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Basic needs (in)security and subjective equivalence scales*

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Abstract

Self-assessed insecurities in terms of clothing, housing and food - or basic needs - imply that at least some households are at lower levels of welfare than those that are meeting their needs. We use those self-assessments in an empirical exercise to determine the increase in total expenditure that would allow them to meet their needs, on average, and thus we are able to calculate the implied equivalence scales. We compare these subjective scales to ones that arise from objective measures, such as expenditure shares on the same items. Our subjective scales are more consistent and smaller across types of need, than those arising from expenditure shares. They are also more plausible, according to the criteria we develop. The resulting scales are smaller than any previously estimated for South Africa, implying that an additional child costs about 40% that of an adult and that household economies of scale are approximately 0.5, which is the scale economy assumed in the square-root scale.

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1 Introduction

In this paper, we revisit the estimation of equivalence scales taking into account the fact that expenditure shares on food, clothing (adult/child) or even housing may not represent household welfare, and, therefore, the scales calculated from those shares following, for example, Deaton (1997), Pendakur (1999), Yatchew, Sun, and Deri (2003) or Dudel, Garbuszus, and Schmied (2021) could be biased. Nicholson (1976), in particular, argues that child cost estimates can be overstated, implying biased equivalence scales, because children primarily consume food and clothing.

Instead, we rely on self-assessed household food, clothing and housing "adequacy", arguing that households not able to meet their basic needs are necessarily achieving lower levels of welfare than those who do meet those needs. We estimate the compensation required for households of different types to have an adequate supply of basic needs, which we translate into equivalence scales for different household types. For comparison purposes, we also estimate equivalence scales from expenditure shares on the same goods. The analysis is predicated on the South African 2014/15 Living Conditions Survey (Stats SA 2017), because it is the most recent survey that captures the relevant information.

It is common to estimate equivalence scales from microdata on consumption, especially food consumption, which is widely available in expenditure surveys around the world. Such estimates still tend to focus on developed countries as a recent series of papers focusing on Germany (Dudel et al. 2021; Dudel, Garbuszus, and Schmied 2021; Garbuszus et al. 2021) and Canada (Pendakur 2018) demonstrates. There is a related literature underpinned by time use data. See, for example Bradbury (2008), who finds relatively larger child costs than are underscored by consumption share analysis. On the other hand, Couprie and Ferrant (2015) find that two singles living apart need about 2h15m additional free time to match their utility as a couple living together; however, the analysis did not consider children. Finally, Borah (2020) incorporates time use data with subjective data, finding greater monetary equivalence weights for adults than for children, while household production increases are associated more with children than with adults. Combining these two leads to rather similar child and adult weights in the equivalence scales.

Not all consumption based estimation focuses on developed countries. Recent work, such as Daley et al. (2020), includes a number of years and countries, including South Africa, which is our focus. South African focused studies also exist; see, for example, Yatchew, Sun, and Deri (2003), Posel, Casale, and Grapsa (2020) and Koch (2022). Although Daley et al. (2020) do not believe the square-root scale is appropriate, Koch (2022) finds robust empirical support for it, when considering South African food shares. Therefore, we provide further clarity on the appropriateness of that scale in this analysis. Daley et al. (2020) also find differences across countries and time, as well as across consumption bundles. In particular, they find larger economies of scale when considering necessities other than food, except for South Africa, where they suggest that consumption bundles for smaller families might include discretionary spending. We offer additional insight into commodity-based scale differences in the country, and, through the use of subjective measures of basic needs adequacy, we remove the potential for discretionary spending among all households, which we find yields more similarity in the underlying scales across goods types.

The literature has also developed equivalence scales from subjective measures of well-being; Bradbury (1989) offers a relatively early review arguing that reference group effects may be systematically related to family type. van Praag and van der Sar (1988) show that income evaluation questions like those in van Praag (1971) may be used without assuming cardinal utility. Income evaluation questions request survey respondents to declare net income amounts that they would regard as very good, or sufficient or even very bad. A similar approach makes use of minimum income questions, which attempt to extract "the smallest amount of income that would be needed by the household to make ends meet each month" (Goedhart et al. 1977). In much of this analysis, the reported minima increase with actual income, which Goedhart et al. (1977) suggest is related to the need to make additional fixed payments, such as mortgages, although other interpretations are also offered. Since these survey questions require respondents to generally address hypothetical scenarios, since they may not be simply making ends meet, for example, the answers may not accurately reflect what is being requested (Bradbury 1989; Melenberg and van Soest 1996). Steiger and Stinson (1997) suggest that the cognitive tasks in answering these seemingly simple survey queries are, in fact, quite complex.

The literature has addressed this concern in at least two different ways. One approach focuses on finding individuals whose minimum income matches their actual income. At the intersection of needs and actual (Goedhart et al. 1977), one can explicitly focus on households in poverty and avoid preference restrictions. Hartog (1988) specifically argues that welfare cardinality is not necessary; rather, we only need assume that there is a "common, interpersonally comparable feeling of welfare" of enough to get along. This argument is formalised as ordinal local comparability by Grodner and Salas (2017), and leads to local equivalence scales. Essentially, ordinal local comparability is the ability to make comparisons only at a specific point, mininum needs income, and offers further support to the intersection method that is generally applied in the literature; see Goedhart et al. (1977), Kapteyn, Kooreman, and Willemse (1987), Bishop et al. (2014) and Mysíková et al. (2022), for example. Kapteyn, Kooreman, and Willemse (1987) find that the subjective evaluations lead to implausibly low family cost parameters, which imply very flat equivalence scales across household structure measures. Bishop et al. (2014) and Mysíková et al. (2022) present comparisons of subjective equivalence scales across Europe. The former finds that there are greater economies of scale in developed welfare states, while the latter suggests that there is an East-West divide in the economies of scale. Both argue that subjective scales are different from modified OECD scales, lead to poverty rate differences, and that child costs are not as low as those in Kapteyn, Kooreman, and Willemse (1987).

The second approach uses income or life satisfaction for scale estimation. Doing so has yielded lower economies of scale than arose from the preceding minimum income questions, with life satisfaction leading to some of the lowest scales (Melenberg and van Soest 1996; Charlier 2002; Schwarze 2003; Biewen and Juhasz 2017). Charlier (2002) finds that satisfaction with income scales increase with household size, and, therefore, are somewhat reasonable. Despite potentially addressing the hypothetical nature of minimum income questions, subjective well-being depends heavily on perceptions, which are likely underscored by a benchmark relative to oneself or even to others (Clark, Frijters, and Shields 2008), income aspirations (Stutzer 2004) or other reference effects. Stutzer (2004) finds that subjective well-being depends on the gap between income aspirations and actual income, not on the income level as such; the higher the gap, the less satisfied. In other words, respondents are likely to conflate both their own views and societal references (Stutzer 2004; Clark, Frijters, and Shields 2008). Ferrer-i-Carbonell (2005), for example, consider three separate measures – own income, reference income and the gap between own and reference.

Given the possibile confounding factors, extracting equivalence scales from these measures requires researchers to estimate appropriate reference groups; otherwise, the subjective view may not reflect what is required for equivalence scales (Borah, Keldenich, and Knabe 2019). The literature suggests that a variety of comparisons, such as reference income from similar individuals (Ferrer-i-Carbonell 2005) or from Mincerian earnings equations (Senik 2008; Borah, Keldenich, and Knabe 2019) are relevant. However, (Boyce, Brown, and Moore 2010) find that income rank is more important for life satisfaction than absolute income. Income gaps (D'Ambrosio and Frick 2012) are also relevant, because households feel better off when they are relatively richer and worse off when they are relatively poorer. Furthermore, there is a dynamic component with respect to relatively newer rich and poor households in the comparison group. This dynamic aspect might have two effects, one that is negative - due to relative deprivation - and another that is positive, as it suggests anticipatory possibilities (Senik 2008). A simpler descriptor is "jealousy" and "ambition", the former of which underscores old European sentiments, while the latter is uncovered in the former eastern bloc of Europe and America (Senik 2008). Even though these subjective approaches do not require utility cardinality, and, therefore, ought to be relatively straightforward, the applied literature suggests that, empirically, it is anything but.

As highighted at the outset, we focus on (self-assessed) food, clothing and housing adequacy - in other words, a respondent in the household replies that the household has "less than adequate", "adequate" or "more than adequate" food, clothing or housing available. Similar to self-assessed life satisfaction, the responses are ordinal, and, therefore, do not require cardinality assumptions. However, because they are self-assessed, we remain concerned that respondents will conflate their views with reference effects. For that reason, we apply control function methods.

We contribute to the literature in many ways. We offer one of the few studies of subjective equivalence scales that is available for developing countries, and the first of which we are aware for Africa. The only developing country study applying subjective approaches that we could uncover is for Mexico (Rojas 2007), which finds that an increase of 40% in household income is required to keep a person's economic satisfaction constant when a second member is added. We diversify the literature away from subjective well-being, defined either by minimum income needs or general life satisfaction, focusing on more fundamental basic needs, such as the adequacy of food, clothing and shelter. This diversification in subjective measures affects the choice of reference measures. We do not use income gaps or Mincerian earnings to underscore reference group proxies, which is rather common in the literature, because we need to proxy for needs adequacy rather than income adequacy. We also offer further insight into the apparent disagreement in the literature on the square-root scale in South Africa (Daley et al. 2020; Koch 2022). Through the use of basic needs (in)security, we remove the potential concern that smaller households have relatively larger discretionary expenditures. Finally, we present a formal comparison of the plausibility of the shares arising from both the subjective analysis and the more traditional share-based analysis, which has not received previous attention in the estimation of scales in developing countries.

In summary, we find that basic needs security leads to subjective scales that are consistent across types of need, which is in sharp contrast to scales calculated from basic needs expenditure shares; this could be due to the removal of potentially discretionary expenditure (Daley et al. 2020). Our subjective scales result in economies of scale and positive weights for both children and adults. We also find that scales for children tend to be larger in multiple-adult households than in single-adult households, and that is especially true for the first child. When we force those estimates into a commonly applied child cost - economies of scale structure, our adequacy models suggest children cost approximately 40% of an adult, while economies of scale are near 0.5. Although the latter of these is consistent with a square-root scale, the former suggests that a square-root scale leads to slightly larger equivalence factors than implied by the data. Finally, we find that scales, at least those we find to be more plausible, do not change all that much after including the control function.

2 Methods

We consider two methods, one based on expenditure shares of basic needs items (food, clothing and housing) and the other based on self-assessed adequacy of the same items. In the case of the former, linear regression will be applied, while for the latter, we will apply an ordered categorical model, since self-assessment is rankable and limited to 'less than adequate', 'adequate' and 'more than adequate'. Regardless of model, the resulting equivalence scales will be indirectly estimated. In our models, the shares and adequacy levels will be assumed to depend on total household expenditure (x_i), household structure characteristics ($\mathbf{D}_i$), such as the number of children and adults, other characteristics ($\mathbf{Z}_i$) and other unobserved factors. We describe each model and the approach to estimating the scales in the following subections.

2.1 Budget share scale methods

Under the assumption that the budget share of a basic needs item – food, clothing and/or housing – is a reasonable indication of household welfare, equivalence scales are indirectly estimated from budget share regressions. The welfare assumption arises from a near two-century old observation that richer households tend to purchase less food, as a proportion of their budget (Engel 1857). We examine whether our shares meet that assumption, below. Thus, models are based on the ratio of an item's (represented by k) expenditure in household i (x_i^k) to that household's total expenditure (x_i). Thus, the share is $w_i^k = x_i^k / x_i$. Assuming additive unobserved factors (u_i^k) yields the function in equation (1), where f is not known.

$$w_i^k = f^k(\ln x_i, \mathbf{D}_i, \mathbf{Z}_i) + u_i^k \tag{1}$$

Although it is common to estimate (1) via semiparametric methods, such as those applied by Blundell, Browning, and Crawford (2003), Yatchew, Sun, and Deri (2003), Dudel, Garbuszus, and Schmied (2021) or Koch (2022), we will focus on a simple linear application. We do so, because we are mainly interested in a comparison for the adequacy-determined scales. As underscored in Koch (2022), although the scale estimates differed for the linear and semi-parametric approaches, confidence intervals overlapped significantly implying that there is not a significant loss in generality in applying linear methods in this setting.

Our linear budget share model incorporates a series of binary variables capturing household structure, rather than assuming household size has a constant effect, as is common (Deaton 1997; Posel, Casale, and Grapsa 2020).[1] We also incorporate additional controls to account for differences in household preferences and

[1]For a household with two adults and three children, the separate binary indicators "two adults" and "three children" will be turned on, while all the other indicators, such as "three adults", "four adults", ... , and "one child", "two children", "four children, ... are switched off. Please, see the empirical results in Tables B.2 for all of the binary indicators included in the model.

expenditure behaviour leading to our linear share regression in (2), where ε_i^k is the error, and is consumption category specific. We discuss endogeneity concerns, below.

$$w_i^k = \alpha_0^k + \alpha_1^k \ln x_i + \sum_j \gamma_j^k Z_{ij} + \sum_j \rho_j^k D_{ij} + \varepsilon_i^k, \tag{2}$$

Assuming food, clothing and housing shares are a reasonable welfare proxy supports an analytic approach to the indirect estimation of scales from equation (2). To do so, set a typical household i's share equal to that of a reference household share, denoted by r, as in (3).

$$\alpha_1^k + \beta_1^k \ln x_i^a + \sum_j \gamma_j^k Z_{ij}^a + \sum_j \rho_j^k D_{ij}^a = \alpha_1^k + \beta_1^k \ln x^r + \sum_j \gamma_j^k Z_j^r + \sum_j \rho_j^k D_j^r. \tag{3}$$

We rearrange equation (3) to capture the equivalence scale, which we denote by Λ_E^k. Intuitively, it is a function of the differences in the observed data across household types and the estimated parameters. In application, the reference household has one adult and zero children. Thus, ($\mathbf{D}_{ij}^a$) are binary non-reference values of adults and children, while D_j^r is "on" for one adult, but "off" for all other adult and child values. Furthermore, reference household baseline characteristics ($\mathbf{Z}_{ij}$) are "off", as well, for ease of calculation. We undertake 399 parametric bootstrap replications to determine the variability of the scales, and the analysis is separately undertaken for each consumption good k, which allows for scales to differ across consumption good.

$$\Lambda_{Ei}^k = \frac{x_i^a}{x^r} = \exp\left[\frac{1}{\beta_1^k}\left\{-\sum_j \rho_j^k \left(D_{ij}^a - D_j^r\right) - \sum_j \gamma_j^k \left(Z_{ij}^a - Z_j^r\right)\right\}\right] \tag{4}$$

In the analysis, we control for a wide range of Z related to the head of the household, such as their age, gender, race, education and marital status, as well as a range of location controls, including province, and urbanity. Thus, it is possible to estimate equivalence scales for each of these different household types; the combinations are many. However, for the scales reported below, we remove all Z factors from the scale calculations, although they are included in the regressions to control for potential unobserved heterogeneities that are correlated with household structure and income/expenditure.

2.2 Basic needs (in)security scales

One problem associated with the use of food, clothing and/or other goods expenditure shares is that such shares may not truly capture welfare (Nicholson 1976) or requires strong assumptions for identification (Blackorby and Donaldson 1993) that do not always hold in application (Pendakur 1999; Dudel et al. 2021).

For that reason, other measures might be of interest. In the living conditions survey we use, there are a series of questions assessing whether the household has less than adequate (as well as adequate and more than adequate) food, housing and clothing. Whether or not all members of a household are adequately fed, sheltered or clothed is plausibly more appropriate on welfare grounds than budget shares on expenditure items. Despite being more plausible, the use of self-assessed values does raise questions related to 'peer effects'. Expenditure shares are objective, while views of adequacy are subjective, and may very well depend on comparisons to others in similar circumstances. We discuss how we control for this concern, below.

Defining b_i^k as the basic need k for household-type i, we are interested in the conditional probability that their basic need is (in-)adequately met. Thus, it is reasonable to focus on the adequate/inadequate frontier. However, from an analytic point of view, doing so ignores potentially relevant information in the data, and, therefore, we pay attention to all three levels of the categorical variable. We do consider the sensitivity of the results to this assumption.

$$b_i^k = \begin{cases} 0 & \text{if adequate needs for household } i \text{ not met for good } k \\ 1 & \text{if adequate needs for household } i \text{ met for good } k \\ 2 & \text{if needs for household } i \text{ more than adequately met for good } k \end{cases} \tag{5}$$

We estimate the probability that a household assesses itself within a particular adequacy level $j \in \{0, 1, 2\}$. For notation, we define p_{ij}^k as the probability that household i's basic need k has adequacy level j, i.e., $p_{ij}^k = P(b_i^k = j | \ln x_i, D_i, Z_i)$. Since the probabilities sum to one, one category will be the base category for identifying the model. We will use inadequacy as the base.

2.2.1 Ordered logit model

To estimate the predicted probabilities used for the scales calculations, we assume that the outcomes in equation (5) can be clearly ranked, and, therefore, fit a proportional odds or ordered logit framework. Recalling $p_{ij}^k = P(b_i^k = j | \ln x_i, D_i, Z_i)$ and noting that the cumulative probability measures the probability of being in any category up to K: $\gamma_{iK} = P(b_i \leq K)$. Therefore $\gamma_{iK} = \sum_{k=1}^{K} p_{ik}$.

Ordered models can be estimated using a cumulative link function, and we will assume the logit version; estimation is conducted in `R` using `polr` from the `MASS` package (Venables and Ripley 2002). Essentially, we consider a single equation model, such as

$$g(\gamma_{ik}) = \theta_k + \beta_2^k \ln x_i + \sum_j \psi_j^k Z_{ij} + \sum_j \phi_j^k D_{ij}. \tag{6}$$

In this formulation, θ_k is a category-specific "intercept". Instead of applying the logit transformation to the response probabilities, they can be applied to the cumulative response probabilities, so:

$$\text{logit}(\gamma_{ik}) = \ln \frac{\gamma_{ik}}{1-\gamma_{ik}} = \theta_k + \beta_2^k \ln x_i + \sum_j \psi_j^k Z_{ij} + \sum_j \phi_j^k D_{ij} \tag{7}$$

Exponentiating leads to

$$\frac{\gamma_{ik}}{1-\gamma_{ik}} = \exp\{\theta_k\} \exp\{\beta_2^k \ln x_i + \sum_j \psi_j^k Z_{ij} + \sum_j \phi_j^k D_{ij}\} = \lambda_k \exp\{\beta_2^k \ln x_i + \sum_j \psi_j^k Z_{ij} + \sum_j \phi_j^k D_{ij}\} \tag{8}$$

On the left hand side, we have the *odds* that $b_i \leq k$, or that the response is in category k or below. In the model, λ_k is the baseline odds. The model is referred to as the *proportional odds* model, because the cumulative odds are proportional to $\exp\{w_i'\zeta\}$. The model is also referred to as the *ordered logit* model, because we make use of a cumulative logit.

To determine equivalence scales, we note that (8) offers an equation similar in form to (2). Thus, it is possible to set the underlying probabilities across goods, and household types equal and solve for the ratio in a fashion similar to that suggested for equations (3) and (4). We follow that process to determine the subjective equivalence scales for each good household- and good-type, denoted by Λ_{Si}^k. As before, it is a function of the differences in the observed data across household types and the estimated parameters, while we continue with the same reference household of one adult and zero children. Again, we eliminate all Z factors from the scale calculations, even though they are included in the regressions to address unobserved heterogeneities that are potentially correlated with household structure and expenditure. We also undertake 399 parametric bootstrap replications to determine the variability of the scales, and the analysis is separately undertaken for each consumption good k.

$$\Lambda_{Si}^k = \frac{x_i^a}{x^r} = \exp\left[\frac{1}{\beta_2^k}\left\{-\sum_j \phi_j^k \left(D_{ij}^a - D_j^r\right) - \sum_j \psi_j^k \left(Z_{ij}^a - Z_j^r\right)\right\}\right] \tag{9}$$

2.2.2 Sensitivity analysis

The preceding categorical analysis makes two assumptions that deserve further scrutiny. The first is that the outcomes are necessarily rankable, such that an ordered model is appropriate. In analyses not reported, we considered a multinomial logit model that relaxes the rank assumption. The results were not particularly different, and are available from the author upon request. The second is that the adequate v more-than-adequate cut line contains relevant information for the underlying analysis of scales. Specifically, it is assumed that more than adequately supplied in food, clothing and housing, can be treated similarly in the model to those who assess that they have only adequately met their needs. We address this final concern by applying a binary logit model, rather than an ordered model; the results are also not too different, but are presented for comparison.

2.3 Endogeneity

Endogeneity issues are likely extensive in this analysis. For example, total expenditure could be measured with error or could be simultaneous to expenditure choices (Summers 1959). Household size might also be endogenous (Edmonds, Mammen, and Miller 2005; Klasen and Woolard 2008). In either case, endogeneity could lead to biased estimates and incorrect expenditure share scales. Finally, due to the subjective nature of views of adequacy, which are likely to depend on lived experiences and peers – which are not observed, but are expected to be correlated with observed data – endogeneity might also bias the categorical response models.

The normal solution is to find an instrument for, say, household size or expenditure. However, an instrument may not be available. We address expenditure endogeneity by applying Dong (2010). It is a control function method that does not require an instrument. Instead, it requires a continuous control that has a large support. We use income, which has a large support, larger than total expenditure. The control function in the second stage is the residual from a nonparametric regression of expenditure against income, $\mathbf{D}$ and $\mathbf{Z}$ from the model.

In the case of unobserved peer effects, a typical solution is to find a proxy variable, although, by definition, such a variable will be measured with error. The proxy we use is the household's share of the budget devoted to food, clothing and housing. Thus, for food adequacy, our proxy is the food share – similarly, we use the clothing and housing shares to proxy for clothing and housing adequacy unobserved peer effects, respectively. As noted, we recognize that these proxies are measured with error, and, therefore, rather than estimating with the proxies, we estimate with control functions that are also based on Dong (2010). The control function in the second stage is the residual from a nonparametric regression of the relevant share (food, clothing and housing) against income, $\mathbf{D}$ and $\mathbf{Z}$ from the model. Again, income is used, because it has large support, even though it may not be exogenous.

For the nonparametric estimates, we follow Li and Racine (2004). We implement the models using the `np` package (Hayfield and Racine 2008) in `R` (R Core Team 2021). For continuous data an epanechnikov kernel is used, while the Li and Racine (2007) kernel underpins the categorical/discrete variables. The results from the nonparametric analyses are avaiable upon request. They are not reported here, in an effort to conserve space.

2.4 Plausibility

Our approach suggests a wide range of estimates. We have food, clothing and housing shares assuming (or not) exogeneity, as well as ordered models and binary models focusing on food, clothing and housing security, again with and without exogeneity. From each of these, the equivalence scales are also estimated. Ror each type of model (linear share, ordered or binary) and each assumption about the error term (endogeneous or endogenous), we have coefficient estimates and share estimates. However, none of them are directly comparable. Similarly, there are no obvious statistical tests associated with the estimated shares. Instead, we borrow from the plausibility rules outlined in Dudel, Garbuszus, and Schmied (2021) to undertake a direct comparison of rules violations across the different models to see where the violations arise, and determine which model performs better, on average. For our purposes, the average is a simple mean based on counts – it is the sum of the violations divided by the total possible violations.

We follow Dudel, Garbuszus, and Schmied (2021) in defining the scales (Λ) to be a function of the household's utility (u), the vector of prices that the household faces ($\mathbf{p}$) and the number of adults (a) and children (k) in the household, such that $\Lambda = \Lambda(u, \mathbf{p}, a, k)$. For plausibility, we assume that each marginal equivalence cost of an child or adult is increasing, but that marginal cost is decreasing; together, these imply that there are consumption/security economies of scale and that larger households require more consumption and have more needs. Implicit in this assumption is that no additional child or adult costs more than an adult on their own. We also assume that an additional adult is relatively more costly than an additional child, at the margin. We formalize these in the following equations:

$$
\begin{aligned}
\text{Increasing adult}|\text{child costs}: \quad & \Lambda(u,\mathbf{p},a+1,k) \geq \Lambda(u,\mathbf{p},a,k) \\
& \Lambda(u,\mathbf{p},a,k+1) \geq \Lambda(u,\mathbf{p},a,k) \\
\text{MC of adult}|\text{child } < 1: \quad & \Lambda(u,\mathbf{p},a+1,k) \leq \Lambda(u,\mathbf{p},a,k)+1 \\
& \Lambda(u,\mathbf{p},a,k+1) \leq \Lambda(u,\mathbf{p},a,k)+1 \\
\text{Decreasing MC of adult}|\text{child}: \quad & \Lambda(u,\mathbf{p},a+1,k) - \Lambda(u,\mathbf{p},a,k) \leq \\
& \Lambda(u,\mathbf{p},a,k) - \Lambda(u,\mathbf{p},a-1,k) \\
\text{and} \quad & \\
& \Lambda(u,\mathbf{p},a,k+1) - \Lambda(u,\mathbf{p},a,k) \leq \\
& \Lambda(u,\mathbf{p},a,k) - \Lambda(u,\mathbf{p},a,k-1) \\
\text{MC adult } > \text{MC child}: \quad & \Lambda(u,\mathbf{p},a+1,k) > \Lambda(u,\mathbf{p},a,k+1)
\end{aligned}
\tag{10}
$$

As we describe further, below, we limit our analysis to households with no more than six adults and no more than four children. Applying these rules across that data yields 152 different comparisons. We report the performance from these different models in tables 1, 2 and 3

3 Data

The preceding methods are applied to data taken from the South African Living Conditions Survey (LCS) 2014/2015 (Stats SA 2017), which is collected to help understand living conditions and poverty in South Africa. It is useful for our analysis, because it captures all of the relevant data, including household expenditure, expenditure on particular types of goods, household size and structure and some information on gender, ethnicity and household location. Expenditure and income information follows classification of individual consumption by purpose (COICOP) categories. Food expenditures lie in Category 01, Clothing expenditures lie in Category 03, while housing expenditures are in Category 04. These expenditure categories match the basic needs categories, and, thus are appropriate for the analysis. Every subcategory of expenditure is summed within a household; however, we do not include food purchased away from home in the food expenditure.

In this data, there are few differences between total consumption and total consumption in-kind. Despite that, for the analysis, we use household consumption expenditure capturing both monetary and in-kind payment for all goods and services, and the money value of the consumption of home-made products.[2]

[2]Furthermore, there is not enough difference between monetary consumption and in-kind or home production in this data

The LCS data is collected for 12 months, with different samples in different provinces. We inflate/deflate expenditure values to April 2015, the midpoint of the survey year, using the consumer price index.[3]

4 Descriptive results

4.1 Sample data

We begin by describing the data used in the analysis, which we present in Appendix Table A.1. The data is separated by self-assessed food adequacy. The initial data included 23380 households. However, after removing data for which there are missing values, we end up with 18354 observations.[4]

The descriptive statistics imply not unexpected correlations across the data. For instance, 69% of households with less than adequate food also have less than adequate clothing, 63% also have less than adequate housing. We similarly see that nearly 20% of adults in such households go hungry often or always; however, the same figure is only about 1% for households who assess that they have above adequate food. We report on a number of additional survey questions related to how households deal with their perceived food access; questions include how common it was for them not to have money to buy food or had to make smaller meals, skip meals or prepare less food. Across the board, we find that worse food security correlated with inadequate food, and, by implication, clothing and housing.

South Africa's apartheid past, as might be expected, offers a subtext for basic needs in/security. Non-whites, Africans in particular, were more likely to be in the below adequate food category, rather than adequate or above. We find that being married correlates with food security, probably due to dual income sources, and that better education - which also correlates with household income/expenditure and wealth - is associated with more favourable food security. Location does not offer as clean a relationship as might have been expected; however, households located in formal urban settings are more likely to be food secure, while those in traditional rural areas are less so.

In terms of expenditure share *welfare*, there is some concern that housing is not an appropriate measure. Although more examination is presented below, we see that the housing budget share is highest for households

to consider home production scales.

[3] The data from the survey is collated in a number of files, including a person file, a household file and an expenditure and income file. For the analysis, we use `haven` (Wickham and Miller 2021), the `tidyverse` (Wickham et al. 2019), `stargazer` (Hlavac 2018), `qwraps2` (DeWitt 2021), `knitr` (Xie 2014), `kableExtra` (Zhu 2021) and `rmarkdown` (Xie, Dervieux, and Riederer 2020), which are packages for `R`, to organize the data for the analysis, prepare the data in tables and write the paper in a completely repeatable manner (Racine 2019). Code for the preparation of the data, figures, tables and all empirical modelling will be made available on https://doi.org/10.25403/UPresearchdata.21550716.

[4] We lose 96 observations for missing information on marital status and education, 254 for missing food expenditures, 2547 for missing clothing expenditures, 83 for missing housing expenditures and 1467 for missing data on adequacy, income, expenditure, and various data related to adult and child hunger. When merging, since these are not all the same households, the result is 5026 fewer observations in total.

that are more food secure. The opposite is true for food and clothing, which suggest they are more in line with Engel's original welfare argument that smaller shares represent higher welfare.

The final variable of interest is the number of children and adults in the household. Our analysis sample does not differ appreciably, especially in terms of adults, when we consider food security. One might even argue that the gradient goes in the wrong direction. It does appear, however, that food security is associated with a reduction in the number of children. Below, after controlling for other household feature differences, we find the gradients to be as expected.

4.2 Budget shares

As we see in Table A.1, there are differences in budget shares by food security category. In order to examine more carefully the plausibility of using food, clothing and housing shares as a measure of welfare, we illustrate fitted shares from a nonparametric regression against the natural log of household expenditure for a subset of household structures. See Figures 1 - 3. The figures suggest that both food and clothing are reasonable shares for welfare purposes, while housing expenditures are not. Despite this fact, we continue to include housing shares in our analysis for comparison purposes.

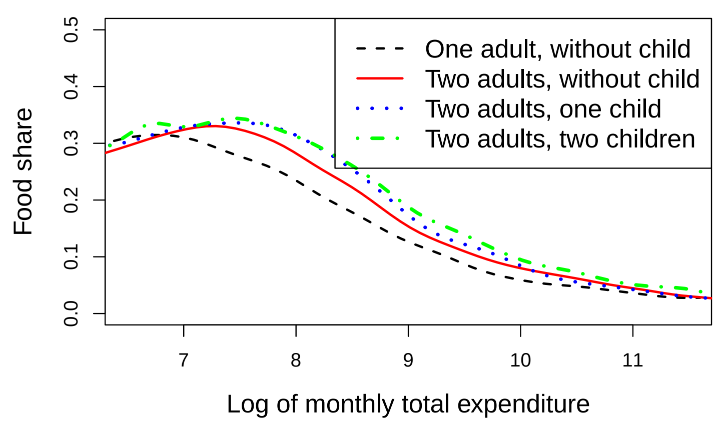

Figure 1: Fitted nonparametric regressions of household food shares against total household log expenditure: selected households sizes

5 Model results

As described in the methods section, we estimated linear share regressions for food, clothing and housing with and without control functions to examine the potential for endogeneity. For adequacy, we estimated

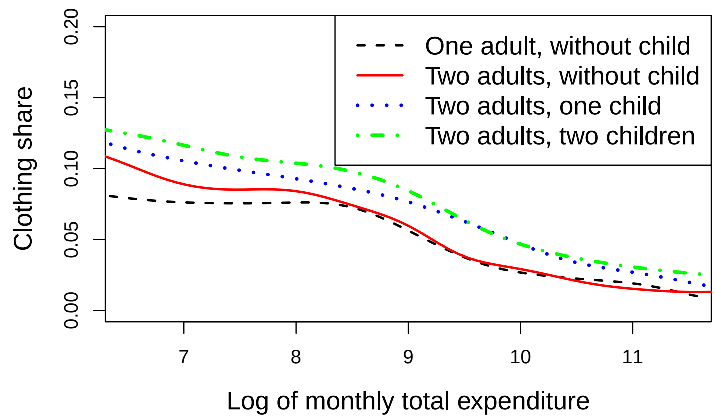

Figure 2: Fitted nonparametric regressions of household clothing shares against total household log expenditure: selected households sizes

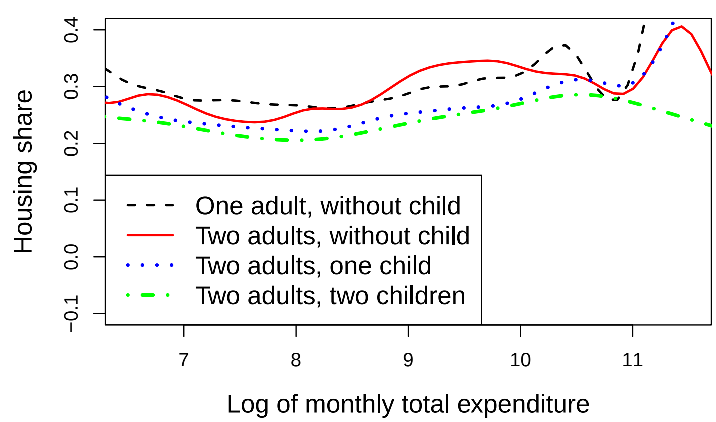

Figure 3: Fitted nonparametric regressions of household housing shares against total household log expenditure: selected households sizes

ordered logit models with and without control functions. As a further sensitivity analysis, we also simplified the model to focus only on the inadequave v. adequate responses, via binary logit, which were also estimated with and without control functions.

5.1 Budget shares

The share estimates are reported in Appendix Table B.1. The table contains three sets of columns, one set for each share: food, clothing and housing. Each set contains results without (Exogenous) and with (Endogenous) the control function for log expenditure. Although there are too many results to discuss, I would like to point out the sign differences for adults and children that can be seen for the housing share relative to the others. The sign differences suggest that food/clothing shares increase with the number of household members, while housing shares decrease along the same dimensions. We also find the expenditure estimate is rather different between food and clothing relative to housing. These differences are not unexpected, given Figures 1 - 3, which showed differences in the relationship between log expenditure and the food/clothing share relative to the housing share.

We also see that the endogeneity effects are somewhat different across the shares. Firstly, the control function for log expenditure is statistically significant in all share models; it is positive for the food share, but negative for both the clothing and housing shares. Focusing on children and adults in the household, controlling for endogeneity leads to increased household size effects, along with an increased magnitude expenditure gradient for food shares. For clothing shares, endogeneity correction leads to small reductions in household size effects, as well as a reduced magnitude expenditure gradient. For housing shares, the expenditure gradient switches sign and increases, while household size effects increase slightly in magnitude. As we will see, these differences also impact the underlying scale estimates – yielding implausible equivalence scales in many cases.

5.2 Adequacy

The main adequacy estimates are available in Appendix Tables B.2 and B.3. In each table, we are present results that do not (Exogenous) and do (Endogenous) account for potential endogeneities.

5.2.1 Ordered model

Although there are still too many estimates to discuss, there is more uniformity across adequacy outcomes than there was across budget share outcomes, which is supportive of the welfare measure that we use to underpin equivalence scale estimates in this research. Across all three household adequacy measures, we see that the parameter estimates for the number of children and the number of adults in the household is negative. We also see that controlling for endogeneity increases the magnitude of these estimates in most cases, as well as the magnitude of the log expenditure gradient. Although the food share control function is not statistically significant in the food adequacy model, the log expenditure control function is negative and statistically significant in all models, while the clothing share and housing share control functions are positive and statistically significant in the clothing and housing adequacy models, respectively.

5.2.2 Binary outcome

We also estimated a binary logit model, limited to households who self-assessed their food, clothing and housing as either less than adequate or adequate. As with the previous models, we also accounted for potential endogeneity in log expenditure and potential peer effects. The parameter estimates from the binary model are reported in Appendix Table B.3. As was the case with the previous estimates tables, the results are split into three sets, one each for food, clothing and housing, while each set includes both exogenous and endogenous-corrected results. We see that household size effects, as measured by the child and adult parameters are all negative, and, after correcting for endogeneity, most of those parameters increase in magnitude. Endogeneity correction also increases the magnitude of the log expenditure estimate, while the log expenditure control function is negative and statistically significant for all three adequacy estimates. Furthermore, the food share control function is not statistically significant in the food adequacy model, but both the clothing share and the housing share are in their respective adequacy models. Qualitatively, these results are the same as was observed in the ordered logit model, which gives us some confidence in suggesting that the results are not overly dependent on whether we look at all three adequacy levels or just two.

6 Equivalence scales

The standard Engel approach assumes that an expenditure share is an appropriate measure of welfare. It may not be. As we have seen so far, budget share estimates, at least with this South African data, follow different patterns with regards to log expenditure and household size characteristics, depending on the share in question. On the other hand, even though normative and potentially meaning different things to different households, whether a household has enough food, clothing and/or shelter, has fairly clear welfare implications. An important observation from the adequacy model estimates is that they follow rather similar patterns, even if estimates are not identical across goods or probability models. This similarity suggests an advantage to basing equivalence scales on self-assessed basic needs. We now turn our attention to the equivalence scales that arise from these different models, comparing and contrasting them across goods and measures of those goods.

6.1 Deaton method

We begin by presenting the scales that arise from the indirect estimation of basic needs budget shares, as outlined in equation (4). The results are reported in Appendix Table C.1. In Table 1, we present the plausibility results underpinned by the equivalence scale properties listed in equation (10). The first conclusion to draw from the results is that neither clothing nor housing share equivalence scales are reasonable, because they violate the assumed plausibility properties in at least 50% of the comparisons. We find that the marginal equivalence cost of both adults and children nearly always exceeds one for clothing in both the exogenous and endogenous settings. For housing, the same is true in the endogenous version of the model. Furthermore, we find that the marginal equivalence costs for adults and children do not follow a consistent diminishing path, while the marginal cost of a child often exceeds that of an adult.

If we look more specifically at the estimated scales in C.1, we find exogenous housing scales to be less than one and as low as zero in many cases. The implication is extensive economies of scale in housing, which is plausible; however, the results do not yield useful equivalence scales. On the other hand, once we control for endogeneity, the housing share scales are often in double digits. In that regard, the estimates are simply not consistent enough to be taken seriously. For clothing, we see estimated scales that are double, triple or an even larger multiple of those estimated from food shares, regardless of whether we controlled for endogeneity in the model. For example, a two-adult and three-child household equivalence is estimated to be 2.6, if based on food shares, but in excess of 8, if based on clothing shares. Despite the fact that the clothing-based shares suggest implausibly high scales, they mostly increase with household size, along both the adult and child dimensions. Furthermore, when controlling for endogeneity, clothing share scales increase even more.

When we turn our attention to food shares, the results are more plausible. For the most part, they increase with household size, but by smaller amounts, suggesting that there are economies of scale; however, the results in Table 1 suggest that child marginal equivalence costs are not diminishing. There is also some evidence that adult marginal equivalence costs are not monotonically decreasing, while the child marginal cost too often exceeds the adult marginal cost.

In summary Deaton-based scales are neither consistent across goods nor across the endogeneity assumption. The housing share scales are entirely implausible, while the clothing shares do not appear any more reasonable. Food-based shares are the most plausible, with 19% and 26% plausibilty violations for the endogenous and exogenous estimates, respectively. The violation percentages for clothing and housing shares are at least double that calculated for food shares across all share models.

Table 1: Count of plausibility violations when scales are indirectly estimated from linear regression models over expenditure shares

	Total	Exogenous violations			Endogenous violations		
	Comparisons	Food	Clothing	Housing	Food	Clothing	Housing
Increasing child cost	24	0	0	24	0	0	0
Child increase less than one	24	0	22	0	0	22	24
Decreasing marginal child cost	18	18	12	14	7	12	18
Increasing adult cost	25	5	0	24	5	0	0
Adult increase less than one	25	0	25	0	0	25	25
Decreasing marginal adult cost	20	5	15	10	5	15	10
MC adult exceeds MC child	16	12	8	10	12	9	11
Total possible violations	152	40	82	82	29	83	88
Proportion of possible violations	1.00	0.26	0.54	0.54	0.19	0.55	0.58

Plausibility results are underscored by the series of rules comparisons outlined in equation (10) and described there. If any comparison fails, that leads to a rules violation, and all failures are counted and presented for each rule, each good and each error assumption. In the second to last row, we present the count of all violations in each column. The last row presents the proportion of violations uncovered out of the total possible. Thus, lower proportion represent better performance.

6.2 Basic needs: ordered model scales

We continue by examining the scales that are derived from the categorical basic needs models. The scales are presented in Appendix Table C.2, while the scale plausibility results are presented in Table 2. When the approach is based on whether or not household needs are met, at least according to the household, we see rather different results to those derived from shares. In particular, the scales are very similar, regardless of which good's adequacy is considered. For example, for two adults and three children, the scales are estimated to be 2.3, 2.3 and 1.8 for food, clothing and housing adequacy. After controlling for endogeneity, the scales reduce to 1.9 and 1.9 for food and clothing adequacy, respectively, but increase to 1.9 for housing; the food share equivalence scale for the same two-adult and three-child household was 2.6 and 2.1, for the exogenous and endogenous-corrected versions, respectively. Similar levels of consistency are observed for different adult and child combinations. Furthermore, the scales from the ordered adequacy models are similar to the food budget share scales for most adult and child combinations.

Despite the similarities in estimated scales, the categorical model is more plausible. The violations proportions range from 0.14 to 0.24, see the bottom row of Table 2, rather than 0.19 to 0.58, as uncovered using expenditure shares. When comparing the exogenous columns to the endogenous columns, we also see that controlling for reference effects and the potential endogeneity associated with mis-measured reference effects yields a slight reduction in the proportion of failures detected across all needs. However, there are some plausibility differences across needs. We do not find monotonic diminishing marginal child equivalence costs for any need, although the performance is relatively better for clothing than it is for either food or housing. On the other hand, adult costs for clothing are more likely associated with a problem: there are more observed decreasing adult costs than expected, which is related to the non-monotonic nature of the diminishing adult marginal equivalence costs.

Table 2: Count of plausibility violations when scales are indirectly estimated from ordered probability models over basic needs (in)security

	Total	Exogenous violations			Endogenous violations		
	Comparisons	Food	Clothing	Housing	Food	Clothing	Housing
Increasing child cost	24	0	0	0	0	0	0
Child increase less than one	24	0	0	0	0	0	0
Decreasing marginal child cost	18	12	6	12	12	6	12
Increasing adult cost	25	0	5	5	0	5	0
Adult increase less than one	25	0	2	4	0	0	2
Decreasing marginal adult cost	20	5	10	5	5	10	5
MC adult exceeds MC child	16	7	8	11	5	7	11
Total possible violations	152	24	31	37	22	28	30
Proportion of possible violations	1.00	0.16	0.20	0.24	0.14	0.18	0.20

Plausibility results are underscored by the series of rules comparisons outlined in equation (10) and described there. If any comparison fails, that leads to a rules violation, and all failures are counted and presented for each rule, each good and each error assumption. In the second to last row, we present the count of all violations in each column. The last row presents the proportion of violations uncovered out of the total possible. Thus, lower proportions represent better performance.

6.3 Basic needs: binary model scales

Finally, in a sensitivity analysis, we applied binary logit models, using those estimates to derive equivalence scales; those scales are reported in Appendix Table C.3, while the plausibility report is available in Table 3. We found little impact on the resulting scales, at least in comparison with those arising from the ordered model. As was the case with the ordered logit models, the scales are fairly similar across the endogeneity assumption, as well as the needs considered. The estimated two-adult and three-child scales are 2.3, 2.1 and 1.6 for food, clothing and housing adequacy, respectively, assuming exogeneity. These are in line with the ones estimated from the ordered models, and cannot be distinguished, if we take into account the estimated variability in the scales. After controlling for endogeneity, food and clothing scales decrease to 1.8 and 1.8, along with a slight increase to 1.8 for housing; again, these are not distinguishable from those estimated from the ordered models, once we take scale variability into account. Similar patterns and scales are observed for other household types.

Although the binary model scales are similar to the ordered model scales, the binary model is more plausible, as violation proportions range from 0.13 to 0.20, rather than from 0.14 to 0.24. When comparing need by need, only the endogenous housing need violation proportion is not improved after switching to a binary model. As before, however, we are finding that the diminishing marginal child (adult) cost assumption it most commonly not met, and this failure is likely behind the relatively common failure arising when comparing the relative marginal cost of an additional adult to an additional child (at fixed household sizes).

Table 3: Count of plausibility violations when scales are indirectly estimated from binary probability models over basic needs (in)security

	Total	Exogenous violations			Endogenous violations		
	Comparisons	Food	Clothing	Housing	Food	Clothing	Housing
Increasing child cost	24	0	0	0	0	0	0
Child increase less than one	24	0	0	0	0	0	0
Decreasing marginal child cost	18	12	12	6	12	6	12
Increasing adult cost	25	0	0	5	0	0	0
Adult increase less than one	25	0	0	0	0	0	0
Decreasing marginal adult cost	20	5	10	10	5	10	10
MC adult exceeds MC child	16	5	7	9	3	4	9
Total possible violations	152	22	29	30	20	20	31
Proportion of possible violations	1.00	0.14	0.19	0.20	0.13	0.13	0.20

Plausibility results are underscored by the series of rules comparisons outlined in equation (10) and described there. If any comparison fails, that leads to a rules violation, and all failures are counted and presented for each rule, each good and each error assumption. In the second to last row, we present the count of all violations in each column. The last row presents the proportion of violations uncovered out of the total possible. Thus, lower proportions represent better performance.

6.4 $(A + \kappa K)^{\theta}$

Given the large number of estimated scales, we undertake a final set of nonlinear estimates. In this nonlinear analysis, we take the scales we have estimated for each model and each good or good adequacy, and place them in the familiar child cost - economies of scale framework: $(A + \kappa K)^{\theta}$. We present the results in three sets of tables. Table 4 contains the results underpinned by the expenditure share models, while Tables 5 and 6 contain the estimates from the ordered and binary adequacy models, respectively.

As highlighted in previous subsections, the expenditure share models lead to a range of scales that differ by expenditure share category. The child cost estimates, although different for each category, cannot be statistically separated from one, which suggests that children are at least as expensive as an adult. For food expenditure, the child cost - economy of scale estimates are reasonably consistent with the square-root scale, in agreement with Koch (2022), but not with Daley et al. (2020). However, for both clothing and housing expenditure, the scale economy ranges from large negative values to approximately two, the latter of which suggests that there are no scale economies. We are not aware of any international estimates in agreement with the equivalence scales estimated from these clothing and housing expenditure shares.

Table 4: Estimate of child cost and household economies of scale from expenditure share models

	Food Share		Clothing Share		Housing Share	
	Exogenous	Endogenous	Exogenous	Endogenous	Exogenous	Endogenous
Child Cost	3.9869	1.3399	0.8122	0.8486	0.9251	1.1898
	(0.41 – 7.56)	(0.76 – 1.92)	(0.49 – 1.13)	(0.50 – 1.19)	(0.82 – 1.03)	(0.72 – 1.66)
Scale Economy	0.3442	0.3938	1.6191	1.9174	-3.7844	2.0207
	(0.26 – 0.43)	(0.35 – 0.44)	(1.50 – 1.73)	(1.78 – 2.06)	(-4.01 – -3.56)	(1.85 – 2.19)

Child cost κ and economies θ estimated nonlinearly, along with 95% confidence intervals in brackets, assuming equivalence scales of the form: $(A + \kappa K)^{\theta}$. Estimates arise from expenditure share models.

For the ordered categorical models – see Table 5 – the share estimates, as noted previously, are more consistent. We find relatively small child costs; depending on which category of adequacy, the child costs range from 0.45 to 0.81, with a midpoint of 0.63. In other words, the adequacy models suggest that the cost of a child is approximately 60-65% of the cost of an adult, on average. Furthermore, the scale economies estimates range from 0.44 to 0.60; in only one case does the estimated confidence interval not include 0.5. A scale economy of 0.5 is in agreement with a square-root scale; however, the lower child costs estimated here suggest that such a scale will overstate the income adjustment needed for families with a relatively large number of children.

Table 5: Estimate of child cost and household economies of scale from ordered adequacy models

	Food Adequacy		Clothing Adequacy		Housing Adequacy	
	Exogenous	Endogenous	Exogenous	Endogenous	Exogenous	Endogenous
Child Cost	0.8140	0.6451	0.5660	0.5469	0.4508	0.6421
	(0.53 – 1.10)	(0.37 – 0.92)	(0.09 – 1.04)	(0.37 – 0.72)	(0.27 – 0.63)	(0.24 – 1.04)
Scale Economy	0.5872	0.5974	0.4463	0.5306	0.5372	0.4766
	(0.54 – 0.63)	(0.55 – 0.64)	(0.38 – 0.51)	(0.50 – 0.56)	(0.50 – 0.57)	(0.42 – 0.53)

Child cost κ and economies θ estimated nonlinearly, along with 95% confidence intervals in brackets, assuming equivalence scales of the form: $(A + \kappa K)^{\theta}$. Estimates arise from ordered categorical basic needs adequacy models.

For sensitivity purposes, we also estimated the child cost - scale economy model for the equivalence scales underpinned by the binary logit model; see Table 6. The resulting child cost estimates cover a slightly lower range than those estimated from the ordered model, 0.40 to 0.76 with a midpoint of 0.58, rather than 0.45 to 0.81. On the other hand, we find scale economies covering a slightly larger range – 0.36 to 0.64, rather than 0.44 to 0.60. As with the ordered model, scale economies near 0.5 are within reason, although that value only once lands within the estimated confidence intervals.

Table 6: Estimate of child cost and household economies of scale from binary adequacy models

	Food Adequacy		Clothing Adequacy		Housing Adequacy	
	Exogenous	Endogenous	Exogenous	Endogenous	Exogenous	Endogenous
Child Cost	0.7339	0.6018	0.6696	0.4807	0.3979	0.7576
	(0.49 – 0.98)	(0.39 – 0.82)	(0.22 – 1.12)	(0.33 – 0.63)	(0.26 – 0.53)	(0.36 – 1.16)
Scale Economy	0.6415	0.5857	0.3610	0.5490	0.5187	0.4162
	(0.60 – 0.68)	(0.55 – 0.62)	(0.31 – 0.41)	(0.52 – 0.58)	(0.49 – 0.54)	(0.37 – 0.46)

Child cost κ and economies θ estimated nonlinearly, along with 95% confidence intervals in brackets, assuming equivalence scales of the form: $(A + \kappa K)^{\theta}$. Estimates arise from binary basic needs adequacy models.

7 Discussion

With this research, we have presented one of the few studies of subjective equivalence scales that is available for developing countries, we are only aware of Rojas (2007), who estimates subjective scales for Mexico. His estimates suggest that an increase of 40% in household income is required to keep a person's economic satisfaction constant when a second member is added, while a 20% increase is required to keep a person's economic satisfaction constant when a sixth person is added to a five-member household. Our estimates are not directly comparable to the linear 40% estimate. However, for food shares, the first additional adult would cost approximately 40% of income, while for food adequacy the estimate is nearer 45%. For the second and third additional adults, and for the different goods and measures, the estimates differ from 45%. Thus, there are some similarities between our estimates and those from Mexico.

Previous literature has presented a range of scale estimates (focusing on expenditure data) for South Africa. Two of the most recent disagree on the appropriateness of the square-root scale (Daley et al. 2020; Koch 2022). Our adequacy-based scales suggest economies of scale within the square-root region, and, therefore, is in agreement with Koch (2022); however, these same estimates suggest child costs much less than one (nearer 0.5). Thus, when combined, our subjective-based equivalence scales are relatively smaller than any scales previously estimated for South Africa (including the square-root scale). That conclusion is not entirely dissimilar to what has been uncovered by other subjective-scale research. Although Charlier (2002), for example, does find that satisfaction with income yields scales that increase with household size, Kapteyn, Kooreman, and Willemse (1987) find that the subjective evaluations lead to implausibly low family cost parameters. In our view, our estimates are not implausibly low, although they may represent a lower bound. Additional subjective scales comparisons are necessary to offer further insight.

Our basic needs security subjective scales are consistent across types of need, which we did not find with expenditure shares on the same types of need. Plausibly, the difference arises, because subjective needs remove any discretionary expenditure that might be incorporated into objective expenditure share measures (Daley et al. 2020). Our results also suggest that endogeneity matters, although maybe not enough to yield big differences in the scales, especially when it comes to subjective-based scales. We did find rather large differences in the scale estimates between endogenous and exogenous clothing and housing expenditure share models; however.

Across the board, we find smaller equivalence scales for housing adequacy, compared to food and clothing adequacy. Furthermore, food adequacy scales exceed those derived from clothing, even though the differences are not statistically meaningful. Such differences are not entirely surprising, due to the fact that both clothing and housing are less private than food; clothing has some durability, while space within a house can be reallocated. Although Frazer (2008) focuses on the manufacturing reduction associated with charitable clothing donations, the reduction in production arises from less demand, i.e, reduced clothing purchases associated with any level of clothing adequacy. Such donations and their impact on clothing expenditure (shares) offers one explanation for the observation that clothing share equivalence scales are not entirely plausible, at least in this analysis.

Finally, although we do not have a statistical criteria for judging the following comment, our simple counting approach suggests that clothing and housing share based estimates are implausible. In no case do we find plausibility scores better than 50%. On the other hand, the food share, food need, clothing need and housing need all have similar plausibility scores. As implied from the preceding discussion, the similarity of the scales derived from these different approaches, lends further credence to their plausibility. However, there is an obvious caveat: improved plausibility does not necessarily equate with correct.

As we have seen, all of the results suggest a non-monotonic pattern to marginal equivalence costs for both adults and children. Although this non-monotonic pattern may simply be a feature of South African households, or this particular data, additional research is needed. Such research can consider other developing countries and non-linearities associated with income/expenditure, the latter of which could even be utility dependent.

8 Conclusion

In this research, we have examined equivalence scales in South Africa making use of relatively standard approaches that rely on expenditure shares, as well as on self-assessed basic needs adequacy. Under the assumption that adequate food, clothing and shelter are needed for survival, the adequacy of these basic needs are plausible measures of welfare. Furthermore, they have the potential to be used to determine the required increase in income/expenditure that would allow an average household to reach adequate access to these basic survival needs. We exploit that thinking, and estimate categorical outcome models, which we use to indirectly estimate the aforementioned required increase, and, thus, equivalence scales for different types of households. We present those scales in a series of tables for each of our different measures: (1) actual expenditure shares on basic needs, and (2) self-assessed adequacy of basic needs.

Our approach has offered some diversification to the literature, in the sense that our subjective measures focus on perceived adequacy of basic needs (food, clothing and shelter), rather than on minimum income needs or general life satisfaction. When using minimum income or life satisfaction, researchers have paid attention to potential reference groups. It was expected that self-assessed adequacy also suffers from reference effects, and, therefore, our diversification was not undertaken to eliminate such effects. Our results also suggests that these effects matter, although they do not materially influence the resulting scales. Approaching the problem via an estimate of the ability of an individual to meet their basic needs has a long history in psychology, however, as the bottom rung of a hierarchy of needs that motivates individuals (Maslow 1943), which motivated our analysis.

Our results suggest that both housing and clothing expenditure shares are inappropriate welfare indicators, and, that scales resulting from such models are more likely implausible than plausible, at least in South Africa. On the other hand, food expenditure shares, as well as food, clothing and housing (in)adequacy, appear to be better candidates. They yield similar scales and similar plausibility scores, regardless of whether we control for potential endogeneity. The adequacy scales are generally less than the food share scales, regardless of household structure, and for the exogenous and endogenous scales. Once controlling for endogeneity, the scale differences across goods are generally lower. Finally, the differences tend to be relatively small compared to the overall estimated scale variability across the scales.

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A Descriptive Statistics

In this appendix, we describe the data according to differences in food adequacy (or insecurity) levels in the household.

Table A.1: Summary statistics of household or household head by self-assessed food adequacy. Note: Categorical variables are presented as the percent of observations in each category within each column. For continuous variables, the mean is presented with its standard deviation, separated by ±.

Adequate Food	Below (N = 4203)	Adequate (N = 12518)	Above (N = 1633)
Adequate Clothing			
Less than adequate	69.38%	8.70%	3.67%
Just adequate	29.34%	89.38%	14.27%
More than adequate	1.28%	1.93%	82.06%
Adequate Housing			
Less than adequate	62.79%	11.18%	6.06%
Just adequate	34.83%	85.86%	15.86%
More than adequate	2.38%	2.96%	78.08%
Adult in Household Gone Hungry			
Never	52.49%	88.90%	96.02%
Seldom	27.31%	8.53%	3.06%
Often	16.32%	2.24%	0.86%
Always	3.88%	0.33%	0.06%
Child in Household Gone Hungry			
Never	45.94%	64.96%	60.62%
Seldom	16.08%	5.04%	1.96%
Often	9.71%	1.30%	0.80%
Always	2.50%	0.24%	0.00%
No children in HH	25.77%	28.46%	36.62%
No Money to Buy Food			
Never	32.67%	74.99%	90.81%
Seldom	32.33%	17.01%	5.94%
Often	35.00%	8.00%	3.25%

Made Smaller Meals			
Never	35.31%	77.52%	91.67%
Seldom	29.19%	14.09%	5.33%
Often	35.50%	8.39%	3.00%
Needed to Skip Meals			
Never	45.13%	82.79%	93.82%
Seldom	25.34%	10.94%	4.23%
Often	29.53%	6.27%	1.96%
Less Food for Meals			
Never	36.57%	77.39%	91.79%
Seldom	27.96%	13.99%	5.14%
Often	35.47%	8.62%	3.06%
Population Group			
African	91.22%	81.61%	46.42%
Mixed	6.95%	10.95%	22.66%
Asian	0.64%	1.99%	3.18%
White	1.19%	5.45%	27.74%
Marital Status			
Marrried	24.98%	36.24%	56.22%
Partners	0.00%	0.00%	0.00%
Never married	36.93%	30.36%	19.41%
Widowed	0.00%	0.00%	0.00%
Separate	3.40%	2.50%	1.22%
Divorced	2.21%	3.02%	5.63%
Education			
No schooling	15.73%	9.55%	2.88%
Some schooling	41.09%	30.38%	16.72%
Completed grade 9	8.37%	7.21%	5.08%
Completed grade 10	9.92%	10.23%	8.02%
Completed grade 11	9.61%	10.26%	5.57%
Completed grade 12	11.75%	20.17%	25.66%
First year university	1.31%	2.99%	4.78%

Second year university	1.07%	3.80%	8.08%
Completed university	0.71%	3.42%	11.27%
Completed honours	0.21%	1.29%	5.88%
Further postgraduate	0.00%	0.00%	0.00%
Wealth Status			
Wealthy	0.45%	0.22%	1.47%
Very comfortable	0.93%	2.88%	13.96%
Reasonably comfortable	4.57%	16.73%	39.93%
Just getting by	31.72%	51.45%	35.58%
Poor	42.56%	23.70%	7.41%
Very Poor	19.77%	5.02%	1.65%
Residence			
Urban formal	44.71%	56.51%	75.93%
Urban informal	9.37%	6.79%	3.00%
Traditional area	41.87%	33.06%	16.90%
Rural formal	4.04%	3.64%	4.16%
Province			
Western Cape	7.23%	11.62%	33.07%
Eastern Cape	14.99%	12.21%	5.82%
Northern Cape	4.43%	5.83%	5.94%
Free State	12.61%	9.58%	9.12%
KwaZulu-Natal	13.25%	17.43%	8.70%
North West	10.40%	8.08%	4.35%
Gauteng	11.78%	14.20%	15.06%
Mpumalanga	11.11%	9.91%	9.31%
Limpopo	14.20%	11.14%	8.63%
Life Circumstances Scale (1-9)			
mean (sd)	2.90 (1.78)	4.14 (1.84)	5.26 (1.88)
Household Head Age			
mean (sd)	48.19 (15.76)	48.65 (16.06)	47.99 (14.34)
Household Composition			
Children: mean (sd)	1.27 (1.26)	1.09 (1.18)	0.84 (1.04)

Adults: mean (sd)	2.56 (1.33)	2.52 (1.29)	2.47 (1.21)
Log Income and Expenditure			
Expenditure: mean (sd)	7.85 (0.81)	8.43 (0.95)	9.47 (1.05)
Income: mean (sd)	7.80 (1.07)	8.55 (1.13)	9.69 (1.19)
Budget Shares			
Food: mean (sd)	0.30 (0.18)	0.24 (0.17)	0.14 (0.13)
Clothing: mean (sd)	0.09 (0.08)	0.08 (0.07)	0.06 (0.06)
Housing: mean (sd)	0.25 (0.17)	0.26 (0.17)	0.28 (0.17)

B Model estimates

In this appendix, we present the underlying model estimates.

Table B.1: Estimates from Linear Food Budget Share Equation

	Food Share		Clothing Share		Housing Share	
Variables	Exog	Endog	Exog	Endog	Exog	Endog
Intercept	0.7960^{a}	1.1147^{a}	0.2665^{a}	0.2382^{a}	0.2410^{a}	0.0495^{c}
	(0.016)	(0.021)	(0.008)	(0.010)	(0.018)	(0.024)
Log expenditure	-0.0633^{a}	-0.1063^{a}	-0.0199^{a}	-0.0161^{a}	-0.0062^{a}	0.0196^{a}
	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.003)
One child	0.0150^{a}	0.0160^{a}	0.0097^{a}	0.0096^{a}	-0.0150^{a}	-0.0156^{a}
	(0.003)	(0.003)	(0.001)	(0.001)	(0.003)	(0.003)
Two children	0.0272^{a}	0.0298^{a}	0.0215^{a}	0.0212^{a}	-0.0263^{a}	-0.0278^{a}
	(0.003)	(0.003)	(0.001)	(0.001)	(0.003)	(0.003)
Three children	0.0402^{a}	0.0448^{a}	0.0253^{a}	0.0249^{a}	-0.0337^{a}	-0.0365^{a}
	(0.004)	(0.004)	(0.002)	(0.002)	(0.004)	(0.004)
Four children	0.0513^{a}	0.0572^{a}	0.0319^{a}	0.0313^{a}	-0.0455^{a}	-0.0491^{a}
	(0.005)	(0.005)	(0.003)	(0.003)	(0.006)	(0.006)
Two adults	0.0205^{a}	0.0317^{a}	0.0164^{a}	0.0154^{a}	-0.0167^{a}	-0.0235^{a}
	(0.003)	(0.003)	(0.001)	(0.002)	(0.004)	(0.004)
Three adults	0.0228^{a}	0.0414^{a}	0.0256^{a}	0.0240^{a}	-0.0200^{a}	-0.0312^{a}
	(0.004)	(0.004)	(0.002)	(0.002)	(0.004)	(0.004)
Four adults	0.0239^{a}	0.0481^{a}	0.0323^{a}	0.0302^{a}	-0.0256^{a}	-0.0401^{a}
	(0.004)	(0.004)	(0.002)	(0.002)	(0.005)	(0.005)
Five adults	0.0289^{a}	0.0579^{a}	0.0362^{a}	0.0336^{a}	-0.0252^{a}	-0.0427^{a}
	(0.005)	(0.005)	(0.003)	(0.003)	(0.006)	(0.006)
Six adults	0.0181^{c}	0.0513^{a}	0.0470^{a}	0.0440^{a}	-0.0333^{a}	-0.0533^{a}
	(0.007)	(0.007)	(0.003)	(0.003)	(0.008)	(0.008)
Head age	-0.0005	0.0002	-0.0014^{a}	-0.0015^{a}	0.0009^{d}	0.0005
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Head age squared	0.0000	-0.0000	0.0000^{a}	0.0000^{a}	0.0000	0.0000^{c}
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Head female	0.0077^{a}	0.0033	0.0014	0.0018	0.0063^{c}	0.0089^{a}
	(0.003)	(0.003)	(0.001)	(0.001)	(0.003)	(0.003)
Mixed race	0.0089^{c}	0.0180^{a}	-0.0133^{a}	-0.0141^{a}	0.0403^{a}	0.0348^{a}
	(0.004)	(0.004)	(0.002)	(0.002)	(0.005)	(0.005)
Indian/Asian	-0.0387^{a}	-0.0158^{d}	-0.0211^{a}	-0.0232^{a}	0.1288^{a}	0.1151^{a}
	(0.008)	(0.008)	(0.004)	(0.004)	(0.009)	(0.009)
White	-0.0070	0.0357^{a}	-0.0189^{a}	-0.0227^{a}	0.1078^{a}	0.0821^{a}

	(0.005)	(0.005)	(0.002)	(0.003)	(0.006)	(0.006)
Eastern Cape	-0.0237[a]	-0.0266[a]	-0.0042[d]	-0.0040[d]	0.0157[a]	0.0174[a]
	(0.005)	(0.005)	(0.002)	(0.002)	(0.005)	(0.005)
Northern Cape	-0.0323[a]	-0.0367[a]	0.0068[b]	0.0072[b]	-0.0111[d]	-0.0084
	(0.005)	(0.005)	(0.003)	(0.003)	(0.006)	(0.006)
Free State	-0.0483[a]	-0.0522[a]	-0.0013	-0.0009	-0.0407[a]	-0.0384[a]
	(0.005)	(0.005)	(0.002)	(0.002)	(0.006)	(0.006)
Kwazulu Natal	-0.0122[b]	-0.0142[a]	0.0012	0.0014	0.0351[a]	0.0363[a]
	(0.005)	(0.005)	(0.002)	(0.002)	(0.005)	(0.005)
North West	-0.0465[a]	-0.0474[a]	-0.0115[a]	-0.0114[a]	0.0093	0.0098
	(0.005)	(0.005)	(0.003)	(0.003)	(0.006)	(0.006)
Gauteng	-0.0335[a]	-0.0321[a]	-0.0088[a]	-0.0089[a]	0.0608[a]	0.0600[a]
	(0.005)	(0.005)	(0.002)	(0.002)	(0.005)	(0.005)
Mpumalanga	-0.0220[a]	-0.0224[a]	0.0121[a]	0.0122[a]	0.0358[a]	0.0360[a]
	(0.005)	(0.005)	(0.002)	(0.002)	(0.006)	(0.006)
Limpopo	-0.0451[a]	-0.0472[a]	-0.0023	-0.0021	0.0624[a]	0.0637[a]
	(0.005)	(0.005)	(0.003)	(0.003)	(0.006)	(0.006)
Urban informal	0.0196[a]	0.0043	0.0086[a]	0.0099[a]	-0.0797[a]	-0.0705[a]
	(0.004)	(0.004)	(0.002)	(0.002)	(0.005)	(0.005)
Traditional area	0.0416[a]	0.0247[a]	-0.0029[c]	-0.0014	-0.0573[a]	-0.0472[a]
	(0.003)	(0.003)	(0.001)	(0.001)	(0.003)	(0.004)
Rural formal	0.0430[a]	0.0337[a]	-0.0003	0.0005	-0.0577[a]	-0.0522[a]
	(0.006)	(0.006)	(0.003)	(0.003)	(0.006)	(0.006)
Living together	0.0206[a]	0.0130[a]	0.0000	0.0007	-0.0159[a]	-0.0113[b]
	(0.004)	(0.004)	(0.002)	(0.002)	(0.004)	(0.004)
Never married	0.0101[a]	-0.0002	0.0037[c]	0.0046[a]	0.0061	0.0123[a]
	(0.003)	(0.003)	(0.002)	(0.002)	(0.004)	(0.004)
Widow/widower	0.0034	-0.0018	0.0029	0.0033[d]	0.0067	0.0098[c]
	(0.004)	(0.004)	(0.002)	(0.002)	(0.004)	(0.004)
Separated	0.0079	0.0014	0.0064[d]	0.0070[c]	-0.0019	0.0020
	(0.007)	(0.007)	(0.003)	(0.003)	(0.008)	(0.008)
Divorced	-0.0142[c]	-0.0178[b]	0.0070[c]	0.0073[c]	0.0154[c]	0.0176[c]
	(0.006)	(0.006)	(0.003)	(0.003)	(0.007)	(0.007)
Primary education	-0.0224[a]	-0.0172[a]	0.0018	0.0013	0.0252[a]	0.0221[a]
	(0.004)	(0.004)	(0.002)	(0.002)	(0.004)	(0.004)
Grade 9	-0.0417[a]	-0.0294[a]	0.0043[d]	0.0032	0.0449[a]	0.0376[a]
	(0.005)	(0.005)	(0.003)	(0.003)	(0.006)	(0.006)
Grade 10	-0.0374[a]	-0.0205[a]	0.0058[c]	0.0043[d]	0.0343[a]	0.0241[a]
	(0.005)	(0.005)	(0.002)	(0.002)	(0.006)	(0.006)
Grade 11	-0.0431[a]	-0.0234[a]	0.0104[a]	0.0087[a]	0.0306[a]	0.0187[a]
	(0.005)	(0.005)	(0.003)	(0.003)	(0.006)	(0.006)

Secondary education	-0.0576^a	-0.0247^a	0.0084^a	0.0055^c	0.0357^a	0.0158^b
	(0.005)	(0.005)	(0.002)	(0.002)	(0.006)	(0.006)
First year university	-0.0812^a	-0.0386^a	0.0105^a	0.0067^d	0.0114	-0.0142
	(0.008)	(0.008)	(0.004)	(0.004)	(0.009)	(0.009)
Second year university	-0.0873^a	-0.0346^a	0.0085^c	0.0039	0.0129	-0.0188^c
	(0.007)	(0.007)	(0.003)	(0.004)	(0.008)	(0.009)
Tertiary education	-0.0828^a	-0.0200^c	0.0070^c	0.0015	0.0163^d	-0.0214^c
	(0.007)	(0.008)	(0.004)	(0.004)	(0.008)	(0.009)
Honours degree	-0.0718^a	-0.0055	0.0097^c	0.0038	0.0070	-0.0328^b
	(0.010)	(0.010)	(0.005)	(0.005)	(0.011)	(0.012)
Masters degree or more	-0.0780^a	-0.0105	0.0099^d	0.0039	0.0295^c	-0.0110
	(0.011)	(0.011)	(0.005)	(0.006)	(0.013)	(0.013)
Expenditure Control Function		0.0760^a		-0.0067^a		-0.0457^a
		(0.003)		(0.001)		(0.004)

Estimates based on linear models. The standard errors for the models with the control functions are not adjusted for the inclusion of a generated variable, due to the fact that these standard errors are not the main point of the analysis. The following notation and significance levels are listed: ^{a} - 0.005, ^{b} - 0.01, ^{c} - 0.05, ^{d} - 0.1.

Table B.2: Ordered Logit Model Parameter Estimates for Self-Reported Food, Clothing and Housing Adequacy in the Household

	Food Share		Clothing Share		Housing Share	
Variables	Exogenous	Endogenous	Exogenous	Endogenous	Exogenous	Endogenous
Log expenditure	0.7648^a	1.3055^a	0.8578^a	1.2431^a	0.7923^a	1.0441^a
	(0.026)	(0.043)	(0.026)	(0.040)	(0.025)	(0.038)
One child	-0.1656^a	-0.1863^a	-0.1528^a	-0.1514^a	-0.0936^c	-0.1304^a
	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)
Two children	-0.2476^a	-0.2936^a	-0.2606^a	-0.2566^a	-0.1929^a	-0.2713^a
	(0.048)	(0.048)	(0.049)	(0.049)	(0.048)	(0.048)
Three children	-0.3561^a	-0.4295^a	-0.3930^a	-0.3968^a	-0.3031^a	-0.4260^a
	(0.061)	(0.061)	(0.061)	(0.062)	(0.060)	(0.061)
Four children	-0.4736^a	-0.5686^a	-0.4177^a	-0.4300^a	-0.3674^a	-0.5231^a
	(0.082)	(0.083)	(0.084)	(0.085)	(0.082)	(0.083)
Two adults	-0.2810^a	-0.4275^a	-0.3080^a	-0.4110^a	-0.1615^a	-0.2467^a
	(0.049)	(0.050)	(0.049)	(0.050)	(0.048)	(0.049)
Three adults	-0.4127^a	-0.6482^a	-0.5647^a	-0.7311^a	-0.2278^a	-0.3638^a
	(0.056)	(0.058)	(0.056)	(0.058)	(0.055)	(0.057)
Four adults	-0.5223^a	-0.8259^a	-0.5755^a	-0.7908^a	-0.2725^a	-0.4409^a

	(0.065)	(0.067)	(0.066)	(0.068)	(0.064)	(0.067)
Five adults	-0.5312^{a}	-0.8906^{a}	-0.5449^{a}	-0.7898^{a}	-0.2656^{a}	-0.4665^{a}
	(0.082)	(0.085)	(0.083)	(0.086)	(0.082)	(0.085)
Six adults	-0.6642^{a}	-1.0712^{a}	-0.8265^{a}	-1.1032^{a}	-0.6638^{a}	-0.8658^{a}
	(0.111)	(0.115)	(0.113)	(0.116)	(0.110)	(0.113)
Head age	0.0031^{c}	0.0007	0.0050^{a}	0.0035^{c}	0.0081^{a}	0.0070^{a}
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Head female	0.0329	0.0783^{d}	0.0418	0.0811^{c}	0.0246	0.0467
	(0.041)	(0.041)	(0.041)	(0.041)	(0.040)	(0.041)
Mixed race	0.5036^{a}	0.4020^{a}	0.6021^{a}	0.5008^{a}	0.4658^{a}	0.4823^{a}
	(0.070)	(0.070)	(0.070)	(0.071)	(0.069)	(0.069)
Indian/Asian	0.0252	-0.2417^{d}	0.0059	-0.2395^{d}	-0.3081^{c}	-0.1996
	(0.134)	(0.136)	(0.135)	(0.136)	(0.134)	(0.136)
White	0.5198^{a}	0.0135	0.4908^{a}	0.0636	0.5670^{a}	0.5541^{a}
	(0.080)	(0.085)	(0.081)	(0.086)	(0.080)	(0.087)
Eastern Cape	-0.7252^{a}	-0.6868^{a}	-0.6546^{a}	-0.6318^{a}	-0.5492^{a}	-0.5045^{a}
	(0.076)	(0.076)	(0.076)	(0.076)	(0.074)	(0.074)
Northern Cape	-0.2748^{a}	-0.2084^{c}	-0.1468^{d}	-0.0942	0.0646	0.0707
	(0.087)	(0.087)	(0.088)	(0.088)	(0.086)	(0.086)
Free State	-0.6386^{a}	-0.5848^{a}	-0.7305^{a}	-0.6982^{a}	-0.4237^{a}	-0.4600^{a}
	(0.079)	(0.079)	(0.079)	(0.079)	(0.078)	(0.078)
Kwazulu Natal	-0.2169^{a}	-0.1907^{c}	-0.1576^{c}	-0.1344^{d}	0.1273^{d}	0.1870^{c}
	(0.075)	(0.075)	(0.075)	(0.076)	(0.074)	(0.074)
North West	-0.7642^{a}	-0.7449^{a}	-0.6154^{a}	-0.6181^{a}	-0.3930^{a}	-0.3778^{a}
	(0.083)	(0.084)	(0.084)	(0.084)	(0.082)	(0.083)
Gauteng	-0.5548^{a}	-0.5687^{a}	-0.4505^{a}	-0.4649^{a}	-0.2810^{a}	-0.1968^{b}
	(0.074)	(0.074)	(0.074)	(0.074)	(0.072)	(0.073)
Mpumalanga	-0.4158^{a}	-0.4042^{a}	-0.4350^{a}	-0.4217^{a}	-0.1794^{c}	-0.1336^{d}
	(0.081)	(0.082)	(0.082)	(0.082)	(0.080)	(0.080)
Limpopo	-0.5575^{a}	-0.5243^{a}	-0.2949^{a}	-0.2752^{a}	-0.1402^{d}	-0.0357
	(0.084)	(0.084)	(0.084)	(0.085)	(0.083)	(0.083)
Urban informal	0.0294	0.2034^{a}	-0.0200	0.1288^{d}	-0.0153	-0.0688
	(0.067)	(0.068)	(0.067)	(0.068)	(0.066)	(0.068)
Traditional area	0.3142^{a}	0.5122^{a}	0.2661^{a}	0.4208^{a}	0.3043^{a}	0.3196^{a}
	(0.048)	(0.049)	(0.048)	(0.049)	(0.048)	(0.049)
Rural formal	0.1085	0.2079^{c}	0.0971	0.1851^{c}	0.1263	0.0695
	(0.087)	(0.088)	(0.088)	(0.088)	(0.087)	(0.088)
Living together	-0.1993^{a}	-0.1153^{d}	-0.2316^{a}	-0.1579^{b}	-0.3152^{a}	-0.2776^{a}
	(0.060)	(0.060)	(0.060)	(0.060)	(0.059)	(0.059)
Never married	-0.3107^{a}	-0.1895^{a}	-0.1993^{a}	-0.0909^{d}	-0.1282^{c}	-0.0542
	(0.051)	(0.052)	(0.052)	(0.052)	(0.051)	(0.052)

Widow/widower	-0.2159^a	-0.1481^c	-0.1300^c	-0.0816	-0.0508	0.0109
	(0.059)	(0.059)	(0.059)	(0.059)	(0.059)	(0.059)
Separated	-0.3443^a	-0.2745^b	-0.2501^c	-0.1898^d	-0.1772^d	-0.1212
	(0.106)	(0.106)	(0.107)	(0.107)	(0.106)	(0.106)
Divorced	-0.2163^c	-0.1669	-0.0808	-0.0479	-0.1432	-0.1004
	(0.102)	(0.102)	(0.103)	(0.103)	(0.102)	(0.102)
Primary education	0.1387^c	0.0785	0.1673^a	0.1170^d	0.2164^a	0.1713^a
	(0.059)	(0.059)	(0.059)	(0.060)	(0.059)	(0.060)
Grade 9	0.2687^a	0.1367	0.2991^a	0.1983^c	0.2441^a	0.1641^d
	(0.084)	(0.085)	(0.084)	(0.085)	(0.084)	(0.084)
Grade 10	0.3043^a	0.1135	0.2617^a	0.1192	0.2631^a	0.1489^d
	(0.079)	(0.080)	(0.080)	(0.081)	(0.079)	(0.080)
Grade 11	0.3073^a	0.0794	0.1544^d	-0.0144	0.2455^a	0.1128
	(0.081)	(0.082)	(0.082)	(0.083)	(0.081)	(0.082)
Secondary education	0.5260^a	0.1545^d	0.4762^a	0.1874^c	0.3633^a	0.1452^d
	(0.077)	(0.080)	(0.077)	(0.080)	(0.076)	(0.079)
First year university	0.5627^a	0.0892	0.4277^a	0.0451	0.4236^a	0.1364
	(0.124)	(0.127)	(0.125)	(0.128)	(0.122)	(0.125)
Second year university	0.7080^a	0.1112	0.6339^a	0.1496	0.6283^a	0.2819^c
	(0.115)	(0.120)	(0.115)	(0.120)	(0.113)	(0.118)
Tertiary education	0.8031^a	0.0852	0.7485^a	0.1717	0.6491^a	0.2342^d
	(0.117)	(0.124)	(0.117)	(0.124)	(0.115)	(0.122)
Honours degree	0.9676^a	0.2035	0.8981^a	0.2896^d	0.9050^a	0.4451^b
	(0.155)	(0.162)	(0.156)	(0.163)	(0.154)	(0.160)
Masters degree or more	1.3550^a	0.5807^a	1.3979^a	0.7830^a	1.1903^a	0.7402^a
	(0.173)	(0.179)	(0.172)	(0.178)	(0.172)	(0.177)
Expenditure share	-0.5124^a	-0.3913^c	2.6261^a	1.0560^b	0.9960^a	-1.0051^a
	(0.113)	(0.199)	(0.247)	(0.403)	(0.104)	(0.206)
Log expenditure CF		-0.9148^a		-0.7101^a		-0.4397^a
		(0.051)		(0.050)		(0.049)
Expenditure share CF		0.0653		0.1486^a		0.5353^a
		(0.042)		(0.032)		(0.050)
Below v Adequate cut	4.3951^a	8.5565^a	5.6065^a	8.4505^a	5.7101^a	7.0629^a
	(0.240)	(0.369)	(0.236)	(0.334)	(0.227)	(0.319)
Adequate v Above cut	8.7737^a	13.0279^a	9.9865^a	12.8968^a	9.9443^a	11.3348^a
	(0.251)	(0.381)	(0.248)	(0.347)	(0.240)	(0.330)

Coefficient estimates for ordered model without (column 1, 3 and 5) and with controls for potential endogeneity of expenditure and unobserved reference effects via the household's expenditure share on food, clothing and housing, respectively columns 2, 4 and 6. The standard errors for the models with the control functions are not adjusted for the inclusion of a generated variable, due to the fact that these standard errors are not the main point of the analysis.

Table B.3: Binary Logit Model Parameter Estimates for Self-Reported Food, Clothing and Housing Adequacy in the Household

	Food Share		Clothing Share		Housing Share	
Variables	Exogenous	Endogenous	Exogenous	Endogenous	Exogenous	Endogenous
Intercept	-4.4607^a	-9.1038^a	-6.1127^a	-9.3334^a	-6.2354^a	-7.2999^a
	(0.283)	(0.459)	(0.286)	(0.426)	(0.283)	(0.407)
Log expenditure	0.6844^a	1.2924^a	0.8164^a	1.2557^a	0.7507^a	0.9757^a
	(0.031)	(0.054)	(0.032)	(0.052)	(0.032)	(0.049)
One child	-0.1888^a	-0.2129^a	-0.1114^c	-0.1109^c	-0.1010^d	-0.1353^c
	(0.053)	(0.053)	(0.054)	(0.054)	(0.053)	(0.054)
Two children	-0.2461^a	-0.2943^a	-0.2102^a	-0.2069^a	-0.1792^a	-0.2557^a
	(0.056)	(0.057)	(0.058)	(0.059)	(0.057)	(0.057)
Three children	-0.3366^a	-0.4229^a	-0.3207^a	-0.3320^a	-0.2856^a	-0.4169^a
	(0.068)	(0.069)	(0.070)	(0.071)	(0.069)	(0.070)
Four children	-0.4458^a	-0.5525^a	-0.3435^a	-0.3650^a	-0.3106^a	-0.4747^a
	(0.089)	(0.091)	(0.093)	(0.094)	(0.092)	(0.093)
Two adults	-0.2237^a	-0.3766^a	-0.2792^a	-0.3855^a	-0.0880	-0.1592^b
	(0.056)	(0.057)	(0.058)	(0.059)	(0.056)	(0.057)
Three adults	-0.3620^a	-0.6163^a	-0.5643^a	-0.7401^a	-0.1151^d	-0.2348^a
	(0.064)	(0.067)	(0.066)	(0.068)	(0.065)	(0.067)
Four adults	-0.5136^a	-0.8503^a	-0.6341^a	-0.8699^a	-0.2393^a	-0.3908^a
	(0.074)	(0.078)	(0.077)	(0.080)	(0.076)	(0.079)
Five adults	-0.5714^a	-0.9661^a	-0.6367^a	-0.8992^a	-0.2335^c	-0.4101^a
	(0.093)	(0.098)	(0.097)	(0.102)	(0.097)	(0.101)
Six adults	-0.6004^a	-1.0557^a	-0.6973^a	-1.0031^a	-0.4633^a	-0.6471^a
	(0.124)	(0.129)	(0.131)	(0.135)	(0.126)	(0.130)
Head age	0.0086^a	0.0057^a	0.0106^a	0.0086^a	0.0119^a	0.0105^a
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Head female	0.0765^d	0.1204^c	0.0657	0.1053^c	0.0405	0.0556
	(0.046)	(0.047)	(0.047)	(0.048)	(0.047)	(0.047)
Mixed race	0.1965^c	0.1382	0.2921^a	0.2238^c	0.2146^c	0.2739^a
	(0.087)	(0.088)	(0.090)	(0.091)	(0.086)	(0.087)
Indian/Asian	-0.0392	-0.3506	-0.2611	-0.5512^b	-0.5716^a	-0.3768^d
	(0.214)	(0.218)	(0.201)	(0.204)	(0.199)	(0.202)
White	-0.0482	-0.6117^a	-0.4208^a	-0.9077^a	0.2016	0.2656
	(0.160)	(0.167)	(0.142)	(0.149)	(0.175)	(0.181)
Eastern Cape	-0.2516^b	-0.1921^c	-0.0120	0.0280	0.0760	0.1381
	(0.095)	(0.096)	(0.096)	(0.096)	(0.091)	(0.092)
Northern Cape	0.1208	0.1934^d	0.4211^a	0.4766^a	0.6592^a	0.6911^a

	(0.109)	(0.111)	(0.114)	(0.115)	(0.110)	(0.111)
Free State	-0.4433^{a}	-0.3864^{a}	-0.3895^{a}	-0.3557^{a}	-0.1945^{c}	-0.2237^{c}
	(0.096)	(0.098)	(0.096)	(0.096)	(0.092)	(0.092)
Kwazulu Natal	0.3278^{a}	0.3657^{a}	0.5506^{a}	0.5839^{a}	0.8726^{a}	0.9639^{a}
	(0.097)	(0.097)	(0.097)	(0.098)	(0.095)	(0.096)
North West	-0.3752^{a}	-0.3503^{a}	-0.0907	-0.0891	0.0462	0.0920
	(0.102)	(0.103)	(0.103)	(0.103)	(0.099)	(0.100)
Gauteng	-0.2276^{c}	-0.2463^{c}	-0.0260	-0.0455	0.1173	0.2105^{c}
	(0.095)	(0.096)	(0.095)	(0.096)	(0.091)	(0.092)
Mpumalanga	-0.1485	-0.1312	-0.0183	0.0013	0.2037^{c}	0.2793^{a}
	(0.101)	(0.102)	(0.101)	(0.102)	(0.097)	(0.098)
Limpopo	-0.2526^{c}	-0.2128^{c}	0.1032	0.1293	0.2865^{a}	0.4157^{a}
	(0.102)	(0.103)	(0.104)	(0.104)	(0.101)	(0.102)
Urban informal	-0.0488	0.1368^{d}	-0.0829	0.0758	-0.0294	-0.1085
	(0.072)	(0.074)	(0.073)	(0.075)	(0.072)	(0.075)
Traditional area	0.1707^{a}	0.3838^{a}	0.0962^{d}	0.2612^{a}	0.1703^{a}	0.1654^{a}
	(0.054)	(0.056)	(0.055)	(0.057)	(0.055)	(0.058)
Rural formal	0.1389	0.2565^{c}	0.0407	0.1436	0.1430	0.0508
	(0.102)	(0.103)	(0.103)	(0.103)	(0.102)	(0.104)
Living together	-0.1920^{a}	-0.1146^{d}	-0.1863^{b}	-0.1186^{d}	-0.2840^{a}	-0.2678^{a}
	(0.068)	(0.069)	(0.068)	(0.069)	(0.066)	(0.067)
Never married	-0.3362^{a}	-0.2157^{a}	-0.2073^{a}	-0.0994	-0.0999^{d}	-0.0370
	(0.059)	(0.060)	(0.060)	(0.061)	(0.059)	(0.060)
Widow/widower	-0.2321^{a}	-0.1569^{c}	-0.1140^{d}	-0.0606	-0.0049	0.0461
	(0.067)	(0.067)	(0.069)	(0.069)	(0.069)	(0.070)
Separated	-0.3005^{b}	-0.2232^{d}	-0.1655	-0.0967	-0.0567	-0.0054
	(0.116)	(0.117)	(0.119)	(0.120)	(0.118)	(0.119)
Divorced	-0.2698^{c}	-0.1965	0.0257	0.0817	-0.1529	-0.0982
	(0.133)	(0.135)	(0.141)	(0.143)	(0.134)	(0.135)
Primary education	0.1597^{c}	0.0845	0.1807^{a}	0.1198^{d}	0.2221^{a}	0.1757^{b}
	(0.062)	(0.063)	(0.064)	(0.064)	(0.065)	(0.065)
Grade 9	0.3580^{a}	0.2136^{c}	0.4184^{a}	0.3133^{a}	0.3534^{a}	0.2769^{a}
	(0.091)	(0.092)	(0.093)	(0.094)	(0.093)	(0.094)
Grade 10	0.4416^{a}	0.2332^{b}	0.4728^{a}	0.3198^{a}	0.3649^{a}	0.2571^{a}
	(0.088)	(0.089)	(0.090)	(0.091)	(0.089)	(0.091)
Grade 11	0.5095^{a}	0.2618^{a}	0.3339^{a}	0.1527^{d}	0.4081^{a}	0.2867^{a}
	(0.090)	(0.091)	(0.090)	(0.092)	(0.091)	(0.093)
Secondary education	0.6904^{a}	0.3074^{a}	0.6447^{a}	0.3522^{a}	0.4533^{a}	0.2602^{a}
	(0.087)	(0.091)	(0.089)	(0.092)	(0.087)	(0.091)
First year university	0.7472^{a}	0.2775	0.4684^{a}	0.0826	0.4463^{a}	0.1925
	(0.167)	(0.172)	(0.161)	(0.166)	(0.156)	(0.161)

Second year university	0.9149^a	0.2714	0.9761^a	0.4525^c	0.8310^a	0.5190^a
	(0.177)	(0.183)	(0.186)	(0.192)	(0.173)	(0.179)
Tertiary education	0.9015^a	0.0999	0.7159^a	0.0738	0.8179^a	0.4574^c
	(0.209)	(0.217)	(0.202)	(0.210)	(0.203)	(0.210)
Honours degree	1.0129^a	0.2032	0.6026^d	-0.0427	1.1283^a	0.7354^d
	(0.358)	(0.365)	(0.317)	(0.324)	(0.378)	(0.383)
Masters degree or more	0.3952	-0.3759	0.9974^c	0.4102	0.9393^c	0.5690
	(0.367)	(0.377)	(0.473)	(0.480)	(0.474)	(0.478)
Expenditure share	-0.4705^a	-0.3827	2.7873^a	0.9907^c	1.3957^a	-0.9234^a
	(0.122)	(0.237)	(0.286)	(0.468)	(0.136)	(0.262)
Log expenditure CF		-0.9560^a		-0.7443^a		-0.3813^a
		(0.062)		(0.062)		(0.060)
Expenditure share CF		0.0743		0.1656^a		0.5694^a
		(0.055)		(0.038)		(0.058)

Coefficient estimates for binary logit model without (column 1, 3 and 5) and with controls for potential endogeneity of expenditure and unobserved reference effects via the household's expenditure share on food, clothing and housing, respectively columns 2, 4 and 6. The standard errors for the models with the control functions are not adjusted for the inclusion of a generated variable, due to the fact that these standard errors are not the main point of the analysis.

C Equivalence scales

In this appendix, we present the equivalence scales for all household structures, holding all non-household variables to be the same as for the reference household.

Table C.1: Estimate of equivalence scales based on food shares, clothing shares and housing shares by household type, underpinned by linear regression model

		Food Share		Clothing Share		Housing Share	
Adults	Kids	Exogenous	Endogenous	Exogenous	Endogenous	Exogenous	Endogenous
1	0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1	0	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
1	1	1.2680	1.1620	1.6260	1.8150	0.0880	2.2080
1	1	(0.057)	(0.030)	(0.058)	(0.032)	(0.059)	(0.056)
1	2	1.5380	1.3240	2.9390	3.7390	0.0140	4.1240
1	2	(0.084)	(0.040)	(0.075)	(0.040)	(0.076)	(0.075)
1	3	1.8880	1.5250	3.5670	4.6970	0.0040	6.4060
1	3	(0.129)	(0.058)	(0.122)	(0.059)	(0.127)	(0.135)
1	4	2.2470	1.7130	4.9520	6.9970	0.0010	12.1610
1	4	(0.216)	(0.101)	(0.216)	(0.096)	(0.217)	(0.230)
2	0	1.3830	1.3480	2.2770	2.6010	0.0660	3.3040
2	0	(0.076)	(0.042)	(0.075)	(0.041)	(0.074)	(0.071)
2	1	1.7540	1.5670	3.7030	4.7210	0.0060	7.2940
2	1	(0.110)	(0.058)	(0.115)	(0.059)	(0.112)	(0.112)
2	2	2.1260	1.7840	6.6910	9.7230	0.0010	13.6240
2	2	(0.148)	(0.075)	(0.135)	(0.071)	(0.140)	(0.133)
2	3	2.6110	2.0560	8.1210	12.2160	0.0000	21.1630
2	3	(0.206)	(0.100)	(0.203)	(0.092)	(0.205)	(0.223)
2	4	3.1080	2.3100	11.2770	18.1960	0.0000	40.1760
2	4	(0.322)	(0.144)	(0.332)	(0.143)	(0.322)	(0.335)
3	0	1.4330	1.4770	3.6190	4.4270	0.0390	4.9040
3	0	(0.086)	(0.053)	(0.088)	(0.050)	(0.084)	(0.085)
3	1	1.8170	1.7170	5.8860	8.0360	0.0030	10.8290
3	1	(0.117)	(0.067)	(0.127)	(0.070)	(0.127)	(0.122)
3	2	2.2040	1.9550	10.6350	16.5510	0.0010	20.2260
3	2	(0.158)	(0.084)	(0.154)	(0.081)	(0.153)	(0.148)
3	3	2.7060	2.2520	12.9080	20.7950	0.0000	31.4170
3	3	(0.219)	(0.111)	(0.223)	(0.105)	(0.225)	(0.245)
3	4	3.2210	2.5300	17.9220	30.9740	0.0000	59.6430
3	4	(0.345)	(0.164)	(0.362)	(0.160)	(0.338)	(0.365)
4	0	1.4590	1.5720	5.0700	6.5140	0.0160	7.7050

4	0	(0.102)	(0.062)	(0.105)	(0.061)	(0.106)	(0.096)
4	1	1.8500	1.8280	8.2460	11.8240	0.0010	17.0130
4	1	(0.132)	(0.078)	(0.144)	(0.081)	(0.141)	(0.132)
4	2	2.2430	2.0810	14.8980	24.3550	0.0000	31.7780
4	2	(0.172)	(0.097)	(0.179)	(0.094)	(0.167)	(0.156)
4	3	2.7540	2.3980	18.0820	30.5990	0.0000	49.3610
4	3	(0.237)	(0.128)	(0.253)	(0.120)	(0.235)	(0.255)
4	4	3.2780	2.6940	25.1070	45.5760	0.0000	93.7080
4	4	(0.351)	(0.179)	(0.375)	(0.182)	(0.364)	(0.377)
5	0	1.5770	1.7250	6.1490	8.0500	0.0170	8.7840
5	0	(0.145)	(0.090)	(0.148)	(0.084)	(0.138)	(0.137)
5	1	2.0000	2.0050	10.0010	14.6130	0.0010	19.3950
5	1	(0.188)	(0.106)	(0.204)	(0.106)	(0.187)	(0.185)
5	2	2.4250	2.2830	18.0700	30.0990	0.0000	36.2260
5	2	(0.237)	(0.127)	(0.241)	(0.122)	(0.226)	(0.222)
5	3	2.9770	2.6300	21.9330	37.8160	0.0000	56.2700
5	3	(0.330)	(0.157)	(0.307)	(0.148)	(0.294)	(0.324)
5	4	3.5440	2.9550	30.4540	56.3270	0.0000	106.8240
5	4	(0.439)	(0.223)	(0.456)	(0.209)	(0.458)	(0.483)
6	0	1.3310	1.6210	10.5630	15.3610	0.0040	15.0590
6	0	(0.157)	(0.120)	(0.166)	(0.116)	(0.171)	(0.169)
6	1	1.6880	1.8840	17.1800	27.8830	0.0000	33.2500
6	1	(0.199)	(0.139)	(0.215)	(0.135)	(0.211)	(0.216)
6	2	2.0470	2.1460	31.0410	57.4330	0.0000	62.1050
6	2	(0.255)	(0.157)	(0.266)	(0.156)	(0.263)	(0.262)
6	3	2.5130	2.4720	37.6750	72.1560	0.0000	96.4690
6	3	(0.314)	(0.196)	(0.335)	(0.191)	(0.332)	(0.354)
6	4	2.9910	2.7780	52.3120	107.4770	0.0000	183.1390
6	4	(0.425)	(0.231)	(0.457)	(0.236)	(0.453)	(0.435)

Estimated equivalence scale by household type, and bootstrapped standard error (99 replications). Estimates underpinned by linear model including controls in addition to expenditure and household structure.

Table C.2: Estimate of equivalence scales based on food clothing and housing adequacy by household type, underpinned by ordered logit model controlling for endogeneity

		Food Adequacy		Clothing Adequacy		Housing Adequacy	
Adults	Kids	Exogenous	Endogenous	Exogenous	Endogenous	Exogenous	Endogenous
1	0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

1	0	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
1	1	1.2420	1.1530	1.1950	1.1300	1.1250	1.1330
1	1	(0.075)	(0.040)	(0.067)	(0.042)	(0.065)	(0.048)
1	2	1.3820	1.2520	1.3550	1.2290	1.2760	1.2970
1	2	(0.089)	(0.046)	(0.076)	(0.050)	(0.075)	(0.063)
1	3	1.5930	1.3900	1.5810	1.3760	1.4660	1.5040
1	3	(0.121)	(0.062)	(0.116)	(0.070)	(0.114)	(0.088)
1	4	1.8570	1.5460	1.6270	1.4130	1.5900	1.6500
1	4	(0.199)	(0.101)	(0.159)	(0.101)	(0.168)	(0.136)
2	0	1.4440	1.3870	1.4320	1.3920	1.2260	1.2670
2	0	(0.092)	(0.049)	(0.080)	(0.055)	(0.074)	(0.060)
2	1	1.7930	1.6000	1.7110	1.5720	1.3800	1.4350
2	1	(0.148)	(0.069)	(0.126)	(0.076)	(0.107)	(0.078)
2	2	1.9960	1.7370	1.9400	1.7110	1.5640	1.6420
2	2	(0.167)	(0.081)	(0.145)	(0.087)	(0.122)	(0.099)
2	3	2.3000	1.9280	2.2640	1.9150	1.7980	1.9050
2	3	(0.214)	(0.101)	(0.196)	(0.111)	(0.161)	(0.128)
2	4	2.6820	2.1450	2.3300	1.9670	1.9500	2.0900
2	4	(0.322)	(0.147)	(0.250)	(0.148)	(0.233)	(0.177)
3	0	1.7150	1.6430	1.9320	1.8010	1.3330	1.4170
3	0	(0.119)	(0.067)	(0.116)	(0.081)	(0.086)	(0.073)
3	1	2.1300	1.8950	2.3080	2.0340	1.5000	1.6050
3	1	(0.179)	(0.091)	(0.176)	(0.106)	(0.119)	(0.093)
3	2	2.3710	2.0570	2.6170	2.2130	1.7000	1.8370
3	2	(0.197)	(0.101)	(0.199)	(0.122)	(0.132)	(0.116)
3	3	2.7330	2.2830	3.0540	2.4780	1.9540	2.1310
3	3	(0.257)	(0.133)	(0.268)	(0.154)	(0.182)	(0.152)
3	4	3.1860	2.5400	3.1430	2.5450	2.1200	2.3380
3	4	(0.373)	(0.177)	(0.330)	(0.193)	(0.247)	(0.204)
4	0	1.9800	1.8830	1.9560	1.8890	1.4110	1.5250
4	0	(0.159)	(0.092)	(0.138)	(0.102)	(0.110)	(0.098)
4	1	2.4580	2.1710	2.3370	2.1340	1.5870	1.7280
4	1	(0.221)	(0.112)	(0.196)	(0.122)	(0.144)	(0.116)
4	2	2.7360	2.3570	2.6500	2.3220	1.7990	1.9780
4	2	(0.253)	(0.127)	(0.223)	(0.138)	(0.168)	(0.139)
4	3	3.1530	2.6160	3.0930	2.5990	2.0680	2.2940
4	3	(0.308)	(0.158)	(0.286)	(0.167)	(0.204)	(0.168)
4	4	3.6770	2.9100	3.1830	2.6700	2.2430	2.5180
4	4	(0.464)	(0.211)	(0.348)	(0.217)	(0.279)	(0.229)
5	0	2.0030	1.9780	1.8870	1.8880	1.3980	1.5630
5	0	(0.219)	(0.122)	(0.178)	(0.128)	(0.131)	(0.116)

5	1	2.4870	2.2820	2.2560	2.1320	1.5740	1.7710
5	1	(0.286)	(0.148)	(0.245)	(0.158)	(0.161)	(0.134)
5	2	2.7680	2.4770	2.5580	2.3200	1.7840	2.0270
5	2	(0.324)	(0.164)	(0.270)	(0.170)	(0.186)	(0.168)
5	3	3.1900	2.7490	2.9840	2.5970	2.0500	2.3510
5	3	(0.393)	(0.194)	(0.351)	(0.206)	(0.234)	(0.213)
5	4	3.7200	3.0580	3.0710	2.6680	2.2230	2.5800
5	4	(0.528)	(0.246)	(0.377)	(0.238)	(0.276)	(0.255)
6	0	2.3830	2.2720	2.6210	2.4290	2.3110	2.2920
6	0	(0.352)	(0.192)	(0.301)	(0.213)	(0.310)	(0.230)
6	1	2.9600	2.6200	3.1320	2.7440	2.6010	2.5960
6	1	(0.466)	(0.225)	(0.390)	(0.241)	(0.368)	(0.269)
6	2	3.2940	2.8450	3.5510	2.9860	2.9480	2.9710
6	2	(0.508)	(0.248)	(0.445)	(0.273)	(0.415)	(0.317)
6	3	3.7970	3.1570	4.1440	3.3420	3.3890	3.4460
6	3	(0.589)	(0.288)	(0.540)	(0.308)	(0.499)	(0.369)
6	4	4.4270	3.5110	4.2650	3.4330	3.6750	3.7820
6	4	(0.765)	(0.350)	(0.576)	(0.346)	(0.549)	(0.424)

Estimated equivalence scale by household type, and bootstrapped standard errors (99 replications). Estimates underpinned by ordered logit model either adjusted (Endogenous) for or not adjusted for (Exogenous) potential expenditure endogeneity and unobserved adequacy reference effects.

Table C.3: Estimate of equivalence scales based on food clothing and housing adequacy by household type, underpinned by binary logit model controlling for endogeneity

		Food Adequacy		Clothing Adequacy		Housing Adequacy	
Adults	Kids	Exogenous	Endogenous	Exogenous	Endogenous	Exogenous	Endogenous
1	0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1	0	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
1	1	1.3180	1.1790	1.1460	1.0920	1.1440	1.1490
1	1	(0.102)	(0.105)	(0.074)	(0.073)	(0.080)	(0.089)
1	2	1.4330	1.2560	1.2940	1.1790	1.2700	1.3000
1	2	(0.118)	(0.117)	(0.090)	(0.091)	(0.091)	(0.101)
1	3	1.6350	1.3870	1.4810	1.3030	1.4630	1.5330
1	3	(0.166)	(0.164)	(0.129)	(0.129)	(0.138)	(0.144)
1	4	1.9180	1.5330	1.5230	1.3370	1.5130	1.6270
1	4	(0.254)	(0.254)	(0.170)	(0.171)	(0.185)	(0.196)
2	0	1.3870	1.3380	1.4080	1.3590	1.1240	1.1770

2	0	(0.120)	(0.110)	(0.100)	(0.099)	(0.082)	(0.082)
2	1	1.8270	1.5780	1.6130	1.4850	1.2860	1.3520
2	1	(0.189)	(0.186)	(0.145)	(0.144)	(0.122)	(0.129)
2	2	1.9870	1.6800	1.8210	1.6030	1.4280	1.5300
2	2	(0.226)	(0.214)	(0.172)	(0.163)	(0.140)	(0.141)
2	3	2.2670	1.8560	2.0850	1.7710	1.6450	1.8050
2	3	(0.270)	(0.263)	(0.211)	(0.213)	(0.189)	(0.186)
2	4	2.6600	2.0520	2.1440	1.8180	1.7010	1.9150
2	4	(0.410)	(0.380)	(0.275)	(0.268)	(0.233)	(0.240)
3	0	1.6970	1.6110	1.9960	1.8030	1.1660	1.2720
3	0	(0.165)	(0.152)	(0.159)	(0.156)	(0.096)	(0.095)
3	1	2.2360	1.8990	2.2880	1.9690	1.3330	1.4610
3	1	(0.249)	(0.236)	(0.216)	(0.225)	(0.133)	(0.137)
3	2	2.4310	2.0230	2.5820	2.1260	1.4800	1.6530
3	2	(0.291)	(0.268)	(0.255)	(0.248)	(0.151)	(0.153)
3	3	2.7750	2.2350	2.9560	2.3490	1.7050	1.9500
3	3	(0.328)	(0.315)	(0.314)	(0.327)	(0.197)	(0.196)
3	4	3.2550	2.4700	3.0400	2.4110	1.7630	2.0690
3	4	(0.517)	(0.480)	(0.392)	(0.414)	(0.243)	(0.260)
4	0	2.1180	1.9310	2.1740	1.9990	1.3750	1.4930
4	0	(0.245)	(0.231)	(0.204)	(0.203)	(0.143)	(0.134)
4	1	2.7910	2.2770	2.4920	2.1840	1.5730	1.7150
4	1	(0.347)	(0.327)	(0.260)	(0.268)	(0.180)	(0.178)
4	2	3.0350	2.4240	2.8130	2.3570	1.7460	1.9400
4	2	(0.401)	(0.377)	(0.304)	(0.298)	(0.203)	(0.205)
4	3	3.4640	2.6780	3.2210	2.6040	2.0120	2.2890
4	3	(0.462)	(0.453)	(0.376)	(0.356)	(0.264)	(0.259)
4	4	4.0630	2.9610	3.3120	2.6740	2.0800	2.4280
4	4	(0.653)	(0.615)	(0.451)	(0.458)	(0.308)	(0.309)
5	0	2.3050	2.1120	2.1810	2.0460	1.3650	1.5230
5	0	(0.318)	(0.329)	(0.260)	(0.271)	(0.170)	(0.160)
5	1	3.0370	2.4900	2.5000	2.2350	1.5610	1.7490
5	1	(0.446)	(0.441)	(0.324)	(0.329)	(0.212)	(0.209)
5	2	3.3020	2.6520	2.8220	2.4130	1.7330	1.9790
5	2	(0.521)	(0.505)	(0.364)	(0.359)	(0.233)	(0.226)
5	3	3.7690	2.9290	3.2310	2.6660	1.9970	2.3340
5	3	(0.578)	(0.603)	(0.439)	(0.438)	(0.289)	(0.289)
5	4	4.4210	3.2380	3.3230	2.7370	2.0640	2.4770
5	4	(0.796)	(0.763)	(0.504)	(0.513)	(0.323)	(0.331)
6	0	2.4040	2.2630	2.3490	2.2230	1.8540	1.9410
6	0	(0.430)	(0.474)	(0.361)	(0.376)	(0.322)	(0.311)

6	1	3.1680	2.6690	2.6930	2.4280	2.1200	2.2300
6	1	(0.603)	(0.638)	(0.433)	(0.450)	(0.391)	(0.375)
6	2	3.4450	2.8420	3.0390	2.6210	2.3530	2.5230
6	2	(0.682)	(0.704)	(0.505)	(0.514)	(0.435)	(0.413)
6	3	3.9320	3.1400	3.4800	2.8960	2.7120	2.9760
6	3	(0.765)	(0.818)	(0.596)	(0.598)	(0.525)	(0.493)
6	4	4.6120	3.4710	3.5780	2.9730	2.8040	3.1570
6	4	(0.961)	(1.060)	(0.622)	(0.667)	(0.571)	(0.566)

Estimated equivalence scale by household type, and bootstrapped standard errors (99 replications). Estimates underpinned by binary logit model either adjusted (Endogenous) for or not adjusted for (Exogenous) potential expenditure endogeneity and unobserved adequacy reference effects.