are mainly interested in the estimation of econometric equivalence scales. The following sections therefore are extended discussions pertaining to this type of equivalence scales.

2.2 A Conceptual Framework

The main interest in this study is the estimation of econometric household equivalence scales (hereon, simply referred to as equivalence scales). A framework of analysis is first defined. Let the economic environment consists of H households and n private goods with per-unit prices $\mathbf{p} = (p_1, ..., p_n)$. It is implied that all households face the same prices. Household h with demographic characteristics $\boldsymbol{\delta}_h$ has total expenditure x_h and preferences represented by a utility function $u_h = U(\mathbf{q}_h, \boldsymbol{\delta}_h)$ assumed continuous, increasing and quasi-concave in consumption $\mathbf{q}_h = (q_{h1}, ..., q_{hn})$. Here, $u_h = U(\mathbf{q}_h, \boldsymbol{\delta}_h)$ is assumed to be the household's

utility level as measured relative to a demographic reference unit.

Household maximisation of utility subject to a total expenditure constraint implies Marshallian demand functions for each good, expressed as functions of $\mathbf{p}, x_h$ and $\boldsymbol{\delta}_h$. The achieved utility level u_h can be summarised by the indirect utility function

$$u_h = V(\mathbf{p}, \boldsymbol{\delta}_h, x_h) \tag{2.1}$$

which is non-decreasing in $\mathbf{p}$, increasing in x_h and homogenous of degree zero in $\mathbf{p}$ and x_h. Moreover, using standard duality results, demands can also be interpreted as choices which minimise the expenditure required to achieve some reference utility level u_h. This is equivalent to saying that preferences for household h can also be represented using a consumer cost function

$$C(u_h, \mathbf{p}, \boldsymbol{\delta}_h) \tag{2.2}$$

which is increasing in u_h and $\mathbf{p}$ and linearly homogenous and concave in $\mathbf{p}$.

With this model, an equivalence scale s_h is defined using the consumer cost function as

$$s_h = \frac{C(u, \mathbf{p}, \boldsymbol{\delta}_h)}{C(u, \mathbf{p}, \boldsymbol{\delta}_r)} \tag{2.3}$$

where $u = u_r$ is the utility level for the reference household type (with characteristics $\boldsymbol{\delta}_r$). An equivalence scale thus shows the relative cost of maintaining household h with composition $\boldsymbol{\delta}_h$ at the same utility level $u = u_r$ enjoyed by the reference household r with composition $\boldsymbol{\delta}_r$. Deaton and Muellbauer (1980) offer an interesting parallelism between equivalence scales and price indices by saying that equivalence scales are to welfare comparisons between households of different characteristics what cost-of-living indices are to welfare comparisons for a given household facing different prices.

There are two general types of econometric equivalence scales. Some equivalence scales are calculated based on an observable variable selected as a "proxy" for household welfare or utility. Another type is derived from the direct specification of a utility function. The various models under this general classification are discussed in the next sections.

2.3 Equivalence Scales Based on Proxies for Measuring Welfare

The Engel Model

The earliest and simplest model of equivalence scales is due to Engel (1895). In his pioneering work, Engel observed that the expenditure share of food decreases as household income increases. Second, he observed that at the same level of expenditure, larger sized families have higher food shares compared to smaller-sized ones. These observations led him to conclude that the expenditure share of food is the best measure of the material standard of living of a population. The first equivalence scale estimates therefore are based on the assumption that the expenditure share of food is a correct indicator of a household's level of welfare.

Let $w_f^h = f(x_h, \boldsymbol{\delta}_h)$ be the budget share of food for household h with x_h total expenditure and demographic composition $\boldsymbol{\delta}_h$ and let $w_f^r = f(x_r, \boldsymbol{\delta}_r)$ be the corresponding budget share for some reference household r with total expenditure x_r and demographic composition $\boldsymbol{\delta}_r$. The Engel principle states that the two households will enjoy the same level of welfare u if $w_f^h = w_f^r$. Then,

$$x_h = f^{-1}(u, \boldsymbol{\delta}_h) = C(u, \boldsymbol{\delta}_h)$$

and

$$x_r = f^{-1}(u, \boldsymbol{\delta}_r) = C(u, \boldsymbol{\delta}_r)$$

The equivalence scales s_h for household h is derived by solving for the ratio

$$s_h = \frac{x_h}{x_r} = \frac{C(u, \boldsymbol{\delta}_h)}{C(u, \boldsymbol{\delta}_r)} \tag{2.4}$$

The Engel scales in (2.4) show how much household h is required to increase or decrease total expenditure to be on the same level of welfare u as the reference household. Clearly, $s_r = 1$.

Consider, for example, two households both having a food expenditure share of 25 percent. Reference household r has no children and an income of 20,000 dollars, while household h has two children and an income of 30,000 dollars. The

equivalence scale for household h, s_h, will be

$$s^h = \frac{30,000}{20,000} = 1.5$$

That is, for household h to be on the same level of welfare as the reference household, it needs 50 percent more in total expenditure compared to household r. Alternatively, this scale is interpreted as showing the cost requirements associated with having two children relative to a once childless household wanting to maintain the same welfare level.

The Engel scale model can be generalised by including other types of goods in the expenditure basket that is taken to be an indicator of welfare. Besides food, researchers have invariably used expenditure shares of clothing, shelter, utilities and medical care, singly or in combination with food, to construct equivalence scales. There have also been studies which estimate scales on the basis of the proportion of total expenditure going to 'luxuries'. Examples of equivalence scales based on the Engel model are found in Deaton (1981) for Sri Lanka, Espendshade (1984) for the United States, Deaton and Muellbauer (1986) for Sri Lanka and Indonesia, Binh and Whiteford (1990) for Australia, Bosch-Domenech (1991) for Spain, Phipps and Garner (1994) for Canada and Valenzuela (1996) for Australia, the Philippines and Thailand.

The Rothbarth Model

The underlying principle that characterises the Rothbarth (1943) model is its *a priori* distinction between goods exclusively consumed by adults and other household goods. Expenditure on goods consumed exclusively by adults are used as a means of identifying the adult portion of household resource allocation. Consumption of children is then identified as the residual. Implicitly, the method uses expenditure on such 'pure' adult goods as the welfare index with which households of different child compositions can be compared.

To apply the Rothbarth model, the commodity vector $\mathbf{q}$ is partitioned exclusively into $\mathbf{q}_A$ and $\mathbf{q}_B$ of adult and non-adult goods. Consequently, the price vector

$\mathbf{p}$ consists of two subvectors $(\mathbf{p}_A, \mathbf{p}_B)$ while total outlay x consists of x_A expenditure on adult goods and x_B expenditure on non-adult goods. The Rothbarth model assumes an additive cost function of the type

$$C(u, \mathbf{p}_A, \mathbf{p}_B, \boldsymbol{\delta}) = \gamma(u, \mathbf{p}_A, \mathbf{p}_B) + \beta(u, \mathbf{p}_B, \boldsymbol{\delta}) \tag{2.5}$$

where $\boldsymbol{\delta}$ only includes the children's demographic attributes, $\gamma(u, \mathbf{p}_A, \mathbf{p}_B)$ represents the fixed cost component of total expenditure attributable to adult goods and $\beta(u, \mathbf{p}_B, \boldsymbol{\delta})$ represents the variable cost due to the presence of children. The equivalence scale is given by

$$s_h = \frac{\gamma(u, \mathbf{p}_A, \mathbf{p}_B) + \beta(u, \mathbf{p}_B, \boldsymbol{\delta}_h)}{\gamma(u, \mathbf{p}_A, \mathbf{p}_B)}. \tag{2.6}$$

where the two-adult (childless couple) household is usually set as the reference unit. The expression for s_h in (2.6) shows the relative cost of maintaining household h at welfare level u. As can be seen, the utility of the reference household in the Rothbarth model is defined by the fixed cost component $x_A = \gamma(u, \mathbf{p}_A, \mathbf{p}_B)$ and the scales for different household types are determined by the cost component $x_B = \beta(u, \mathbf{p}_B, \boldsymbol{\delta})$ made variable by its dependence on the demographic characteristics (i.e. the number of children) of the non-reference household.

There are two key assumptions required for the Rothbarth model to be valid. The first is that adult goods can be correctly identified as such. The second is that consumption of adult goods is assumed to be separable from the consumption of non-adult goods (Gronau, 1988). The rationale for the first assumption is obvious. The separability assumption implies that the household resource allocation involves two steps. Resources are first allocated between parents (adults) and children, and then within these two demographic groups, allocations are made to particular commodities. Once the amount available for adult consumption is given, it is assumed that the allocation of a portion of that consumption to the adult good will be the same irrespective of the proportion of their budget allocated to children, and indeed whether or not the family has children. A detailed discussion of the properties of the Rothbarth model are found in Gronau (1988, 1991) and Nelson (1992).

Given the identification of a suitable adult good or goods, the estimation proceeds as follows. For households without children, all expenditure is assumed to be adult expenditure, and the relationship between total expenditure and adult expenditure found for these households can be applied to households with children to calculate the implicit total level of adult expenditure in these zero-children households. These can then be compared with the total expenditure of those households to estimate the proportion devoted to child consumption.

The Rothbarth model is often used in studies that aim to measure costs of children. In that context, the utility under investigation pertains to the utility of the parents or parental welfare and the cost of children is established by estimating the cost of restoring the welfare of the parents to the level before they had children. Recent applications of the Rothbarth methodology are Gronau (1988, 1991), Nelson (1992) and Bradbury (1994).

A Comparison of the Engel and Rothbarth Models

The Engel and Rothbarth models are two popular ways of computing equivalence scales. Scales based on the Engel model are estimated by comparing households of different compositions at equal foodshares while those based on the Rothbarth method utilise the level of expenditures going to adult goods. A major advantage of both models is that they are relatively easy to use requiring a single cross-section dataset only. Notwithstanding, it is a well-known fact that they have implicit in them different behavioural assumptions, and that they produce quite different estimates (see Blackorby and Donaldson (1993)).

In the literature, there is serious criticism regarding the basic premise that households with equal expenditure shares have the same level of welfare or utility. This is not a testable assumption and many have questioned it on theoretical grounds. For the Engel model, it has been argued that the scales overestimate the additional requirement of larger households, particularly if the expenditure share on food alone is used. This problem is compounded by the arbitrariness of the commodities used as an indicator of welfare, which lends the Engel model to a good amount of subjectivity. Results from Deaton and Muellbauer (1986)

empirically verify these points. The general trend is for the scale estimates to be biased upwards if the commodities chosen are necessities rather than luxuries, or if they are a more important component of a child's budget than that of an adult (e.g. food). There will be a downward bias in the estimates if the commodities used are both necessities and subject to economies of scales (e.g. housing).

The arbitrariness of the 'adult-goods' definition has drawn similar criticisms for the Rothbarth model. Since the consumption of certain adult-specific goods can often be observed in households with and without children, this method is empirically very convenient. There exists, however, no single definition of what adult goods are. In empirical research, the adult goods basket includes such commodities as adult clothing, alcohol and tobacco but so far there is no consistent definition being used. Another practical problem is that expenditure survey data on such commodities are subject to large measurement errors.

One other major criticism levelled against both the Engel and Rothbarth scales is the approaches' inability to differentiate the effect of a change in demographic composition of a household across a range of different goods. The models make an implicit assumption that the addition of a household member will have the same effect on spending on food or adult goods as on total spending by the household. Such is clearly not the case. The addition of a new baby to a family will increase the consumption of milk and nappies more than that of petrol or light or heating. As a result, commodity-specific scales have evolved.

Prais-Houthakker Model

Prais and Houthakker (1955) were the first to formulate an equivalence scale model that permits the effect of demographic composition to vary between commodities and, hence, allowed for the estimation of what Syndenstricker and King (1921) first called a commodity-specific equivalence scale. Under this model, it is assumed that the consumption of particular commodities in different families will be influenced by both a commodity-specific equivalence scale and a general income scale. That is,

$$q_i/s_i(\boldsymbol{\delta}) = g_i(x/s_o(\boldsymbol{\delta})) \tag{2.7}$$

where q_i is quantity consumed of the i^{th} commodity, x is total expenditure, $s_i(\boldsymbol{\delta})$ is the commodity-specific demographic effect, and $s_o(\boldsymbol{\delta})$ is the overall or general income effect. Under general conditions of demand theory, the general scale $s_o(\boldsymbol{\delta})$ is a weighted average of the commodity-specific scales $s_i(\boldsymbol{\delta})$ for the household under investigation (Cramer 1969). This means that the general scales $s_o(\boldsymbol{\delta})$ can be expressed in terms of the commodity-specific scales $s_i(\boldsymbol{\delta})$ such that

$$x = \sum_{i=1}^{n} p_i q_i = \sum p_i s_i(\boldsymbol{\delta}) g_i \left(\frac{x}{s_o(\boldsymbol{\delta})} \right) \tag{2.8}$$

The commodity-specific and general scales are set to unity for the reference family. From equation (2.7), the demand for each commodity is scaled by the corresponding $s_i(\boldsymbol{\delta})$ and is a function of a scaled total consumption. The following interpretation can be applied: the arrival of a child increases expenditure on commodity i by a factor $s_i(\boldsymbol{\delta})$ but reduces the "available income" by a factor $s_o(\boldsymbol{\delta})$ at the same time. Using the commodity specific scales and the general scale, household expenditures can thus be expressed in equivalent-household (or adult, as the case may be) terms and thus, for each commodity, all household types can be included into a single expenditure function. This approach gives rise to a system of expenditure functions relating expenditures on different commodities to total expenditure and various demographic characteristics. By estimating commodity-specific scales and the equivalent budget shares, the general equivalence scales can be obtained. Recent work on the Prais-Houthakker model are found in Bradbury (1994) and Griffiths and Chotikapanich (1996, 1997).

2.4 Utility Theory Consistent Models

Much of the economic literature on equivalence scales has been concerned with the generation of plausible models relating preferences and demographic structure. As Lewbel (1985) has shown, the potential ways in which demand functions could be modified to take account of demographic influences is vast (though not restricted). In this section, we will discuss a number of common ways on how this may be done through the explicit consideration of a utility function which allows for a

systematic method of incorporating demographic variables in the demand system.

The Barten Model

Barten (1964) was the first to propose a model of equivalence scales by first specifying a utility function. He generalised Engel's work by explicitly considering a "collective utility function" defined by:

$$u_h = U\left(\frac{q_1}{s_1(\boldsymbol{\delta}_h)}, \frac{q_2}{s_2(\boldsymbol{\delta}_h)}, ..., \frac{q_n}{s_n(\boldsymbol{\delta}_h)}\right) \tag{2.9}$$

where $q_i/s_i(\boldsymbol{\delta}_h)$ refers to the household per adult equivalent consumption of commodity i and the $s_i(\boldsymbol{\delta}_h)$'s are the commodity-specific scales that measure the number of equivalent adults specific to the good i. A large value of $s_i(\boldsymbol{\delta}_h)$ implies that the household needs a relatively large amount of that commodity (compared to the reference household) in order for that commodity to have the same input into the utility function. The $s_i(\boldsymbol{\delta}_h)$'s are also often used to refer to the number of 'equivalent adults' specific to good i. Pollak and Wales (1980, 1981) point out that such interpretation must be made with some caution since changes in the $s_i(\boldsymbol{\delta})$'s imply a reallocation of total expenditure among the goods leaving total expenditure unchanged.

There are several ways in which the utility function in (2.9) can be interpreted. See, for example, Bojer (1977), Gorman (1976), Muellbauer (1977), and Lewbel (1985). One interpretation is given by Deaton and Muellbauer (1986):

> "For our purposes, the most attractive [interpretation] is to regard u as a measure of the parents' standard of living so that $q_i/s_i(\boldsymbol{\delta}_h)$ is the consumption of good i that actually reaches the parents when an amount q_i is purchased for the family as a whole" - Deaton and Muellbauer (1986: pp. 735-36).

The function u_h may thus be seen as a measure of the welfare of the parents, with the s_i parameters representing the cost (to the parents) of having children on a per commodity basis. For the purposes of this work, this interpretation is most appealing because it appears to be consistent with income support policies

towards child poverty. An implicit assumption of such policies is that income given to parents will assist in raising the living standards of their children. A parallel assumption to make in the estimation of equivalence scales might be that resources are allocated within families in such a way as to equalise well-being among family members (according to some generally accepted norms of allocation).

The associated cost function in the Barten model can be derived as

$$C(u, \mathbf{p}, \boldsymbol{\delta}) = C\left[u, p_1 s_1(\boldsymbol{\delta}), ..., p_n s_n(\boldsymbol{\delta})\right] \tag{2.10}$$

Let $q_i^* = q_i / s_i(\boldsymbol{\delta})$ be the Barten (scaled) quantities, and $p_i^* = p_i s_i(\boldsymbol{\delta})$ be the Barten (scaled) prices. The utility function in (2.9) and the corresponding cost function in (2.10) can be rewritten in more familiar form as

$$u_h = U(q_1^*, q_2^*, ..., q_n^*) \tag{2.11}$$

and

$$C(u, \mathbf{p}^*, \boldsymbol{\delta}) = C(u, p_1^*, ..., p_n^*) \tag{2.12}$$

respectively. The Barten quantities represent the quantity of the i^{th} good per equivalent adult. Similarly, the Barten prices are the price per unit of good i per equivalent adult, or equivalently, the effective price of a good i to a household with $\boldsymbol{\delta}_h$ demographic composition. According to the utility function in (2.11), the household derives utility not from the consumption of q_i but from the consumption of q_i^*.

An important behavioural implication of the Barten model is the possibility of demographically induced substitution effects. According to Deaton and Muellbauer (1980), allowing for substitutability in this way is important because it indicates that a change in family composition can have a direct effect on demand (e.g. a child needs milk, clothes, toys, etc.) and an indirect effect because these goods become relatively more expensive for the household. As an example, they say that "having children makes ice cream, milk and soft drinks relatively more expensive and makes whisky or cigarettes relatively cheaper". Apparently, however, these substitution effects have also been the main source of the model's inconsistencies.

Muellbauer (1977) argues that for goods with 'high' price elasticities (smaller than -1), an increase in the family size could lead to an absolute decrease in the amount spent on a good for "which the child's requirements are high" (p.481). This is equivalent to saying that there are excessive substitution effects. What is needed is a model that permits, but does not require, the substitution relationship of the Barten model.

The Translation Model

The simplest alternative to the Barten utility model is what Pollak and Wales have called "demographic translation". Instead of dividing quantities by commodity-specific factors, the translation model due to Pollak and Wales (1981) assumes different "pre-committed quantities" of each good for households with different demographic compositions. The utility function is given by

$$u_h = U\left[q_1 - t_1(\boldsymbol{\delta}_h), q_2 - t_2(\boldsymbol{\delta}_h), ..., q_n - t_n(\boldsymbol{\delta}_h)\right] \tag{2.13}$$

where the $t_i(\boldsymbol{\delta}_h)$ terms are the translating functions which are functions of a household's demographic composition. The $t_i(\boldsymbol{\delta}_h)$'s are defined to be zero for the reference household. According to Bradbury (1994), if the $t_i(\boldsymbol{\delta}_h)$ terms are negative, this means that a household needs less of commodity i than the reference household to have the same input into welfare generation. The interpretation of this model is straightforward. Households other than the reference household first allocate their income to purchase the pre-committed $t_i(\boldsymbol{\delta}_h)$ commodities, and then allocate their remaining income in the same way as the reference household. One advantage of this model over the Barten model is that it can handle the case where the reference family does not purchase the commodity, but the comparison family does (Bradbury, 1989). This is significant for the case of children who generate consumption of such non-adult commodities as feeding bottles, diapers, babysitting, etc. In Barten's scaling model, if the reference family does not purchase the good, then neither will any other family. In this demographic translation model, this restriction does not hold. Empirical applications of this model are found in Pollak and Wales (1981) and Bradbury (1994).

The Gorman Modifications

Gorman's (1976) modification of the Barten model is also meant to address inconsistencies in the Barten formulation which arise in cases where the reference household does not consume the good while the other households do. Gorman's approach is to introduce "overheads" or fixed costs to effect a reduction in the excessive substitution characteristic of the Barten model. In this so called Barten-Gorman model, the quantities from which utility is derived are scaled as in the following utility function

$$u_h = U\left[\frac{q_1 - t_1(\boldsymbol{\delta}_h)}{s_1(\boldsymbol{\delta}_h)}, \frac{q_2 - t_2(\boldsymbol{\delta}_h)}{s_2(\boldsymbol{\delta}_h)}, ..., \frac{q_n - t_n(\boldsymbol{\delta}_h)}{s_n(\boldsymbol{\delta}_h)}\right] \tag{2.14}$$

In a household production sense (Lewbel 1985), the fixed costs have to be incurred before any scaled quantities q_i^* can be produced. Deaton and Muellbauer (1986) estimated this model of equivalence scales and found estimates to lie between the Engel and Rothbarth scales. They concluded that the Barten-Gorman model is "richer" than either the Engel or Rothbarth model and can be regarded as a generalisation of both of them.

Pollak and Wales (1981) also propose an alternative specification, the so called reverse Gorman model. The direct utility function for this model is of the form

$$u_h = U\left[\frac{q_1}{s_1(\boldsymbol{\delta}_h)} - t_1(\boldsymbol{\delta}_h), \frac{q_2}{s_2(\boldsymbol{\delta}_h)} - t_2(\boldsymbol{\delta}_h), ..., \frac{q_n}{s_n(\boldsymbol{\delta}_h)} - t_n(\boldsymbol{\delta}_h)\right] \tag{2.15}$$

This is equivalent to first translating the original demand system and then scaling it.

Cost Function Modifying Technique

All the above specifications utilise a direct utility function with demographic characteristics. They differ in the way the utility function parameters depend on demographic variables and also in the parameters that are allowed to "demographically change". Lewbel (1985) proposed a general method of introducing demographic effects into any demand system. The technique involves taking an

initial cost function $C^*(u, \mathbf{p}^*)$ and modifying it to create a new, demographically varying cost function C defined by

$$C(u, \mathbf{p}, \boldsymbol{\delta}) = f\left[C^*(u, h(\mathbf{p}, \boldsymbol{\delta})), \mathbf{p}, \boldsymbol{\delta}\right]. \tag{2.16}$$

The function f and the vector valued function h are called modifying functions which permit elaborate interactions of demographic variables with prices and expenditures. Lewbel's results guarantee that the cost function in (2.16) represents the same set of preferences as the original cost function $C^*(u, \mathbf{p}^*)$. The technique facilitates the inclusion of demographic effects in such a way that the theoretical consistency of the demographically modified system is maintained.

The inclusion of a wide variety of demographic variables in the analysis of household demands and welfare comparisons is now considered indispensable for obtaining valid equivalence scale estimates. The question of how best to introduce them is still open. This research will use Barten's scaling technique to introduce demographic composition to the chosen demand system of this study. As the focus will be on the econometric estimation of the equivalence scales, the Barten model is seen as the best medium (among the other utility-based approaches) through which the algebraic derivation of the new methods can be demonstrated. The application of the methods that are developed to the other more sophisticated modifying techniques can build on the results obtained in this study.

2.5 Conditional or Unconditional Scales?

In the equivalence scale literature, there exists a long-standing debate about the legitimacy of making welfare comparisons based on conditional equivalence scales. Conditional equivalence scales are those derived from demand data and are computed 'conditioned' on a predetermined demographic composition. In contrast, unconditional equivalence scales are those that result if the household's demographic composition is treated as a choice variable itself in addition to the vector of commodities.

Pollak and Wales (1979) were the first to point out that conditional equivalence

scales estimated from observed differences in the consumption patterns of families with different demographic profiles cannot be used to make welfare comparisons. Household welfare, they argue, should be thought of as depending on household composition directly, as well as through the effects of household composition on commodity demands. "The expenditure level required to make a three-child family as well off as it would be with two children and $12,000 depends on how the family feels about children," wrote Pollak and Wales (1979, p.216).

More formally, their argument is that household welfare should be determined by a function like

$$U^*(U(\mathbf{q}, \boldsymbol{\delta}), \boldsymbol{\delta}) \tag{2.17}$$

where $\mathbf{q}$ and $\boldsymbol{\delta}$ are vectors of commodities and household composition, respectively. Whereas, in the more traditional formulation, household welfare is specified by a function like

$$U(\mathbf{q}, \boldsymbol{\delta}) \tag{2.18}$$

The problem lies in the fact that information from demand data is not able to distinguish between these two situations so meaningful welfare comparisons cannot be made.

Blundell and Lewbel (1991) explain this identification problem in terms of cost functions. Accordingly, for any function $F(\xi, \boldsymbol{\delta})$ that is monotonically increasing in its first (scalar-valued) element ξ, the identification problem results because observable demands of the form $q = d(\mathbf{p}, x, \boldsymbol{\delta})$ can arise, by ordinality, either from a cost function of the type $C(u, \mathbf{p}, \boldsymbol{\delta}) = \{\min \mathbf{p}'\mathbf{q} | U(\mathbf{q}, \boldsymbol{\delta}) > u\}$ or from a cost function given by $C(u, \mathbf{p}, \boldsymbol{\delta}) = \{\min \mathbf{p}'\mathbf{q} | F(U(\mathbf{q}, \boldsymbol{\delta}), \boldsymbol{\delta}) > u\}$. This implies that many different cost functions and hence many different equivalence scales may be recovered from the same expenditure data.

This identification problem led Pollak and Wales (1979), later supported by Fisher (1987) and others, to argue that equivalence scales calculated from demand data cannot be used for welfare comparisons. Other authors, however, regard this as an overly negative assessment and counter claim that estimation of equivalence scales based on conditional preferences has a purposeful role in welfare comparisons. Blundell and Lewbel (1991) argue that some useful information about rel-

ative costs can still be derived. They show that while demand equations alone provide no information about equivalence scales in any one price regime, they also prove that demand data can be used to identify the unique true equivalence scale in all other price regimes once the 'true' equivalence scale is known for a given price regime. The equivalence scales from demand data do contain some relevant information and many people prefer them to scales derived otherwise as described in Section 2.1.

Deaton and Muellbauer (1980, 1986) also argue in favour of conditional equivalence scales and demonstrate their point in the context of measuring costs of children i.e. how much compensation would need to be paid to parents to restore them to their utility level prior to having a child or children. They point out that "how parents feel about children" is not relevant to the problem of measuring child costs in that, "that parents choose to have children means that the benefit of having them are greater than the costs, but it does not mean that the costs are zero".

More recently, Nelson (1993) revisits the arguments and offers some explanations for the contrasting views. She says that Pollak and Wales' "subjective utility" approach equates welfare with happiness whereas most of the historical literature on equivalence scales and the position taken by Deaton and Muellbauer are concerned with welfare in the standard of living sense. Following Sen (1987), she distinguishes these two concepts. In the context of a family, happiness refers to some good feeling derived by one member (e.g. a parent) derived from the presence of other members (e.g. a child/children). Such good feeling, however, can be distinguished from the reduced "capability" of each member to be well-clothed, well-fed, well-rested, etc., which is brought about to a considerable extent by the additional demand on limited household resources. Nelson observes that most distributional and policy studies center around the questions of the economic means relative to needs in the latter sense. She concludes that "as questions of the distribution of pure subjective happiness are rarely raised in practical applications, equivalence scales in the older, more materialistic and more objective sense remain of great practical concern".

It is not the purpose of this study to contribute to the debate about the identi-

fication problem concerning equivalence scales based on demand data. The author believes the household welfare or utility that unconditional and conditional equivalence scales purport to measure are not the same. In addition, empirical studies show that different assumptions lead to rather different models of preferences even for those that use very general models of preferences. And with regard to the use of conditional equivalence scales, the author agrees with Nelson's conclusion that they are of great practical concern. The fact is that equivalence scales continue to be derived from demand data and are in demand for use in almost all tax and transfer policy studies as well as in most distributional and welfare research. It does not help that unconditional scales are, at the present time, not estimable and hence not available. In practice, no better alternative exists and the use of conditional equivalence scales is still the best approach in terms of comparing standards of living. Unless a better alternative is found, the use and derivation of such scales will continue to occupy an important place in economic research and welfare analysis. In this context, this dissertation explores alternative estimation techniques for the estimation for conditional equivalence scales.

2.6 A Review of Australian Equivalence Scales

The first set of equivalent-income scales used in Australia came about in 1970 in connection with the work of the Commission on Inquiry into Poverty. The Commission, headed by Professor Henderson, adopted an equivalent-income scale produce in 1954 by the Budget Standard Service of New York. This scale is presented in Table 2.1. This scale is in the form of minimum (subsistence level) cost of families of different size and composition. It is mentioned that the commission adopted the New York equivalent scale because of the 'almost complete lack of material in Australia on which to base judgements of this kind' (Henderson, Harcourt, and Harper, 1970). Needless to say, the 'Henderson' scale as it has become known, has been subjected to considerable criticism on the grounds that it is hardly relevant to the Australian lifestyle. Clearly, this scale is appropriate only if contemporary Australian lifestyles are similar to those of New York a generation ago. Even if the two lifestyles were exactly identical, the scale would still be inappropriate because

it was constructed on the basis of physical needs of individuals[1].

The first attempt to estimate the equivalent-income scale for Australia was made by Podder (1971) using data from the 1966-68 Survey of Consumer Finances and Expenditures. Podder's estimated scales are presented in Table 2.2. This set of equivalent-income scales were derived by applying the Prais-Houthakker methodology to food only so the procedure was, in effect, Engel's. Being so, they suffer from the deficiencies of the Engel approach[2]. Note that the scales are presented for eight different family compositions. All families that are of different compositions from those mentioned in the table are excluded. For purposes of measuring the distribution of economic welfare, Podder's scale is not helpful because it excludes the one-adult household with children as well as all the three- or more adult households with or without children. The proportion of such households is fairly large in Australia and their exclusion will certainly lead to biased estimates of the size distribution of income or expenditure.

A modified version of the Engel method was applied by the Social Welfare Policy Secretariat (SWPS) to the 1974-75 Household Expenditure Survey (HES) unit record data in a study of poverty measurement in Australia (SWPS, 1981). This method is a generalised Engel method where food was replaced by a basket of 'necessities' which included food, clothing, housing and fuel. These scales are tabulated in Table 2.3.

Kakwani (1977) estimated the equivalent-income scale using the same data as Podder but with a different method. The scale is presented Table 2.4. His estimation procedure was based on the linear-demand form of the Barten model which incorporates a linear aggregate consumption function as the identifying restriction i.e. the extended linear expenditure system (ELES). There are two main drawbacks in this approach. First, and most seriously, the method requires the use of permanent income which cannot be measured in practice. The use of current instead of permanent income weakens the practical application of the ELES approach as it is doubtful whether current income as measured in household surveys is even a useful approximation to permanent income, and whether the inherent

[1]See discussion on budget standard scales in Section 2.1
[2]See discussion of Engel scales in Section 2.3.

biases are uniform across households. Second, the results can be interpreted in a utility framework only for those households whose expenditures exceed the 'subsistence' level for their particular group. For households with lower income, no such interpretation can be made meaningful which makes some of the results not meaningful.

A simplified version of the Kakwani approach has been applied to the 1974-75 HES data by the SWPS 1981. To minimize computational effort the equivalence scale was estimated at the subsistence expenditure of the reference household. At that income level, the scale turns out to be simply the ratio of the subsistence expenditures of the comparison and reference households. Binh and Whiteford (1990) demonstrate that this is in fact a modified version of the Engel method.

The availability of the 1984 HES microdata has stirred renewed interest in the estimation of equivalence scales on the Australian front. Using this microdata, Binh and Whiteford (1990) update Australian scale estimates - using both Engel methodology and the ELES based model of Kakwani. The estimated scales, shown in Table 2.5, are observed to have higher relativities compared to the SWPS (1981) scales as well as compared to other scales derived from 'earlier' studies. Relative costs are shown to be closest to the scales derived by Kakwani (1977) but the numerical estimates are nonetheless significantly different.

A more recent study on the estimation of Australian equivalence scales is that of Bradbury (1994). Bradbury presents a generalisation of the translation model of Pollak and Wales (1981) which allows the presence of children to influence consumption behaviour in a non pricelike but economically plausible manner. His scale estimates, shown in Table 2.6, yield numerical values that compare favourably with those of Binh and Whiteford (1990). The resulting relativities are also noted to have lower estimates of child costs compared to those based on the Australian income support system. At the same time, however, the wide confidence intervals of Bradbury's estimates do not allow him to reject the hypothesis that the two scales are not significantly different from each other. Also, Bradbury estimates are based on subsamples selected and estimated on the basis of their *a priori* satisfaction of certain constraints.

Very recently, Valenzuela (1996) reports estimates of Australian Engel scales

calculated from the 1988-89 Household Expenditure Survey. The study presented scale estimates based on alternative baskets of expenditures and also compares Australian results with those of the Philippines and Thailand. The scales are presented in Table 2.7. The findings reveal that Australian Engel scales are comparable to those of the two countries except when the basket of expenditure is defined in terms of food alone.

Research on equivalence scales in Australia continues to flourish. This is because scales are in great demand for public policy in such areas as tax transfer and social welfare. It has also become preferred that equivalence scales be used in research that seeks to analyse the distribution of income or welfare. Inspite of itself and the availability of other more updated scale estimates, the Henderson scales continue to be used in most income distribution and poverty research in Australia. When making international comparisons of inequality and poverty, equivalence scales derived from the Belgium-based Luxembourg Income Study (LIS) project are often used. This set of scales allocate a value of 0.5 to the first individual in any unit, a value of 0.25 for each individual from the second to the ninth unit, and a value of 3.0 to all units with ten or more members (Saunders, 1992). For some empirical applications of the LIS scales to Australia, see Saunders, Stott and Hobbes (1991) and Saunders (1992).

Table 2.1 The Henderson equivalent-income scale based on the New York Survey

Type of Household	*Adult Equivalent Scale (Single Adult =1.0)*	*Household Equivalent Scale (Married Couple = 1.0)*
Single Adult	1.00	0.75
Married Couple	1.34	1.00
Couple + 1 child	1.61	1.20
Couple + 2 children	1.88	1.40
Couple + 3 children	2.15	1.60
Couple + 4 children	2.42	1.81
Couple + 5 children	2.67	2.00
Couple + 6 children	2.93	2.19
Couple + 7 children	3.19	2.38
Single parent + 1 child	1.28	0.96
Single parent + 2 children	1.55	1.16
Single parent + 3 children	1.82	1.36
Single parent + 4 children	2.09	1.56
Single parent + 5 children	2.36	1.74

Source: Henderson, et.al. (1970) and author's calculations.

Table 2.2 Podder's equivalent-income scale

Type of Household	*Equivalent Income Scale*
Single-member household	0.488
Married Couple	1.000
Couple + 1 child	1.250
Couple + 2 children	1.481
Couple + 3 children	1.675
Couple + 4 children	1.972
Couple + 5 children	2.381
Couple + 6 children	2.731

Source: Podder (1971).
Note: (a) Estimated using 66-68 Consumer Finance and Expenditure Survey.

Table 2.3 The Social Welfare Policy Secretariat (SWPS) income-equivalent scales

Type of Household	*Overall Basic*	*Overall Detailed*	*Head Working*
Single Adult	0.59	0.58	0.69
Single parent + 1 child	1.00	1.05	1.10
Single parent + 2 children	1.18	1.14	1.22
Single parent + 3 children	1.35	1.30	1.40
Couple	1.00	1.00	1.00
Couple + 1 child	1.18	1.15	1.14
Couple + 2 children	1.35	1.28	1.33
Couple + 3 children	1.53	1.51	1.67

Source: Whiteford (1985)
Note: (a) Estimated using 74-75 Household Expenditure Survey.

Table 2.4 Kakwani's equivalent-income scales

Type of Household	*Per capita income*			
	<$1220	*$2,000*	*$3,000*	*$4,000*
Single-member household	0.438	0.444	0.447	0.449
Married Couple	0.752	0.729	0.731	0.732
Couple + 1 child	0.877	0.879	0.880	0.880
Couple + 2 children	1.000	1.000	1.000	1.000
Couple + 3 children	1.075	1.072	1.070	1.070
Couple + 4 children	1.114	1.102	1.096	1.092
Couple + 5 children	1.151	1.128	1.116	1.110
Couple + 6 children	1.187	1.144	1.122	1.111

Source: Kakwani (1980)
Note: (a) Estimated using 66-68 Consumer Finance and Expenditure Survey.

Table 2.5 Binh and Whiteford's Engel and ELES scales

Type of Household	*Engel Scales*		*ELES Scales*		
	based on Food Basket only	*based on Food, Clothing, Housing & Fuel*	*Low Income*	*Medium Income*	*High Income*
Single Adult	0.590 (0.007)	0.710 (0.010)	0.530	0.520	0.520
Single parent + 1 child	0.750 (0.011)	0.900 (0.017)	0.800	0.810	0.810
Single parent + 2 children	0.950 (0.019)	1.140 (0.030)	0.950	0.940	0.940
Single parent + 3 children	1.200 (0.033)	1.450 (0.050)	1.270	1.280	1.290
Couple	1.000 -	1.000 -	1.000	1.000	1.000
Couple + 1 child	1.270 (0.010)	1.270 (0.012)	1.200	1.200	1.190
Couple + 2 children	1.610 (0.025)	1.610 (0.031)	1.280	1.270	1.260
Couple + 3 children	2.030 (0.048)	2.050 (0.060)	1.440	1.440	1.450

Source: Binh and Whiteford (1990)

Notes: (a) Estimated using 1984 Household Expenditure Survey.
(b) Low income scales based on reference household income of $325 in 1984 AU$.
(c) Medium income scales based on reference household income of $450 in 1984 AU$.
(d) High income scales based on reference household income of $700 in 1984 AU$.
(e) The estimated standard errors are in parentheses.

Table 2.6 Bradbury's Low Income Scale estimates

Type of Household by no. of children	*Engel Scales*	*ELES Scales*	*Generalised Translation Scales*
Couple Only	1.00 -	1.00 -	1.00 -
Couple + 1 child	1.24 (0.07)	1.42 (0.08)	1.21 (0.08)
Couple + 2 children	1.22 (0.06)	1.12 (0.22)	1.31 (0.09)
Couple + 3 children	1.39 (0.08)	2.34 (0.27)	1.37 (0.13)

Source: Bradbury (1994)
Notes: (a) The estimated standard errors are in parentheses.
(b) Estimated using 1988-89 Household Expenditure Survey.

Table 2.7 Valenzuela's Engel Scales for Australia

	Engel Scales	
Type of Household by no. of children	*based on food basket only*	*based on food, clothing & housing*
Single Adult	0.51 (0.01)	0.57 (0.01)
Single Parent + 1 child	0.85 (0.02)	0.99 (0.03)
Single Parent + 2 children	1.05 (0.03)	1.30 (0.05)
Single Parent + 3 children	1.16 (0.05)	1.52 (0.09)
Couple Only	1.00 -	1.00 -
Couple + 1 child	1.24 (0.07)	1.42 (0.08)
Couple + 2 children	1.22 (0.06)	1.12 (0.22)
Couple + 3 children	1.39 (0.08)	2.34 (0.27)

Source: Valenzuela (1996) and own calculations.
Notes: (a) The estimated standard errors are in parentheses.
(b) Estimated using 1988-89 Household Expenditure Survey.

Chapter 3

The Data: 1988-89 Australian Household Expenditure Survey

The increasing availability of cross-sectional micro-unit data has been a positive development for researchers interested in demographic effects and cross-section welfare. The use of cross-section data allows the researcher to make use of the rich demographic detail and extensive variation in expenditure levels which is a characteristic of a large-scale household survey. Data on individual units contain greater variation in each variable and less co-variation among variables than aggregate data, simply because the latter are sums or averages of the former. This fact is important in econometric models since the precision with which each parameter is estimated increases with the variance of the variable entering the model and decreases with the covariance among the variables. Consequently, disaggregated models are often able to capture effects that cannot be accurately estimated using more aggregated models.

In this dissertation, a unit-record file detailing expenditure information of Australian households is used in all the empirical applications. This chapter describes in detail this data file.

The Data

The data used in the empirical sections of this dissertation comes from the 1988-

89 Household Expenditure Survey (HES) conducted by the Australian Bureau of Statistics (ABS). The 1988-89 HES is the fourth of a series of surveys designed to obtain details of expenditure, income and a wide range of demographic characteristics of Australian private households on a nation-wide basis. The public-use tape released in November 1990 contains a total of 7225 households randomly selected from private dwellings and caravan parks in Australia. The household units were selected in a manner which ensured the households living there were representative of Australian households as a whole. The sample households were spread evenly over the enumeration period (July 1988-July 1989) to ensure that the seasonal expenditure patterns do not affect the final data. When accompanying "expansion factors" are applied, the 7225 households represent an estimated 5.42 million households Australia-wide.

Table 3.1 shows some household characteristics for the full HES sample of 7225 household units. About 60 percent of the households draw income mainly from wages and salaries and about 25 percent rely primarily on government pensions and benefits. In terms of composition, the largest proportion of households are the married couples with dependant children[1] (28.4 percent), while childless couples and multiple income unit households[2] have a share of about 23 percent each. Single person households comprise 20 percent of the total while households consisting of single parents with dependant children have the smallest share of 4.6 percent.

For the empirical applications in this work, the sample households needed to be grouped into types according to the number of adults and the number of children. Adults are all persons aged 17 or older and children refer to all those aged 16 or younger. This results in sixteen different household types as shown in Table 3.2. Households not belonging to any of these types were excluded. Some 290 households were also discarded because of reported negative expenditures on certain items[3]. These observations were not consistent with the economic models

[1]The ABS defines dependant children as all children up to age 14 plus all those between 15 and 20 who are full-time students.

[2]The ABS defines multiple income unit households as those which have members, other than the head and the spouse, who earn income.

[3]For example, 72 percent of these negative expenditures were on transport while 27 percent were on recreation and entertainment.

developed in this thesis. One household was also excluded because it contained no adult members.

Different sample sizes were used in different parts of the thesis. In Chapter 4, the sample used consisted of all of the 16 household types - ranging from the one-person household to those with four adults with varying numbers of children up to three. On the other hand, the empirical sections of Chapters 5, 6 and 7 had an estimation sample restricted to households of related persons with one or two adults and at most three children. This restriction was applied so that the results from these chapters can be compared consistently with those of previous studies, particularly that of Binh and Whiteford (1990). It can also be seen from the table that some of the other household types contained few observations. Altogether, this meant that for Chapter 4, 6794 households or 93 percent of the full HES sample was used. For Chapter 5, 6 and 7, meanwhile, this meant using 5532 households as a basis for estimation. This is about 77 percent of the full set (top panel only of Table 3.2) and we further describe this subsample below.

Of the 5532 households considered (see top panel of Table 3.2), 37 percent were of the type (2,0) where the first number in the bracket refers to the number of adults, and the second number refers to the number of children. Further, 24 percent were of the type (1,0). This implies that 61 percent of the total households in the sample are without children. These households are mostly in the older age groups (household head usually 45 years or older) and are inferred to have children who are already living away and/or financially independent. Meanwhile, the households with children tend to belong to the younger age bands (household head age between 25 and 40). Two-adult households tend to have higher weekly incomes compared to one-adult household, and households with children tend to have higher incomes than those without. The differences in these income levels are more significant across households with two-adults than across those with one adult.

The 1988-89 HES microunit data set contains expenditure information on 672 finely aggregated commodity groups. Information on expenditures are obtained by asking respondents to fill in a diary of expenditures for a period of two weeks. The information gathered from these diaries is then averaged so that the weekly

average expenditures for each item are recorded in the data file. These two-week diaries are supplemented by another form that the respondent is asked to complete, pertaining to expenditures on consumer durables, and other items requiring large outlays. Examples of these are holiday expenses, purchase of a house or a car and certain health expenditures. Items included in this form have longer recall periods than just two weeks.

This dissertation utilises expenditure data on commodity items that are far more aggregated than what is provided by the 1988-89 HES. The empirical sections of the next four chapters require commodity groupings that are generally not the same but which are either all, some, or a combination, of the following eleven expenditure categories:

1. **Housing** includes expenses incurred for the payment of rent, mortgage, property rates, house and contents insurance as well as housing repairs and maintenance.

2. **Fuel and Power** includes all expenses towards electricity, gas and other fuels.

3. **Food** includes all expenses towards bakery products, flour and other cereals, meat and fish, dairy products, fruits and vegetables, miscellaneous food (jams, jellies, coffee, tea), non-alcoholic beverages, meals out and take-away food.

4. **Alcohol and Tobacco** refers to all expenses towards the purchase of cigarettes and all types of alcoholic beverages.

5. **Clothing and Footwear** includes all expenses towards the purchase of clothing and footwear for men, women and children, clothing accessories (e.g. ties, gloves, handkerchiefs) as well as clothing and footwear services (e.g. drycleaning and shoe repairs).

6. **Household Furnishings and Equipment** includes all expenses towards furniture and floor coverings, blankets and rugs, household linen and furnishings, household appliances, glassware, tableware, household utensils and

cleaning agents. This category also includes expenditure incurred for the operation of the household such as gardening services, housekeeping, childcare and the repair and maintenance of household durables.

7. **Medical and Health Care** covers items such as accident and health insurance premiums, practitioner's fees, prescriptions, medicines, pharmaceutical products, hospital and other health charges.

8. **Transport** refers to all expenses made for the purchase of motor vehicles, petrol and fuels, vehicle registration and insurance, vehicle servicing and repairs, driver's licenses, driving lessons, subscriptions to motor organisations, vehicle hire, as well as public transport fees.

9. **Recreation and Entertainment** includes expenses incurred for the purchase of television and other audio-visual equipment, books, newspapers and other printed material, recreational equipment (cameras, musical instruments, toys), gambling, entertainment and recreational services. Holiday expenses as well as those incurred for animal pets are also included in this category.

10. **Personal Care** pertains to expenses towards toiletries, cosmetics, hair dressing and beauty services.

11. **Others** includes expenses for miscellaneous goods (watches, jewellery, stationery), interest payments on selected credit services, education fees, and other miscellaneous services. This category also includes income tax payments, other capital housing costs (extensions, renovations, landscaping) and superannuation and life insurance.

Table 3.3 presents full sample means and standard deviations for selected expenditure categories, income and demographic variables for the 5532 Australian households. On average, total yearly expenditure of a typical household amounts to $29,123. The largest component of this is food (19.20 per cent) followed closely by housing (16.52 percent). Expenditure on clothing has a budget share of just over 6 percent while that of health care has a budget share of just over 4 percent

of total expenditure. These four commodity groups together make up 46 percent of household total expenditure. The sample proportion estimates for each of the eleven commodity groups by household type are presented in Table 3.4. Except for housing, the estimated proportions are stable across the household types. A typical Australian household spends about 20 percent of expenditure on food, about the same proportion for housing, about 15 percent on transportation expenses, and about 12 percent each on household furnishings and recreation. The remaining 21 percent are distributed across the other item types.

Table 3.1 All Households, 1988-89 Household Expenditure Survey: Selected Characteristics by Gross Income Decile

Household Characteristics	Gross Income Decile										All Households
	Lowest 10%	*2nd Decile*	*3rd Decile*	*4th Decile*	*5th Decile*	*6th Decile*	*7th Decile*	*8th Decile*	*9th Decile*	*Highest 10%*	
Proportions of households with principal source of gross income being --						*- percent -*					
Wages & Salaries	3.6	6.7	16.1	62.2	80.1	84.2	85.4	89.9	90.2	83.4	60.3
Own Business	2.5	3.9	6.5	10.4	8.1	9.9	10.5	7.4	6.6	13.0	7.9
Other Private Income	11.4	9.4	11.8	12.8	6.7	4.1	3.7	2.2	2.9	3.6	6.9
Government Pensions & Benefits	80.0	80.0	65.7	14.6	5.1	1.7	0.4	0.4	0.3	0.0	24.7
Total	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
Proportion of Households with composition --						*- percent -*					
Married couple only	8.5	40.4	42.1	23.2	16.5	16.0	21.3	21.7	26.0	16.0	23.2
Married couple w/ dependants only	6.9	6.8	18.1	27.8	37.0	42.3	41.1	39.5	34.1	29.9	28.4
Single parent with dependants only	1.6	17.2	9.8	7.5	4.5	2.9	1.7	0.3	0.4	0.0	4.6
Single person household	80.0	31.2	14.6	25.1	21.1	15.0	7.6	4.9	2.2	2.1	20.3
Multiple income unit household	3.1	4.4	15.4	16.3	20.8	23.8	28.3	33.6	37.3	52.0	23.6
Total	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
Number of households in sample	696	697	723	709	709	706	734	786	729	736	7225
Estimated total number in population						*(000's)*					
Households	538.5	534.7	545.4	541.9	544.6	544.4	537.0	548.6	542.1	543.3	5420.4
Persons	737.6	1,029.5	1,291.3	1,409.9	1,547.2	1,657.8	1,736.3	1,794.6	1,816.6	1,965.5	14,986.4

Source: Australian Bureau of Statistics, Catalouge No. 6544.0

Table 3.2 Sample Characteristics

	Household Type (no. of adults, no. of children)							
	(1,0)	*(1,1)*	*(1,2)*	*(1,3)*	*(2,0)*	*(2,1)*	*(2,2)*	*(2,3)*
Sample Size	1372	132	103	42	2074	532	889	388
Age of Household Head	52.68	33.52	30.28	28.76	48.38	32.68	33.84	35.12
	(22.71)	(15.93)	(13.93)	(14.32)	(23.58)	(16.44)	(13.09)	(10.55)
Weekly Household Income	306.73	274.54	315.38	313.64	595.93	697.00	767.83	720.57
	(246.53)	(172.51)	(166.09)	(159.76)	(417.50)	(579.69)	(493.50)	(378.47)
Weekly Household Expenditure	255.04	281.20	315.15	310.44	461.62	555.94	603.90	623.19
	(194.60)	(162.12)	(153.57)	(142.05)	(285.24)	(285.82)	(348.75)	(321.88)

	Household Type (no. of adults, no. of children)							
	(3,0)	*(3,1)*	*(3,2)*	*(3,3)*	*(4,0)*	*(4,1)*	*(4,2)*	*(4,3)*
Sample Size	509	207	123	37	182	86	41	67
Age of Household Head	51.51	44.71	44.06	44.81	50.06	46.3	42.98	50.43
	(14.17)	(7.74)	(9.27)	(9.10)	(10.78)	(7.71)	(3.06)	(9.14)
Weekly Household Income	902.67	891.80	958.26	928.34	1274.10	1232.60	954.2	986.99
	(556.96)	(381.36)	(681.98)	(649.21)	(634.76)	(570.02)	(410.89)	(420.00)
Weekly Household Expenditure	817.35	807.54	864.42	887.52	1093.36	1059.24	886.85	849.57
	(493.16)	(352.96)	(609.53)	(613.13)	(521.04)	(444.57)	(473.56)	(411.23)

Notes: (a) Chapter 4 used a total sample of 6784 households (i.e. all household types in this table); Chapters 5, 6 and 7 used a total sample of 5532 households (i.e. households restricted
(b) Adults are all those aged 17 or over and children are all those aged 16 or younger.
(c) Standard errors are in parentheses.

Table 3.3 Variable Means and Standard Deviations of selected variables, Australia 1988-89.

Variable	*AU$*
Yearly Expenditure on Food	5,591 (2,853)
Yearly Expenditure on Clothing	1,755 (2,646)
Yearly Expenditure on Housing	4,810 (4,121)
Yearly Expenditure on Health Care	1,244 (1,288)
Yearly Expenditure on Food, Clothing & Housing	12,156 (6,623)
Yearly Expenditure on Food, Clothing, Housing & Medical Care	13,400 (7,023)
Total Yearly Expenditures	29,123 (17,698)
Total Yearly Income (before tax)	37,454 (26,422)
Total Yearly Income (after tax)	29,885 (20,557)
Sample Size	5532

Note: (a) The estimated standard errors are in parentheses.

Table 3.4 Proportions of Expenditures for Sample Households

	Household Type (no. of adults, no. of children)							
Commodity Group	*(1,0)*	*(1,1)*	*(1,2)*	*(1,3)*	*(2,0)*	*(2,1)*	*(2,2)*	*(2,3)*
Housing	0.19	0.20	0.20	0.19	0.14	0.17	0.16	0.16
Fuel & Power	0.03	0.04	0.04	0.04	0.03	0.03	0.03	0.03
Food	0.17	0.20	0.23	0.23	0.18	0.18	0.19	0.20
Alcohol & Tobacco	0.05	0.04	0.03	0.02	0.05	0.04	0.04	0.03
Clothing & Footwear	0.05	0.06	0.06	0.08	0.05	0.05	0.06	0.06
Household Furn. & Equip	0.12	0.11	0.12	0.11	0.13	0.15	0.11	0.12
Medical & Health Care	0.04	0.03	0.04	0.02	0.04	0.04	0.04	0.04
Transport	0.15	0.13	0.13	0.14	0.16	0.13	0.14	0.15
Recreation& Entertainment	0.12	0.10	0.08	0.11	0.13	0.11	0.13	0.12
Personal Care	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Others	0.06	0.08	0.06	0.05	0.07	0.07	0.08	0.09

Notes: (a) Adults are all those aged 17 or over and children are all those aged 16 or younger.
(b) Total sample size is 5532.

Chapter 4

New Engel Scales for Australia

In Chapter 2, several models of equivalence scales derived from demand data were reviewed. Of all the approaches covered, the Engel methodology for the estimation of equivalence scales is by far the most popular. It is intuitively attractive, involves simple calculation techniques and has minimal data requirements. In this chapter, Engel scales for Australia are estimated and presented using the 1988-89 Household Expenditure Survey. These new estimates update earlier results from previous surveys. Also in this chapter is a comparison of the new Engel scales for Australia with those obtained in similar manner for the Philippines and Thailand. This is facilitated by the availability of Philippine and Thai micro data sets for the same year, 1988. Such comparisons are important in public policy research particularly those that focus on international comparison. Note that the journal version of this chapter has been published in the 2nd Quarter 1996 issue of the *Australian Economic Review.*

4.1 The Model and the Estimation Procedure

Engel's approach to the estimation of equivalence scales rests on the assumption that household well-being is correctly ascertained from the budget share of food expenditures (or, more generally, of expenditures on a basket of commodities). The cost of an additional household member can therefore be measured by the compensation that would have to be given to the household to retain the same

budget share for food.

Calculation of this measure requires an equation relating income with expenditure share (called an Engel curve) to indicate welfare. A survey of empirical studies shows that the specification of a functional form for the Engel curve is largely arbitrary. The choice of a functional form can depend on all or any combination of the following factors: (i) the availability of the required information (data) for estimation (e.g. cross-section or time-series data); (ii) economic-theoretic appeal; (iii) mathematical tractability; (iv) computational feasibility; (v) plausibility of resulting estimates; and, (vi) historical interest.

For the purposes of this chapter, four basic functional forms were considered. Let x refer to income, n to the number of household members or household size, and n_j to the number of household members belonging to demographic grouping j. If w is used to refer to the expenditure share, the functional forms considered were

$$\text{(i)} \quad w = \beta_0 + \beta_1 \ln x + \sum_{j=1}^{J} \gamma_j n_j$$

$$\text{(ii)} \quad w = \beta_0 + \beta_1 \ln \frac{x}{n} + \sum_{j=1}^{J} \gamma_j n_j$$

$$\text{(iii)} \quad \ln w = \beta_0 + \beta_1 \ln x + \sum_{j=1}^{J} \gamma_j n_j$$

$$\text{(iv)} \quad \ln w = \beta_0 + \beta_1 \ln \frac{x}{n} + \sum_{j=1}^{J} \gamma_j n_j$$

where β_0, β_1 and γ_j are unknown parameters. Specifications (i) and (ii) are demographically modified extensions of the Working (1943)-Leser (1963) form, in which the expenditure share is a linear function of the logarithm of total outlay. Deaton and Muellbauer (1986) say that this form frequently fits the data well, at least for the many household surveys from developing countries that they have examined. Specification (iii) is a form used by Binh and Whiteford (1990) in their study using Australian data (1984 HES). Specification (iv) is a form officially employed by

Statistics Canada (see Phipps and Garner (1994)) for Engel curve estimation.

The first step in the general procedure for calculating equivalence scales using the Engel approach is to equate the two budget shares w^h and w^r of household h and the reference household r. The Engel scales defined earlier in equation (2.4) of Chapter 2 are obtained by solving the resulting equation for the ratio x_h/x_r. To illustrate, the Engel scales from specification (ii) are derived below. At equal expenditure shares, $w^r = w^h$, we have

$$\begin{aligned}
\beta_0 + \beta_1 \ln\left(\frac{x_r}{n_r}\right) + \sum_{j=1}^{J} \gamma_j n_j^{(r)} &= \beta_0 + \beta_1 \ln\left(\frac{x_h}{n_h}\right) + \sum_{j=1}^{J} \gamma_j n_j^{(h)} \\
\beta_1 \left[\ln\frac{x_r}{n_r} - \ln\frac{x_h}{n_h}\right] &= \sum_{j=1}^{J} \gamma_j n_j^{(h)} - \sum_{j=1}^{J} \gamma_j n_j^{(r)} \\
\ln\left(\frac{x_r}{n_r}\right) - \ln\left(\frac{x_h}{n_h}\right) &= \sum_{j=1}^{J} \frac{\gamma_j}{\beta_1}(n_j^{(h)} - n_j^{(r)}) \\
\ln\left(\frac{x_h}{x_r}\right) - \ln\left(\frac{n_h}{n_r}\right) &= \sum_{j=1}^{J} \frac{\gamma_j}{\beta_1}(n_j^{(r)} - n_j^{(h)}) \\
\ln\left(\frac{x_h}{x_r}\right) &= \ln\left(\frac{n_h}{n_r}\right) + \sum_{j=1}^{J} \frac{\gamma_j}{\beta_1}(n_j^{(r)} - n_j^{(h)}) \\
\frac{x_h}{x_r} &= \frac{n_h}{n_r} \exp \sum_{j=1}^{J} \frac{\gamma_j}{\beta_1}(n_j^{(r)} - n_j^{(h)}) \qquad (4.1)
\end{aligned}$$

In general, the Engel equivalence scales can be expressed as $s_h = x_h/x_r = s_h(\theta, \delta)$ where θ is a m-vector of parameters and δ a vector of household and economic characteristics. Let $\hat{\theta}$ and $\hat{s_h}$ be consistent estimates of θ and s_h, respectively. From Judge, et.al. (1988), the estimated asymptotic variance of s_h can be written as

$$\hat{\text{Var}}(\hat{s_h}) = \sum_{l=1}^{m} (\partial \hat{s}_h/\partial \hat{\theta}_l)^2 \hat{\text{Var}}(\hat{\theta}_l) + 2 \sum_{l>k}^{m} \sum_{k=1}^{m} (\partial \hat{s_h}/\partial \hat{\theta}_l)(\partial \hat{s_h}/\partial \hat{\theta}_k)(\hat{\text{Cov}}(\hat{\theta}_l, \hat{\theta}_k)) \qquad (4.2)$$

This is used to derive the standard errors of the estimated scales.

The procedure just described was applied to all the specifications above using $J = 2$ demographic groupings: n_1 refers to the number of adults and n_2 refers

to the number of children. If the reference household comprises 2 adults and no children, as indeed it does in the empirical work, then equation (4.1) in this case becomes

$$\frac{x_h}{x_r} = \frac{n_h}{2} \exp\left[\frac{\gamma_1}{\beta_1}(2 - n_1^{(h)}) - \frac{1}{\beta_1}\gamma_2 n_2^{(h)}\right] \tag{4.3}$$

Estimation for $J = 3$ where n_2 and n_3 in this case refer to younger and older children, respectively, was also undertaken. With the 2-adult, no children household for a reference unit, the equivalence scale for specification (ii) is defined as

$$\frac{x_h}{x_o} = \frac{n_h}{2} \exp\left[\frac{\gamma_1}{\beta_1}(2 - n_1^{(h)}) - \frac{1}{\beta_1}\gamma_2 n_2^{(h)} - \frac{1}{\beta_1}\gamma_3 n_3^{(h)}\right] \tag{4.4}$$

The following three commodity baskets were used as alternative indicators of welfare:

$w1$	food only
$w2$	$w1$ plus clothing and housing
$w3$	$w2$ plus health care

where the specific commodity groups are as defined in Chapter 3. Here, category 5 (Clothing and Footwear) is simply referred to as Clothing and category 7 (Medical and Health Care) simply as Health Care.

The various equations were estimated by using simple least squares procedures using the econometric package SHAZAM. Diagnostic checks were routinely carried out in running the regressions and, not surprisingly, heteroskedasticity always appeared to be present. The results presented are derived from models that have been corrected for heteroskedasticity where the error variances are assumed to be directly related to the income variable. F-tests for equality of coefficients are consistent in indicating that for all the expenditure items used, demographic variable coefficients are clearly different from each other.

4.2 Estimation Results and Calculated Scales

The estimation results obtained by applying the procedures described in the last section - inclusive of the estimated parameters for each of specifications (i)-(iv) and the estimated scales - showed that functional form (ii) was the best specification for the purposes of this chapter. Compared to the others, this specification showed the best fit and yielded results which were plausible and economically justifiable. The results presented in this section now all pertain to this chosen specification.

Table 4.1 presents the estimated Engel curve parameters for the different baskets $w1$, $w2$ and $w3$ used as the dependent variable and for the functional forms where $J = 2$ and $J = 3$. Engel curves for all expenditure categories show reasonable fits with the food equation exhibiting the highest R^2 value. The regression results are shown to be sensitive to the choice of basket as the values of the estimated coefficients change considerably when one moves from food-based equations to the those based on the two other baskets.

The signs of the coefficient estimates conform with the *a priori* expectation that expenditure share of food or some other basket of necessities is inversely proportional to income levels. At the same time, these shares are shown to increase with the addition of household members. Most coefficients were found to be highly significant at the 5 percent level. The magnitude of the coefficients for the demographic variables γ are observed to be consistently small compared to those of the per capita income coefficient β_1.

Table 4.2 presents the estimated Engel scales for households composed of 1, 2, 3 or 4 adults with varying numbers of children. In all the calculations, the (2,0) household is chosen as the reference household. The equivalence scale of .513 for a (1,0) household implies that to be on the same level of utility (as measured by the budget share of food), a single adult household requires 51.3 percent of the total expenditure of a two-adult, zero children household. Further, the scale value of .849 for a (1,1) household imply that a single mum with 1 child will need to maintain a total expenditure which is 84.9 percent that of a childless couple to be on the same level of well-being. Similarly, an equivalence scale of 1.24 for a couple with one child implies that this household will need 24 percent more in total expenditures

to be on the same welfare level as that of the reference household. The scales show that the presence of a second child will push total expense requirements up by another 12 per cent. It is also apparent from the scale estimates that the marginal cost for additional children is declining which is a very plausible result.

From the right hand side of Table 4.2, it can be inferred that an additional adult will increase household expenditure requirements by 46.2 per cent and a second extra adult will require more or less the same extra amount. The increase in the expenditure requirements of children are relatively less when more adults are present in the household, exemplifying gains due to size economies. However, we also observe that the estimated scales for the 3rd and 4th children in 3- and 4-adult households tend to decline (i.e. negative costs). This result is counter-intuitive and could perhaps be attributed to sampling error.

Across commodity groups, the estimated scales are observed to increase with the addition of clothing, shelter and medical care in w. It is clear that scales based on $w2$ and $w3$ are very close in value and that they show higher scale relativities compared to those based on foodshares alone. Expenditure on $w3$ which includes a medical care expenditure component exhibits lower scale relativities compared to $w2$. This can be explained by the fact that the price of health care services in Australia is primarily paid via the tax system rather than the market mechanism.

4.3 Comparison with Philippine and Thai Engel Scales

This section presents results comparing the Australian Engel scales with those of the Philippines and Thailand. This cross-country comparison is undertaken because of the growing awareness among public policy researchers, particularly those who focus on international comparisons, of the importance of the choice of scales in determining conclusions reached. In a survey article by Coulter, Cowell and Jenkins (1992), it is shown that there is a systematic relationship between equivalence scale 'generosity' and the extent of inequality and poverty. This finding supports those of an earlier study by Buhmann, et.al. (1988) which reports the

sensitivity of cross-country estimates of poverty and inequality to the choice of equivalence scale. The question 'Which equivalence scale should be used?' is thus a researcher's dilemma that many find difficult to resolve. Researchers in the area have come up with conflicting recommendations. In a study which analysed the impact of divorce on the economic well-being of men, women and children in the United States (US) and Germany, Burkhauser, et.al. (1990) strongly recommend that it is best to use German scales to analyse German data and US scales to analyse US data. On the other hand, Hanratty and Blank (1992) assume the simplest case and implicitly use the same equivalence scale for the US and Canada to compare poverty between the two countries. A more recent study by Phipps and Garner (1994) which derived scales for the US and Canada found that their estimated scales were not, in general, statistically different.

In the Asia-Pacific region, a comparison of equivalence scales has not been formally undertaken until Valenzuela (1996). This section presents a summary of the results from that study. To facilitate comparison, the equivalence scales for the Philippines and Thailand were derived using the Engel approach applied to similarly selected samples. Also, a common model specification was used to estimated the scales for the three countries and this is specification (ii) in the Section 4.1.

4.3.1 Comparability of the Data Sets

The data used for the estimation of the Philippine equivalence scales are from the Family Income and Expenditure Survey (FIES) conducted by the Philippines' National Statistics Office covering the period between February 1988 and January 1989. The survey involved the interview of a national sample of about 18,500 households deemed sufficient to provide reliable estimates of income and expenditure levels for each province of the country, including key cities. The 1988 FIES uses a two-stage cluster sampling design where the urban and rural areas of each province are the principal domains of the survey. The primary sampling units under the sample design are the *barangays* and the households within each sample *barangay* comprise the secondary sampling units.

Data for the estimation of the Thai Engel scales are from the 1988 Socio Economic Survey (SES) conducted by the National Statistics Office of Thailand covering the period between February 1988 and January 1989. The sample of households is designed to represent all private, non-institutional households in Thailand which can be found in municipalities, sanitary districts or villages. The 1988 SES utilised a stratified-three stage sampling design to collect some 11500 sample households. The primary and secondary sampling units were the *amphoe* and the block or village. Households were the ultimate sampling units.

For the three surveys, the operational definition of the household appears to be comparable i.e. a household refers to a group of persons with common meal and other living arrangements. In the Philippines, it is common to find 'extended family' type households composed of the nuclear family plus one or more other relatives and/or domestic helpers. This set-up is quite typical of the Thai household as well but less common for the Australian household. In effect, Philippine and Thai households are generally larger in size relative to the Australian household.

The three surveys maintain a comparable definition of expenditure: the amount spent on the purchase of goods and services used for private consumption. In all cases, expenditure is collected on a household basis rather than for selected individuals in the population. The definitions of the broad commodity groups namely, food, clothing, housing and medical care for the Philippine and Thai data sets were so designed so that they are consistent with the Australian definition outlined in Chapter 3. It is noted though that a large difference in the definition of medical care nonetheless exists because of the fact that the price of health services in Australia is primarily paid via the tax system rather than the market mechanism as in the two other countries. This should be borne in mind when interpreting the results.

With regards to the demographic groupings, a difference exists with the definition of children. For Australia, children are defined as those aged 16 or younger; for Thailand, children are those aged 15 younger; while for the Philippines, children are those aged 14 and younger. This slight discrepancy is ignored and assumed not to significantly affect the results.

4.3.2 Results

Table 4.3 presents full sample means and standard deviations for expenditure, income and demographic variables. Philippine and Thai currencies are presented in 1988 Australian dollars to facilitate comparison[1]. Expenditure levels in Australia are substantially higher compared to the Philippines and Thailand and of the two latter countries, households in Thailand spent more than Philippine households for all types of expenditure items. Not surprisingly, the average income levels of households in both the Philippines and in Thailand stand at a mere 7 percent of that of the average Australian household. Overall, Philippine households devote about 44 percent of expenditures to food, Thai households 37 percent and Australian households 20 percent. The combined expenditures on food, clothing, shelter and medical care comprise about 70 percent of the total expenditures of Philippine and Thai households. The same basket comprises less than half (46 percent) of the Australian household's total expenditure. As expected, Australian households tend to be smaller than Philippine or Thai households. The estimated average household sizes are 5.4 and 4.2 for Philippine and Thai households, respectively; they also have large variances.

Table 4.4 presents Engel curve parameter estimates for Australia, the Philippines and Thailand, respectively. Engel curves for all expenditure categories show reasonable fits for both Thailand and the Philippines with food equations exhibiting the highest R^2 values. Engel curves for Australia exhibited relatively poor fits for all basket types. The regression results are shown to be sensitive to the choice of basket as the values of the estimated coefficients change considerably when one moves from food-based equations to the those based on the two other baskets. Coefficient estimates for the Philippines and Thailand appear to be reasonable as they have the correct signs and are statistically significant. While the magnitudes of the coefficients are different, they follow the same trend as the Australian estimates.

Table 4.5 presents the Engel scales estimated using specification (ii) in Section 4.1 for all the countries. The scales show that, if foodshare expenditures is used as

[1]Conversions rates used: AU$ 1.00 = 20 Philippine pesos = 20 Thai Baht. Source: *International Financial Statistics Yearbook 1989.*

a base, an additional child costs about 44 percent of a couple in the Philippines, about 41 percent of the same in Thailand, but only about 24 percent of a couple in Australia. Understandably, the relative food cost requirements of having children increase with the increase in family size, but as expected, the corresponding marginal costs clearly increase at a diminishing rate. Considering that there is not much room for economies of scale in food, these results make empirical sense.

Notwithstanding, the observed food-cost differentials between Australia, on the one hand, and the Philippines and Thailand, on the other, need to be explained. To this effect, two things are noted. First, it must be recognised that costs of food items in both the Philippines and Thailand are higher relative to those in Australia. A consequence of this is shown in Table 4.3 which indicates that, on the average, households in the Philippines and Thailand spend a greater proportion (over 40 per cent) of their budget on food compared to Australian households (20 per cent)[2]. In this context, it is easy to imagine that the addition of a child (who is a largely food-consuming individual) to a family will increase food cost requirements for Philippine and Thai households more than it will for Australian households. Secondly, the availability of government support payments (otherwise known as Family Allowance) for every child to a large majority of Australian families has the effect of softening the impact of the additional demand on the family's resources due to the presence of an additional child[3]. As this type of subsidy is not seen in the Philippine or Thai system, the need to meet the extra demand becomes the sole burden of the household itself, hence, the higher relative costs shown.

Moving on now from the food-based equations to the scales based on more composite baskets of necessities, that is $w2$ and $w3$, it is observed that the scales for both the Philippines and Thailand decrease while those of Australia increase. This shift in magnitude effectively brings the values of the estimated scales very

[2]It is well known that the high cost of basic commodities, particularly food, is a common characteristic of poor and less-developed countries.

[3]This may also explain why the food-based scales for Australia decrease with the fourth child. That is, given that the typical household derives gains from the operation of economies of scale in the family while the Family Allowance is fixed for each child, it is possible that the total allowance for four children in a family is more than sufficient to cover the food costs the household may require.

close across the three countries. The marginal costs of additional children based on these basket types are also seen to decrease as the household size increases.

The comparability of these scales is further demonstrated when the average per person cost of the first two adults incurred with different numbers of extra children is calculated. Table 4.6 shows that the level of agreement between the three countries and between the two levels of inclusiveness of the definition of necessities is remarkably high. In contrast, the corresponding results for $w1$ shown on the bottom half of the same table show more variability in the proportions. What these observations imply is that Engel scales for the Philippines and Thailand show more economies of scale for the more composite basket of commodities considered compared to those based on the food-only basket. Whereas, in Australia, the scales based on food alone exhibit more economies of scales compared to those that are based on the composite baskets.

The results just mentioned are opined to reflect the different 'standards' by which households in these different countries operate. In the Philippine and Thai context, society's standards are met if the household (that is, the parents) is able to provide sufficient food for the additional child in the family. Because of the poor economic state of the typical household, very little concern is given to the other needs of the child. In terms of housing, for instance, it is not uncommon for a new baby in the family to have no provision for a room of its own. In fact, the household set-up where a family of four children share a one-bedroom or two-bedroom unit is very typical in both of these countries. In the Australian setting, the arrival of a baby will, of course, create an extra demand for food. But in addition to this, society's standards dictate that the child also be provided a room of his or her own. The obtained scales based on either $w2$ or $w3$ possibly reflect this one-room-per-child trend among Australian households which pressures families to incur extra housing expenditures (by renovating or moving to a bigger house, maybe) to accommodate the additional child in the family. Also, children in developed countries like Australia bring with them a lot of non-food expenses which may help explain the increase in relative costs as shown by the scales.

Has this empirical regularity been observed elsewhere? A survey of the literature revealed that Engel scale estimates have been calculated previously for

individual countries. More often than not, however, these country-specific scales are not comparable because they were either obtained from household surveys pertaining to different years or the estimation procedures were very different to each other. In addition, it is noted that of the few studies that compute comparable scales across countries, the comparison is usually between developed countries (for example, Phipps and Garner (1994) and Burkhauser, et.al. (1990)). Therefore, a satisfactory answer to the question posed above is not possible with the current level of research into equivalence scale estimation for developing countries. It is nonetheless maintained that the findings here are very plausible and the observed cost differentials can be economically justified.

Table 4.1 Parameter Estimates of Engel Equations, Australia 1988-89

	w1		*w2*		*w3*	
	Form 1	*Form 2*	*Form 1*	*Form 2*	*Form 1*	*Form 2*
Constant	1.542	1.161	1.936	1.942	2.145	2.151
	(0.028)	(0.028)	(0.054)	(0.054)	(0.059)	(0.059)
ln(x/n)	-0.176	-0.176	-0.268	-0.269	-0.298	-0.298
	(0.005)	(0.005)	(0.010)	(0.010)	(0.011)	(0.011)
n_1	-0.005	-0.006	-0.033	-0.035	-0.035	-0.036
	(0.003)	(0.003)	(0.007)	(0.007)	(0.007)	(0.007)
n_2	-0.033	-	-0.036	-	-0.045	-
	(0.003)		(0.005)		(0.057)	
n_{2*}	-	-0.049	-	-0.041	-	-0.059
		(0.005)		(0.009)		(0.010)
n_3	-	-0.027	-	-0.031	-	-0.039
		(0.003)		(0.006)		(0.066)
R^2	0.174	0.176	0.124	0.125	0.126	0.127
σ^2	0.042	0.042	0.156	0.156	0.185	0.185

Notes: (a) *w1*, *w2* and *w3* indicate the reference basket used as the dependent variable.
w1 consists of food only; *w2* consists of food, clothing & shelter; *w3* consists of food. clothing, shelter & medical care.
(b) n_1 refers to the number of adults; n_2 refers to the number of children; n_{2*} and n_3 refer to the number of younger (age<5) and older (5-16) children, respectively.
(c) The estimated standard errors are in parentheses.

Table 4.2 Estimated Engel Scales, Australia 1988-89

Household Type (no. of adults, no. of children)	*w1*	*w2*	*w3*	*Household Type* (no. of adults, no. of children)	*w1*	*w2*	*w3*
(1,0)	0.513	0.567	0.562	(3,0)	1.462	1.324	1.334
	(0.010)	(0.014)	(0.014)		(0.029)	(0.033)	(0.033)
(1,1)	0.849	0.992	0.968	(3,1)	1.611	1.545	1.530
	(0.018)	(0.028)	(0.027)		(0.042)	(0.051)	(0.050)
(1,2)	1.053	1.302	1.249	(3,2)	1.665	1.691	1.645
	(0.033)	(0.053)	(0.049)		(0.063)	(0.080)	(0.076)
(1,3)	1.160	1.520	1.433	(3,3)	1.652	1.776	1.699
	(0.050)	(0.085)	(0.078)		(0.083)	(0.113)	(0.106)
(2,0)	1.000	1.000	1.000	(4,0)	1.899	1.558	1.581
	-	-	-		(0.074)	(0.078)	0.077
(2,1)	1.240	1.313	1.291	(4,1)	1.962	1.705	1.700
	(0.018)	(0.024)	(0.023)		(0.087)	(0.095)	(0.093)
(2,2)	1.367	1.533	1.480	(4,2)	1.947	1.791	1.755
	(0.039)	(0.056)	(0.053)		(0.103)	(0.119)	(0.114)
(2,3)	1.412	1.677	1.592	(4,3)	1.878	1.829	1.762
	(0.061)	(0.091)	(0.085)		(0.119)	(0.146)	(0.138)

Notes: (a) An adult refers to all persons aged 17 or older; children are all those aged 16 or younger.
(b) *w1*, *w2* and *w3* indicate the reference basket used as the dependent variable. *w1* consists of food only; *w2* consists of food, clothing & shelter; *w3* consists of food, clothing, shelter and medical care.
(c) The estimated standard errors are in parentheses.

Table 4.3 Variable Means and Standard Deviations, 1988-89

Variable	Australia AU$	Philippines Pesos	Philippines AU$	Thailand Baht	Thailand AU$
Yearly Expenditure on Food	5,591	16,344	895	23,030	1,067
	(2,853)	(11,071)	(607)	(15,568)	(721)
Yearly Expenditure on Clothing	1,755	999	55	3,524	163
	(2,646)	(2,996)	(164)	(6,711)	(311)
Yearly Expenditure on Housing	4,810	7,945	435	15,113	700
	(4,121)	(30,459)	(1,669)	(35,364)	(1,638)
Yearly Expenditure on Health Care	1,244	615	34	3,727	173
	(1,288)	(3,156)	(173)	(10,469)	(485)
Yearly Expenditure on Food, Clothing & Shelter	12,156	25,288	1,385	41,667	1,930
	(6,623)	(39,369)	(2,157)	(44,610)	(2,066)
Yearly Expenditure on Food, Clothing, Shelter & Medical Care	13,400	25,903	1,419	45,394	2,102
	(7,023)	(39,940)	(2,188)	(47,557)	(2,202)
Total Yearly Expenditures	29,123	37,518	2,056	62,314	2,886
	(17,698)	(60,227)	(3,300)	(70,462)	(3,263)
Total Yearly Income (before tax)	37,454	47,541	2,605	62,458	2,893
	(26,422)	(104,790)	(5,741)	(76,519)	(3,544)
Total Yearly Income (after tax)	29,885	46,936	2,572	62,031	2,873
	(20,557)	(99,159)	(5,433)	(75,524)	(3,498)
Mean No. of Household Members	3.22		5.41		4.16
	(1.23)		(2.20)		(1.64)
Mean No. of Children	0.85		2.17		1.38
	(1.10)		(1.76)		(1.22)

Note: (a) The estimated standard errors are in parentheses.

Table 4.4 Parameter Estimates of Engel Equations

	Australia			*Philippines*			*Thailand*		
	w1	*w2*	*w3*	*w1*	*w2*	*w3*	*w1*	*w2*	*w3*
Constant	1.542	1.936	2.145	1.857	1.638	1.611	1.352	1.574	1.640
	(0.028)	(0.054)	(0.059)	(0.010)	(0.011)	(0.010)	(0.013)	(0.014)	(0.013)
ln(x/n)	-0.175	-0.268	-0.298	-0.147	-0.098	-0.093	-0.124	-0.112	-0.112
	(0.005)	(0.010)	(0.011)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
n_1	-0.005	-0.033	-0.035	-0.013	-0.016	-0.016	-0.011	-0.016	-0.016
	(0.003)	(0.007)	(0.007)	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)
n_2	-0.033	-0.036	-0.045	-0.005	-0.008	-0.008	-0.008	-0.015	-0.016
	(0.003)	(0.005)	(0.057)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
σ^2	0.042	0.156	0.185	0.011	0.012	0.011	0.015	0.017	0.015
R^2	0.174	0.124	0.126	0.524	0.317	0.309	0.363	0.285	0.308

Notes: (a) *w1*, *w2* and *w3* indicate the reference basket used as the dependent variable.
w1 consists of food only; *w2* consists of food, clothing & shelter; *w3* consists of food. clothing, shelter & medical care.
(b) n_1 refers to the number of adults; n_2 refers to the number of children.
(c) The estimated standard errors are in parentheses.

Table 4.5 Estimated Engel Scales

Household Type (*no. of adults, no. of children*)	*Australia*			*Philippines*			*Thailand*		
	w1	*w2*	*w3*	*w1*	*w2*	*w3*	*w1*	*w2*	*w3*
(1,0)	0.513	0.567	0.562	0.546	0.650	0.664	0.544	0.575	0.576
	(0.010)	(0.014)	(0.014)	(0.002)	(0.029)	(0.031)	(0.012)	(0.006)	(0.005)
(1,1)	0.849	0.992	0.968	1.054	1.093	1.112	1.028	1.004	1.002
	(0.018)	(0.028)	(0.027)	(0.005)	(0.038)	(0.040)	(0.021)	(0.013)	(0.012)
(1,2)	1.053	1.302	1.249	1.527	1.401	1.421	1.456	1.315	1.307
	(0.033)	(0.053)	(0.049)	(0.011)	(0.041)	(0.043)	(0.031)	(0.027)	(0.026)
(1,3)	1.160	1.520	1.433	1.966	1.617	1.636	1.833	1.530	1.515
	(0.050)	(0.085)	(0.078)	(0.019)	(0.043)	(0.046)	(0.041)	(0.046)	(0.043)
(2,0)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	-	-	-	-	-	-	-	-	-
(2,1)	1.240	1.313	1.291	1.448	1.292	1.290	1.417	1.309	1.304
	(0.018)	(0.024)	(0.023)	(0.005)	(0.029)	(0.030)	(0.022)	(0.013)	(0.012)
(2,2)	1.367	1.533	1.480	1.865	1.500	1.495	1.783	1.523	1.512
	(0.039)	(0.056)	(0.053)	(0.012)	(0.030)	(0.030)	(0.031)	(0.029)	(0.028)
(2,3)	1.412	1.677	1.592	2.250	1.647	1.640	2.104	1.662	1.644
	(0.061)	(0.091)	(0.085)	(0.021)	(0.032)	(0.033)	(0.047)	(0.048)	(0.045)

Notes: (a) An adult refers to all persons aged 17 or older; children are all those aged 16 or younger.
(b) *w1*, *w2* and *w3* indicate the reference basket used as the dependent variable. *w1* consists of food only; *w2* consists of food, clothing & shelter; *w3* consists of food, clothing, shelter and medical care.
(c) The estimated standard errors are in parentheses.

Table 4.6 Proportion of the average per person cost of the first two adults of a household incurred by adding a first through a fourth child to the household based on w2 and w3.

Additional	*Australia*		*Philippines*		*Thailand*	
Child	*w2*	*w3*	*w2*	*w3*	*w2*	*w3*
1st Child	0.6	0.6	0.6	0.6	0.6	0.6
2nd Child	0.4	0.4	0.4	0.4	0.4	0.4
3rd Child	0.3	0.3	0.3	0.3	0.3	0.3
4th Child	0.2	0.1	0.2	0.2	0.2	0.1

Proportion of the average per person cost of the first two adults of a household incurred by adding a first through a fourth child to the household based on w1.

Additional	*Australia*	*Philippines*	*Thailand*
Child	*w1*	*w1*	*w1*
1st Child	0.5	0.9	0.8
2nd Child	0.3	0.8	0.7
3rd Child	0.1	0.8	0.6
4th Child	negative	0.7	0.6

Notes: (a) *w1, w2* and *w3* indicate the reference basket used as the dependent variable.
w1 consists of food only; *w2* consists of food, clothing & shelter;
w3 consists of food, clothing, shelter and medical care.