Chapter 6

Conclusion

The aim of this work has been to estimate conditional economic equivalence scales based on ordinal utility theory. The solution of two problems has been central to the work: Firstly, economic equivalence scales suffer from a fundamental identification problem that must be solved before any equivalence scales can be estimated. Secondly, two of the suggested solutions to the identification problem require the estimation of price elasticities and a complete demand system. Because of data constraints, estimation was limited to only a single cross section of expenditures without price data.

The fundamental identification problem originates from the fact that there is no unique mapping of the indifference curves of one type of household or individual to those of another: it cannot be determined if indifference curve α of household type A grants the same utility level as indifference curve β of household type B. Because equivalence scales evaluate the incomes that different household types need to attain the same utility level, they cannot be identified from a comparison of household-preference maps alone.

The identification problem would not not arise, however, if the *same* individual were to be observed in different situations, as long as the change of situation does not alter the preference map. Therefore, equivalence scales can be identified if the same types of individual are compared in different demographic situations. This approach was followed here. The observable behaviour of different household types was broken down to the utility functions of identical reference units, i.e. identical individuals or identical couples, that are indeed comparable between household types.

Specific models of household behaviour were employed to deduce the effect of a change in household demography on the reference unit. This effect can work through redistribution between household members and through a change in effective prices due to joint consumption of household public goods and economies of scale in household production. Three models have been described in this work, each of which achieves the separation and identification

of distribution and effective prices in different ways.

Equivalence scales for couples with and without children were assessed separately from scales for (childless) single and couple households. This separation was a consequence of the different reference units used in the comparison of single households, childless couples and families with children. While both parents were used as a reference unit for households with children, individual adults must necessarily be used as a reference for the estimation of equivalence scales between couples and single households.

The household model is best developed within the collective framework for childless households (Chapter 5), where two distinct reference units (a man and a woman) living in one household do affect each other via joint consumption and via redistribution. A complex model was possible here, because the individual preferences of both partners could be recovered from observations of single households.

This is not possible for children's preferences, hence separation of distribution and effective prices must remain incomplete for families. Two models have been examined: the Rothbarth model (Chapter 3) analyzes distribution, but does not account for changes in effective prices, while in the Barten-Gorman model (Chapter 4) distribution is not independent of changes in effective prices. Because all models include the childless couple, equivalence scales can be chained and a complete system of equivalence scales for single households, childless couples and couples with one, two or three children can be calculated from the combined results of different models.

The problem of estimating a demand system arises in the Gorman-Barten model and in the collective model, as both models incorporate the reactions of reference units to changes in effective prices. With only a single cross section available and no price variation, price elasticities could not be estimated in the conventional way. Both models, however, imply changes in effective prices that can be used in the estimation of the demand system if they are known a priori. Not all implicit price changes can be determined in advance, but it was found that price changes for some goods (clothing, tobacco and alcohol) can be determined from additional data. The choice of demand system was constrained by the relative paucity of price variation in the data. The quadratic expenditure system offered a solution, because it is restrictive enough to be estimated with a minimum of information about price variation and complex enough to exploit the curvature of Engel curves in the estimation process. It could be shown that in principle, the QES can even be estimated without additional restrictions. In application, this option was limited by a very flat likelihood function.

Evaluation of Models

What are the relative merits of the different models?

Rothbarth equivalence scales can be determined by using data on adult goods, the consumption of which can be attributed to parents. Provided data on such adult goods are available, Rothbarth scales can easily be estimated using linear regression methods. The underlying theoretical assumptions of the model, namely the separability of parents' and children's preferences, are clear and easily testable by comparing estimates using different adult goods. Notably, it is possible to evaluate the direction and magnitude of the resulting bias when the theoretical assumptions of the model are not met. It is a further advantage of the Rothbarth model, that the inclusion of additional demographic variables is particularly easy to achieve. These variables can include household income, so that income dependent equivalence scales can be calculated.

In this work, it was shown that a Rothbarth scale that has been estimated using a private adult good is biased upwards while a public good leads to a downward bias, when the assumption on the separability of preferences of parents and children is not met by the data. Adult goods that have been used to estimate Rothbarth scales in the past have always been private goods: tobacco, alcohol, clothing. A new aspect could be given to the method by adding a new, public good to the range of adult goods: non-child floor space which is the floor space in a households dwelling that is not attributed to children's rooms. Some of this space is public to the household (kitchen, bathroom, living room). With non-child floor space as a public good and alcohol, clothing and jewelry as private goods, the direction of the predicted bias could indeed be confirmed. Equivalence scales for non-child floor space were significantly lower than those calculated with other goods.

It was found that estimates of income dependent equivalence scales for private goods were increasing with income, while estimated scales for the public good were falling. This was be explained by substitution elasticities that are increasing in income: The bias is the consequence of a substitution effect. While poor households have little opportunity to substitute when they have to buy minimum requirements of each good, richer households can substitute. Therefore the bias – upward or downward – is higher for richer households than for poorer households.

Apart from income also variables reflecting parents' work status, the age of children and the education of the mother were included in the model. It was found that the cost of children are higher when both parents work full time compared to a household with a sole earner. This result is not unexpected, but it was possible to quantify the effect. For all goods, this effect was independent of who earns more, the man or the woman. This is indicative of equal sharing within the household – a result that was confirmed for married couples in the collective model.

Barten equivalence scales interpret the cost of children in terms of price effects; in addition, **Gorman** scales allow for fixed costs of children. It is assumed that parents complement their own consumption with adequate consumption quantities for their children according to the children's needs. If parents consume one unit of a good, they also have to buy the complementary amount for their children, effectively making the consumption of the good more expensive. This is a change in effective prices that has consequences on demands: parents substitute away from goods that are child intensive (mostly private goods for which children have high needs), and towards goods that are less child intensive (public goods and goods where children have low needs). Such substitution effects are not incorporated into the Rothbarth model. This can be seen as an advantage over the Rothbarth model, because such substitution effects could lead to a bias in the Rothbarth scales. The size of the difference was found to be quite substantial.

Substitution effects are not the same in both household models: The focus on child intensity in the Barten-Gorman model has the consequence that a household would substitute away from private, child intensive clothing towards equally private but not at all child intensive alcohol. The predictions are different in the Rothbarth model, where a larger household would substitute away from both private goods and towards more public goods. A careful grouping of commodities is necessary to avoid such seemingly paradoxical results.

The Barten-Gorman model must be estimated within an entire demand system. This required non-linear estimation techniques, which are difficult to handle with long computation times, slow convergence and the possibility of multiple local maxima. As a consequence, no additional demographic variables could be included in the model. Using the quadratic expenditure system, both Barten and Gorman scales could be estimated when at least one effective price was fixed for the Barten model and when at least three prices were fixed for the Gorman model.

To fix effective prices, an analysis of possible constraints was carried out, and effective prices for different household types were calculated for clothing, tobacco and alcohol. The resulting equivalence scales were similar for all estimated Barten-Gorman models at the median expenditure level, but scales differed at low incomes, where the Barten model seemed to be too restrictive. The Gorman model allowed for a better adjustment, because it accounts for fixed costs of children that are of considerable magnitude relative to total expenditures at low incomes, but almost negligible at higher incomes.

In contrast to common practice in the equivalence scale literature, standard errors were calculated for all equivalence scales to asses the precision of the estimates. The Barten model showed generally lower standard errors than the Gorman model, but it must be kept in mind, that a possible specification bias is not reflected in these error values.

The **collective model** avoids many problems of the other models. First of

all, the model incorporates qualities of both child-cost models: separability of preferences and economies of scale from joint consumption that can affect the partner's consumption choices. Second, there are fewer degrees of freedom in the model, because the preferences of all members of the all-adult household are defined by the observation of single households, whereas in a family-model the consumption of children can never be observed directly.

Like the Barten-Gorman model, the collective model had to be integrated into an empirical demand system. The QES framework that was developed for the Barten-Gorman model could be used here as well. Again, restrictions on the effective prices of some goods were necessary to make estimation possible. Clothing, tobacco and alcohol were evaluated as possible goods for such a restriction, because as private goods, they should show no economies of scale and no change in effective prices.

The resulting equivalence scales were determined by distribution between partners and the economies of scale from joint consumption. It was found, that married couples do share their income evenly, while each partner keeps a higher control over his or her own income in non-married couples. In these, an increase of the income share of one partner by ten percentage points, say from 50% to 60%, would increase his or her expenditure share by 2.5 percentage points. For practical applications, equivalence scales were calculated for the case of equal sharing, as well as for different sharing situations, resulting in Equivalence scales that depend on distribution characteristics.

A Short Summary of Empirical Results

Overall, the investigation has shown that the identification of economic equivalence scales is possible, if one is willing to assume a certain structure of the household decision process and economies of scale from joint consumption. With these assumptions it is possible to make a situation comparison of the same reference unit in different demographic situations. This is more difficult for families with children, because the needs of children cannot be separated from economies of scale.

The results found in the application of the household models can be summarized as follows:

Equivalence scales: A child costs between 13% and 20% of a couple while a couple saves about 40% over both partners living alone.

Working parents: When both partners are working, children are considerably more expensive. When only one partner is working, who is staying at home – the father or the mother – has no significant effect on estimated child cost.

Two and three children: There are economies of scale in having two children: the second child is "cheaper" than the first child, but there are

also diseconomies of scale in having more than two children with the third child being more expensive than the first.

Sharing in couples: Married couples share their income approximately evenly, while unmarried couples show some but not equal sharing. Unmarried partners keep more control over their personal income.

Income dependence: Evidence on income dependent equivalence scales was mixed. Not all models are well suited to investigate this question, but the Gorman model showed some significantly decreasing equivalence scales for households with three children.

Suggestions for Applied Work

Besides the substantive findings just listed, there are several lessons of an applied, methodological nature worth sharing:

Families with Children: It is difficult to decide which of the models described in this work is best suited for the estimation of equivalence scales for families with children, were not the decision often dictated by the availability of appropriate data in the first place. The Rothbarth model is easy to estimate and allows for an analysis of demographic variables but is subject to a bias. The Barten model is possibly less biased, but it cannot separate distribution from prices, and a remaining bias is harder to assess. The model is also too restrictive to reflect well the characteristics of households at the lower end of the income range. The Gorman model is better suited for the application to poor households. It also achieves a better but not complete separation of distribution from prices. On the downside, the Gorman model is difficult to estimate and has high data requirements. Considering the options, either the Rothbarth or the Gorman model should be used for poor households. The Barten model can be used for the median income household.

Singles and couples: The collective equivalence scale model was the only model used for the comparison of couples and singles in this work, and for a reason. Singles could also be included in a Barten-Gorman model, but this should not be done, on theoretical and empirical grounds. The Barten-Gorman model interprets additional household members as an addendum to the reference unit. If necessary, this might be an acceptable interpretation for children, but not for a husband or wife, especially when they do not share the same preferences. The interpretation is also rejected by the application of the collective model in this work as well as in the collective model literature.

Single parents: Single parents were not covered in this work. In principle, the same methods that can be applied to families with children can also be applied to single parents by changing the reference unit to a

single woman or man. Difficulties might arise, though, because the behaviour of single parents might differ from childless singles more than the behaviour of couples with children differs from childless couples.

Other comparisons: One might want to calculate equivalence scales between young and old persons or between employed and unemployed persons. This is difficult with ordinal utility theory because of the identification problem. For families, identification was achieved because a household consumption technology could be identified, and then a situation comparison could be made. Other equivalence scales can only be calculated if a meaningful consumption technology can be found that changes in relation to the characteristic of interest. Technically, the Barten method could be applied for this type of comparison, but it would lack an interpretation that would allow for the calculation of equivalence scales.

Future Work

It would be promising to continue into the field of collective equivalence scales, but the equally important question of child costs requires further investigation as well. In particular I would like to draw attention to the following issues:

Each of the two child-cost models that were applied in this work are rather restrictive. A combination of both models might remedy these restrictions. This would be similar to an extension of the collective equivalence scale model to families with children. However, it will be difficult to identify the model, because children cannot be observed living alone, and therefore their preferences are not directly recoverable. It would be a first step to integrate direct information on children's goods into the estimation process.

I also suggest to inquire into the possibility of estimating equivalence scales for families with children without using childless couples as a reference. This, however, could have the consequence that equivalence scales for families cannot be chained with equivalence scales for childless couples.

A test of the presented models with richer data, in particular with data that contains price variation, would be desirable so that the estimated demographic price elasticities can be compared with price elasticities that are estimated directly. This would lead to a deeper understanding of the estimation process and the validity of the restrictions that are imposed to make identification of the models possible.