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Differences Across Place and Time in Household Expenditure Patterns: Implications for the Estimation of Equivalence Scales

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Abstract

Equivalence scales are often used to adjust household income for differences in characteristics that affect needs. For example, a family of two is assumed to need more income than a single person, but not double due to economies of scale in consumption. However, in comparing economic well-being across countries and/or time, we ask whether it is appropriate to use the same equivalence scale if consumption expenditure patterns differ? We estimate equivalence scales for eight countries with data ranging from 1999 to 2012, using the same Engel approach in all cases. We find considerable variation in economies of scale across countries and some increases over time. Notably, we find that economies of scale are generally larger than those implied by the 'square root of household size' equivalence scale. Our results have important implications when deciding whether to use a common equivalence scale in comparisions of economic well-being across place and time.

Keywords: economic well-being; Engel; necessities; equivalence scale; economies of scale

JEL Codes: D12; I31

1. Introduction

Comparing economic well-being using income or expenditures, it is important to consider differences in needs by household size, composition and other characteristics. This is commonly done using equivalence scales, which transform households to 'equivalent individuals' (Atkinson, 2019; Buhmann et al., 1988; Organisation for Economic Co-operation and Development (OECD), 2013; Ravallion, 2016; World Bank, 2018).[1] Equivalence scales may be simple adjustments based on per capita income (i.e. dividing income or expenditures by household size). However, this approach fails to account for household economies of scale in consumption (e.g. a family of two needs more income than a single person, but not twice as much), and it does not account for different needs of adults and children within the household. More rigorous, demand system approaches incorporate the characteristics of households and consumption bundles under consideration, as well as the assumptions underlying the theory and estimation of equivalence scales (Banks et al., 1994; Banks et al., 1997; Blundell and Lewbel, 1991; Browning et al., 2013). Subjective and expert equivalence scales have also been used to transform households to 'equivalent individuals' (Bishop et al., 2014; Brázdilová and Musil, 2017; Citro and Michaels, 1995; De Vos and Zaidi, 1997; Garner and Short, 2003). The latter includes the widely accepted 'square root of household size' equivalence scale (Buhmann et al., 1988) and OECD-modified equivalence scale whereby each household is assigned a value proportionate to its needs: the head of the household is assigned a value of one, plus 0.5 for each adult and 0.3 for each child (OECD, 2013). Each approach has advantages and limitations, yielding different estimates of economies of scale, and thus different estimates of economic well-being. For example, Bishop et al. (2014) find larger economies of scale in subjective equivalence scales compared to those implicit in the expert, OECD-modified equivalence scale. Comparing income poverty using the two types of scales, Bishop et al. (2014)

[1] Equivalence scales are not the only approach that can be used. Refer to Decancq et al. (2015) for a discussion of the alternatives.

conclude that subjective scales redistribute poverty from larger to smaller families. Moreover, Burniaux et al. (1998) find that, while the level and distribution of poverty are sensitive to the choice of equivalence scale, comparisons across countries and time are less affected.

Indeed, a common equivalence scale is often used to compare economic well-being across place and time. However, this may not accurately reflect differences in economic well-being if the distribution of spending on necessities by household size varies across countries. For example, based on reference budgets and their role in poverty measurement, Goedemé et al. (2019, p. 14) highlight the importance of country-specific equivalence scales in cross-country comparisons when "economies of scale vary substantially across countries or if the provision and subsidization of essential goods and services vary in important respects within or across countries." Using a common equivalence scale to compare economic well-being is also problematic if spending on necessities by household size varies across time, or if expenditure patterns change at different rates across place and time. To better understand the extent to which expenditure patterns vary across place and time (and thus to better understand whether it is appropriate to use a common equivalence scale in comparing economic well-being across these dimensions), we estimate equivalence scales at different points in time for a diverse set of countries, including some that have received less attention in the literature (e.g. South Africa, Taiwan). Our equivalence scales are produced using an Engel approach. We do not claim this is the 'best' way to estimate equivalence scales, rather we use this simple approach to facilitate comparisons across time and place.[2] As precedent, this approach has long been used by Statistics Canada to estimate differences in needs by household size for low income cut-offs (Statistics Canada, 2012) and other cross-country

[2] Limitations of the Engel approach abound (Deaton and Muellbauer, 1980; Ravallion, 2016; Lewbel and Pendakur, 2008; Browning et al., 2013). For example, contemporary equivalence scales are based on cost functions derived from consumer demand data. Lewbel and Pendakur (2008, p. 3) find that reconciling Engel scales with contemporary scales "requires strong restrictions regarding the dependence of demand functions on characteristics such as age and family size, and on the links between demand functions and utility for these different household types."

comparisons. For example, Phipps and Garner (1994) use an Engel approach to compare equivalence scales in Canada and the United States (US).

Indeed, some of the earliest equivalence scales were based on Engel's observation that poorer families spend a greater share of income on food than richer ones. Further, for a given level of income, larger families spend a greater share of income on food than smaller ones (Engel, 1883; Engel, 1895). Thus, an Engel methodology can be used to estimate equivalence scales assuming the share of income spent on food is indicative of economic well-being (i.e. families that devote the same share of income to food are equally well-off). The share of income spent on food may be regarded as fixed at a point in time for a given household size or, at the very least, less susceptible to differences in preferences and resources than total household consumption.

We generalize the original Engel approach to include the necessities of food, housing, clothing and health care, which may differ in the economies of scale they provide (e.g. housing versus clothing). Moreover, even within a given category, economies of scale may vary across place and time. For example, there may be fewer economies of scale in housing if children of opposite sex are not legally allowed to share a bedroom. Likewise, there may be fewer economies of scale in food if single parents and/or dual-earner couples are prevalent. For example, time shortages may necessitate pre-packaged, ready-made meals instead of home-cooked meals that are more amenable to sharing (e.g. a turkey or large pot of soup). There may also be differences across place and time in the nature and availability of necessities, with important implications for economies of scale. For example, high-quality clothing can be passed from one child to the next, but this may be limited by trends toward low-quality 'disposable clothing' (Tan, 2016). Moreover, the introduction of some new necessities may provide economies of scale (e.g. home Internet), while others may not (e.g. cell phones). Finally, differences across place and time in the relative prices of necessities affect how much extra income larger families need to have the

same standard of living as a single person.[3] For example, if food is relatively expensive and housing is relatively inexpensive, then economies of scale may be smaller compared to a situation in which the opposite is true.

To better understand whether it is appropriate to use a common equivalence scale in comparing economic well-being across place and time, we use an Engel methodology to estimate equivalence scales in several countries and time periods, considering household spending on three consumption bundles: (1) food; (2) food, housing and clothing; (3) food, housing, clothing and health care. We examine relative income needs by looking at the shapes of the equivalence curves across household size, as well as smoothed single-parameter estimates. As expected, we find that equivalence scales differ across consumption bundles; for most countries, economies of scale are larger when considering necessities other than food. Moreover, for all consumption bundles, we find considerable differences in estimated economies of scale across countries. We also find that economies of scale have generally increased over time and, indeed, our single-parameter equivalence scales imply larger economies of scale than the widely accepted 'square root of household size' (Buhmann et al., 1988). Our results indicate that using one equivalence scale to compare economic well-being across place and/or time may be misleading.

In what follows, we describe our data and methodology. We then discuss results, which include descriptive statistics, equivalence scales by household size and single-parameter equivalence scales. In Section 4, we conclude.

[3] We assume that individuals who live in the same household have the same standard of living, but we acknowledge this is not always the case (Burton et al., 2007).

2. Data and Methodology

We consider comparisons between Canada and the US, as well as France, Israel, Poland, South Africa, Switzerland and Taiwan. We selected countries for which we had data on both income and expenditures for at least two years. Another criterion was the availability of before-tax income because we do not observe after-tax income in the US.[4] Table 1 summarizes the source and availability of data by country. Data for Canada come from public-use files of the Survey of Household Spending, which is administered by Statistics Canada.[5] Data for the US come from the Bureau of Labor Statistics, Consumer Expenditure Survey. All other data come from the LIS Data Center (www.lisdatacenter.org), which is an archive of harmonized survey data on income and wealth across countries. Expenditure data are also included in the harmonization as available.[6] LIS data have been collected for over three decades and are available for almost 100 countries. Our data range from 1999 to 2012, however this varies by country. For example, data for Poland are available in 1999, 2004, 2007 and 2010, whereas data for South Africa are available in 2008 and 2010. Likewise, data for Canada are available from 2004 to 2009, whereas data for the US are available from 2004 to 2012. For the US, we focus on data since 2004 because this is when the Bureau of Labor Statistics began to impute missing before-tax income for the US and we wanted to ensure the greatest comparability across countries.[7]

[Table 1]

Household-level data on income and expenditures are recorded via interviews, diaries and sometimes both. For example, in Canada, respondents are first interviewed, then they keep a diary of expenditures

[4] During the study period, "[self-]reported income tax data were not accurate enough for economic analysis" (Bureau of Labor Statistics, 2015, p. 36). The Bureau of Labor Statistics started to impute federal, state and local income tax in quarter two of 2013, so after-tax income is available in more recent years.
[5] Our data are not comparable with the Survey of Household Spending after 2009 because of a major re-design.
[6] See Sierminska and Garner (2005) for an early comparison of expenditures using LIS data.
[7] The Bureau of Labor Statistics accounts for missing income using multiple imputation techniques. It produces and recommends using five imputations to account for variability in the imputation process (Bureau of Labor Statistics, 2018). In what follows, we use the mean of the five imputations.

by all household members for a one- to two-week period. Income data are recovered from tax files with respondents' permission. In the US, households were interviewed quarterly over a 12-month period.[8] Our analysis is based on annual income and expenditures, so we only include households that are observed for four quarters. For example, we defined the 2004 sample to include households observed in quarters one to four of 2004, as well as households observed from quarter two of 2004 to quarter one of 2005 since most of their expenditures refer to the year 2004. Expenditures are summed over the four quarters and annual income is reported in the last interview.

For all countries, 'income' consists of before-tax earnings, transfer payments, investment income and other sources (e.g. pensions, scholarships, child support). 'Expenditures' are outlays on goods and services for private use, including tax and transaction costs. We consider three consumption bundles: (1) food; (2) food, housing and clothing; (3) food, housing, clothing and health care.[9] The first bundle is consistent with the original Engel methodology. The second bundle is similar to the definition of necessities used in the estimation of low income cut-offs in Canada (Statistics Canada, 2012) and US Supplemental Poverty Measure (Dalaker, 2017).[10] The third bundle includes health care, the private cost of which differs across place and time, and thus is important for comparisons of economic well-being.

The consumption bundles used in this study limit cross-country differences in the definition of necessities. However, they are broad enough to accommodate some differences. For example, snow shovels are necessary in most of Canada, but generally not in Israel, South Africa or Taiwan. On the

[8] Prior to 2015, the Bureau of Labor Statistics collected expenditure data over five consecutive quarters, with data from the first interview being used for bounding but not estimation. Beginning in 2015, only four quarters of data are collected with no bounding.

[9] 'Food' includes that purchased from stores and prepared at home, excluding alcohol. 'Housing' includes rent, mortgage principal and interest (imputed rent in LIS data), property taxes, maintenance and repairs, insurance premiums, telecommunications and utilities. 'Clothing' includes outerwear, footwear and accessories, but not dry cleaning or laundry services. 'Health care' consists of direct expenditures on goods and services, as well as insurance premiums (except in LIS data). LIS data follows the classification of individual consumption by purpose.

[10] We do not include food from restaurants, which is consistent with low income cut-offs in Canada. In contrast, 'food away from home', including that purchased from restaurants, is included in the US Supplemental Poverty Measure (Office of Management and Budget, 2010).

other hand, 'clothing' includes snow boots and parkas. Differences in relative prices are also captured to some extent, as well as important institutional factors. For example, some countries have public health care. At the same time, there may be economies of scale in private health insurance since many providers offer family plans.

2.1 Equivalence Scales by Household Size

We estimate equivalence scales by household size based on the approach used by Statistics Canada to estimate low income cut-offs (Statistics Canada, 2012). Phipps and Garner (1994) use a similar approach to compare equivalence scales in Canada and the US. With household-level data, we start by estimating Equation 1 for each country. We do so using Ordinary Least Squares (OLS) regressions with robust standard errors and normalized sampling weights.

$$lnEXP = \beta_0 + \beta_1 lnY + \sum_{j=2}^{6} \gamma_j SIZE\, j + \boldsymbol{\alpha X} + \varepsilon \quad [1]$$

EXP is real spending on necessities, defined by each of the three consumption bundles. Y is real before-tax household income. $SIZE$ is a set of dummy variables to indicate household size. The base is a single person. $\boldsymbol{X}$ includes rural/urban residence, region and time. β_0, β_1 and γ_j and $\boldsymbol{\alpha}$ are parameters to be estimated. ε is the error term.

Rearranging the predicted values, we find an expression for log income share devoted to necessities, as outlined in Equation 2 where $SHARE$ equals EXP divided by Y.

$$lnSHARE = \beta_0 + (\beta_1 - 1)\, ln\, Y + \sum_{j=2}^{6} \gamma_j SIZE\, j + \boldsymbol{\alpha X} \quad [2]$$

All else constant, a household with j members and Y_j income will be equally well-off as a single person with Y_1 if Equation 3 holds.

$$\beta_0 + (\beta_1 - 1)\, ln\, Y_1 + \boldsymbol{\alpha X} = \beta_0 + (\beta_1 - 1)\, ln\, Y_j + \gamma_j + \boldsymbol{\alpha X} \quad [3]$$

Cancelling and rearranging terms, we find the equivalence scale for a household with j members. As outlined in Equation 4, it indicates the relative income needed to spend the same share on necessities, and thus have the same economic well-being, as an otherwise similar single person.

$$\frac{Y_j}{Y_1} = e^{\frac{\gamma_j}{1-\beta_1}} \quad [4]$$

Using the OLS estimates for each country, we evaluate Equation 4 by household size with the respective dummy variable coefficient (γ_j) and coefficient on income (β_1). Suppose that $\frac{Y_2}{Y_1} = e^{\frac{\gamma_2}{1-\beta_1}}$ = 1.4. This would imply that a family of two needs 1.4 times (40 percent) more income to spend the same share on necessities, and thus have the same economic well-being, as a single person.

2.2 Single-Parameter Equivalence Scales

Next, we estimate single-parameter equivalence scales, which smooth across household size. They are useful for comparing levels, rather than shapes of the equivalence curves. This approach is consistent with the widely accepted 'square root of household size' equivalence scale (Buhmann et al., 1988).[11] Based on this methodology, we estimate Equation 5 using OLS regressions with robust standard errors and normalized sampling weights. We do so for each country with a pooled sample and by year.

$$lnEXP = \beta_0 + \beta_1 lnY - \beta_2 lnSIZE + \boldsymbol{\alpha X} + \varepsilon \quad [5]$$

Here, $SIZE$ is a continuous measure of household size that is top-coded at six. Rearranging the predicted values, we find an expression for log income share devoted to necessities, as outlined in Equation 6.

$$lnSHARE = \beta_0 + (\beta_1 - 1)\, ln\, Y - \beta_2 lnSIZE + \boldsymbol{\alpha X} \quad [6]$$

[11] See Coulter et al. (1992), Jenkins and Cowell (1994) for a discussion of parameterized equivalence scales.

All else constant, a household with j members and Y_j income will be equally well-off as a single person with Y_1 if Equation 7 holds.

$$\beta_0 + (\beta_1 - 1)\, ln\, Y_1 + \boldsymbol{\alpha X} = \beta_0 + (\beta_1 - 1)\, ln\, Y_j - \beta_2 lnj + \boldsymbol{\alpha X} \quad [7]$$

Cancelling and rearranging terms, Equation 8 is the single-parameter equivalence scale for a household with j members.

$$\frac{Y_j}{Y_1} = j^{\frac{\beta_2}{\beta_1 - 1}} \quad [8]$$

Using OLS estimates of Equation 5, we evaluate Equation 8 with the coefficients on household size and income (β_2 and β_1, respectively). We do so for each country with a pooled sample and by year. Suppose that $\frac{\beta_2}{\beta_1 - 1}$ = 0.6. This would imply that a family of two needs $2^{0.6}$= 1.52 times (52 percent) more income to spend the same share on necessities, and thus have the same economic well-being, as a single person. A family of three would need $3^{0.6}$= 1.93 times (93 percent) more income, and so on.

3. Results

3.1 Descriptive Statistics

Table 2 outlines the average share of income spent on food, housing, clothing, and health care in each country during the study period. We find that households in Poland and South Africa spend a relatively large share of income on food (25.9 and 26.7 percent, respectively), especially compared to Switzerland (8.7 percent) and the US (9.8 percent). On the other hand, households in the US spend a large proportion of income on housing and health care (25.6 and 6.1 percent, respectively), while those in South Africa spend the least. Table 2 also indicates that households in Canada, France, and Taiwan spend a large share of income on housing, clothing and health care, respectively.

[Table 2]

3.2 Equivalence Scales by Household Size

We first compare results for Canada and the US, followed by comparisons with other countries. We do this because the consumption bundles are most similar in Canada and the US, and these two countries have more overlapping years of data.

3.2.1 Comparisons between Canada and the US

Figures 1 and 2 depict equivalence scales by household size for Canada and the US. Scales are reported separately for the three consumption bundles: (1) food; (2) food, housing, and clothing; (3) food, housing, clothing, and health care. Appendix Table 1 contains the coefficients upon which these scales are based (i.e. country-specific coefficients on income and household size from OLS regressions of Equation 1).

[Figures 1 to 2]

In both countries, economies of scale are smaller when the consumption bundle includes only food. Moreover, economies of scale for food are smaller in Canada. For example, a family of four spends 2.9 times as much on food as a single person, compared to 2.4 in the US. Similarly, a family of six spends 4.1 times as much on food as a single person, compared to 3.1 in the US. This is unexpected given longer hours of paid work in the US (Burton and Phipps, 2007), which may lead families to purchase more pre-packaged, ready-made meals with limited economies of scale. However, if families eat out more (instead of purchasing pre-packaged meals, ready-made meals), the lower estimate for the US may be explained by the exclusion of 'food away from home' from the analysis. Another explanation for the difference between Canada and the US could be that food prices are considerably higher in Canada relative to the US (Gopinath et al., 2011). This is consistent with Table 2, which indicates that Canadian households spend a larger proportion of income on food.

Also shown in Figures 1 and 2, economies of scale increase when housing and clothing are added to the consumption bundle. For example, a Canadian family of six spends 2.5 times as much on food, housing and clothing as a single person, compared to 4.1 on food. Likewise, in the US, a family of six spends 2.1 times as much on food, housing and clothing as a single person, compared to 3.1 on food. Economies of scale remain larger in the US, which may reflect lower prices or buying in bulk. However, there are fewer differences between Canada and the US with larger consumption bundles, compared to the bundle that includes only food. These results are consistent with those of Goedemé et al. (2019) regarding equivalence scales that are implicit in reference budgets for European cities: as housing cost shares increase, the relative cost of additional household members decreases, resulting in flatter implicit equivalence scales.

Finally, in the US, economies of scales increase when health care is added to the consumption bundle, perhaps due to family plans in private health insurance. Out-of-pocket spending on health care is much lower in Canada in the presence of public health care (Table 2). Although many Canadian households purchase extended coverage with economies of scale in family plans, the major components of out-of-pocket spending are prescription drugs and dental care (Sanmartin et al., 2014), which are per-person expenditures. Also, differences in equivalence scales that include health care may reflect the additional costs faced by people with disabilities, some of which are not covered by health insurance and thus must be paid out-of-pocket. This issue is alluded to by Atkinson (2019).

3.2.2 Comparisons between Canada, the US and Other Countries

Next, we expand our analysis beyond North America to consider France, Israel, Poland, South Africa, Switzerland and Taiwan. Figures 3 to 8 depict equivalence scales by household size for these countries, separately for the three consumption bundles. Again, Appendix Table 1 contains the coefficients upon which these scales are based.

[Figures 3 to 8]

We find that economies of scale are quite different across countries. For example, based on the consumption bundle of food, housing, clothing and health care, a family of two needs between 27.9 (Canada) and 59.8 (Israel) percent more income to have the same economic well-being as a single person. The mean is 43.1 percent. Equivalence scales also differ across countries for larger families, but the rates at which needs increase by household size are not constant. Moreover, the highs and lows occur in different countries. For example, based on the consumption bundle of food, housing, clothing and health care, the equivalence scale for a four-person household is lowest in Switzerland at 1.54 and highest in Taiwan at 2.38. The estimate for Taiwan is an outlier, while the next highest equivalence scale occurs in France, where a four-person household needs 89 percent more income to have the same economic well-being as a single person. Bishop et al. (2014) note that such differences may reflect differences in the generosity of welfare states.

3.2.3 Comparisons between Canada and the US across Time

In addition to comparisons across countries, it is important to consider how temporal changes in consumption affect economies of scale. Thus, Figure 9 contains equivalence scales by household size for Canada and the US across time, comparing our estimates to those from 1986-1988 based on Phipps and Garner (1994).[12] We find that economies of scale increased over time in both countries, and gains were generally larger in Canada. For example, a Canadian family of three spent 76 percent more than a single person on food, housing, clothing and health care in 1986. This decreased to 57 percent in 2004-2009. In the US, a family of three spent 62 percent more than a single person on food, housing, clothing and health care in 1986-1988, compared to 52 percent in 2004-2012. Changes in economies of scale may be

[12] We use before-tax income, while Phipps and Garner (1994) use after-tax income. Moreover, household size is top-coded at six in our data, versus seven in Phipps and Garner (1994). Thus, we use the average for households of six and seven in comparing their equivalence scales to our estimates.

explained by changes in consumption across time, as evidenced by comparing Table 2 to Phipps and Garner (1994). Specifically, there was a reduction in spending on necessities with smaller economies of scale (i.e. food, clothing), as well as an increase in spending on necessities with larger economies of scale (i.e. housing, health care). Moreover, changes in consumption were generally larger in Canada.

[Figure 9]

Taken together, these findings suggest that economies of scale vary across place and time. Thus, using a common equivalence scale in cross-country and/or temporal comparisons may be inappropriate. For example, if economies of scale are overstated, the relative poverty experienced by larger versus smaller families may be understated. We also find that economies of scale vary by consumption bundle and household size. Thus, using single-parameter equivalence scales (which smooth across household size) may be misleading for some purposes, such as estimating the needs associated with having an additional child.

3.3 Single-Parameter Equivalence Scales

Yet, single-parameter equivalence scales are useful for comparing needs by household size in terms of levels, rather than shapes of the curves; they smooth across household size. They are also appropriate if differences in equivalence curves result from cross-country anomalies in household composition or other factors that are not directly relevant to the comparison. Table 3 contains the coefficients on income and household size from OLS regressions of Equation 5, and the associated single-parameter equivalence scales. We continue to probe differences across place and time by providing estimates for each country and year, in addition to a pooled sample for each country.

[Table 3]

3.3.1 Comparisons between Countries

The widely-accepted 'square root of household size' equivalence scale (Buhmann et al., 1988) corresponds to $\frac{\beta_2}{\beta_1 - 1}$ = 0.5 in Equation 8. This implies that a family of four needs double the income of a single person ($4^{0.5}$= 2) to have the same economic well-being. Estimates less than 0.5 indicate larger economies of scale. For example, in the US, the equivalence scale equals 0.37 based on the consumption bundle of food, housing, clothing and health care. This implies that a family of four needs 67 percent more income ($4^{0.37}$ = 1.67) than a single person. Except Taiwan, equivalence scales are consistently less than 0.5, ranging from 0.246 in South Africa to 0.465 in Israel. Moreover, the relationship of needs to household size is steeper in Canada, France, Israel and Poland. It is flatter in South Africa, Switzerland and the US. Economies of scale are especially large in South Africa. For example, based on the consumption bundle of food, housing, clothing and health care, a family of four needs 41 percent more income ($4^{0.246}$ = 1.41) to have the same economic well-being as a single person. This is consistent with Figure 6 and Appendix Table 1, which indicate that needs actually decline with household size for larger families. It is possible that consumption bundles contain discretionary spending among smaller South African families, and thus do not represent basic needs.

3.3.2 Comparisons across Time

In addition to the pooled sample for each country, we estimate single-parameter equivalence scales by year. We find negligible changes across time in countries for which we have many years of data (i.e. Canada, Poland, the US). Presumably, this differs from our comparison with Phipps and Garner (1994) because we do not have a long horizon over which to assess changes in single-parameter equivalence scales.

4. Conclusions

We use an Engel methodology to assess differences in economies of scale across place and time, with important implications for comparisons of economic well-being. For example, if economies of scale are overstated, the relative poverty experienced by larger versus smaller families may be understated. For each country, we examine the distribution of needs by considering the shapes of the equivalence curves across household size, as well as smoothed single-parameter estimates. We do so using three consumption bundles: (1) food; (2) food, housing and clothing; (3) food, housing, clothing and health care.

We find that equivalence scales differ across consumption bundles, such that economies of scale are larger when considering necessities other than food. This occurs in every country except South Africa, where consumption bundles likely include discretionary spending among smaller families, and thus do not represent basic needs. It is also interesting to note that, in the US, economies of scale increase when health care is added to the consumption bundle. In future work, it would be interesting to consider groups for whom health care may have a greater impact, such as the elderly and/or disabled (Morciano et al., 2015). It is also important to consider the effect of health care policy on economic well-being, such as the Patient Protection and Affordable Care Act, implemented in the US after our study period.

For all consumption bundles, we find important differences in economies of scale across countries. This is important when deciding whether to use a common equivalence scale in cross-country comparisons. For example, based on the consumption bundle of food, housing, clothing and health care, additional needs for a family of two range from 27.9 percent (Canada) to 59.8 percent (Israel). Similarly, for a family of four, additional needs range from 54.3 percent (Switzerland) to more than double (Taiwan). In fact, we find that additional needs not only vary across countries for a given household size, but across

household size for a given country. For example, the relationship of needs to household size is steeper in Canada, France, Israel and Poland. It is flatter in South Africa, Switzerland and the US.

Despite these differences, there are some cross-country similarities in the distribution of needs by household size. For example, except the consumption bundle that includes only food, most single-parameter equivalence scales are less than 0.5. This implies larger economies of scale than the widely-accepted 'square root of household size'. Thus, contemporary comparisons might be more accurate if a lower parameter is used. This coincides with our finding that economies of scale have increased over time, as suggested by the comparison with Phipps and Garner (1994), despite being roughly constant in the short run.

Our equivalence scales reflect differences in needs by household size, and thus economies of scale in the consumption of necessities. This is similar to the widely-accepted 'square root of household size' equivalence scale. In contrast, the equivalence scales recommended for poverty measurement in the US account for both economies of scale in consumption, as well as the different needs of adults and children within the household (Citro and Michaels, 1995; Office of Management and Budget, 2010). Future comparisons of equivalence scales across place and time should consider household composition (e.g. number of adults and children) and other characteristics that affect relative income needs such as age, gender, health, education and labor market status. For example, children of different ages have different needs (Blundell and Lewbel, 1991), as do men and women (Haddad and Kanbur, 1990; Ravallion, 2016; World Bank, 2018). Such differences could be related to developmental consumption needs or to bargaining power within the household (Browning et al., 2013). Also, purchasing power parity could be used to account for cross-country differences in prices.

Of course, comparisons of economic well-being are imperfect because we cannot account for the myriad of ways in which countries differ, including institutional differences and measurement issues across

surveys. We also recognize that necessities differ across place and time with important implications for economies of scale (e.g. home Internet, cell phones, food from restaurants). Moreover, our equivalence scales do not provide information about the welfare derived from spending on necessities or the views of families on their needs. Although we do not claim that an Engel approach is the 'best' way to estimate equivalence scales, our work shows that cross-country comparisons should be done with care. Using a common equivalence scale may simplify the analysis, but can provide misleading results in comparisions of economic well-being.

[Appendix Table 1]

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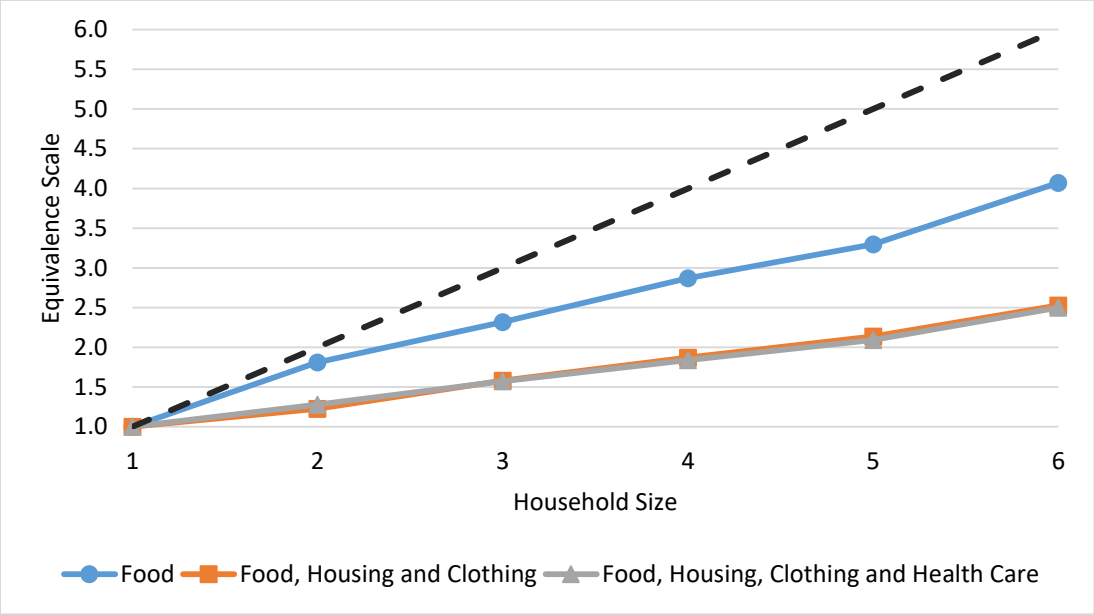
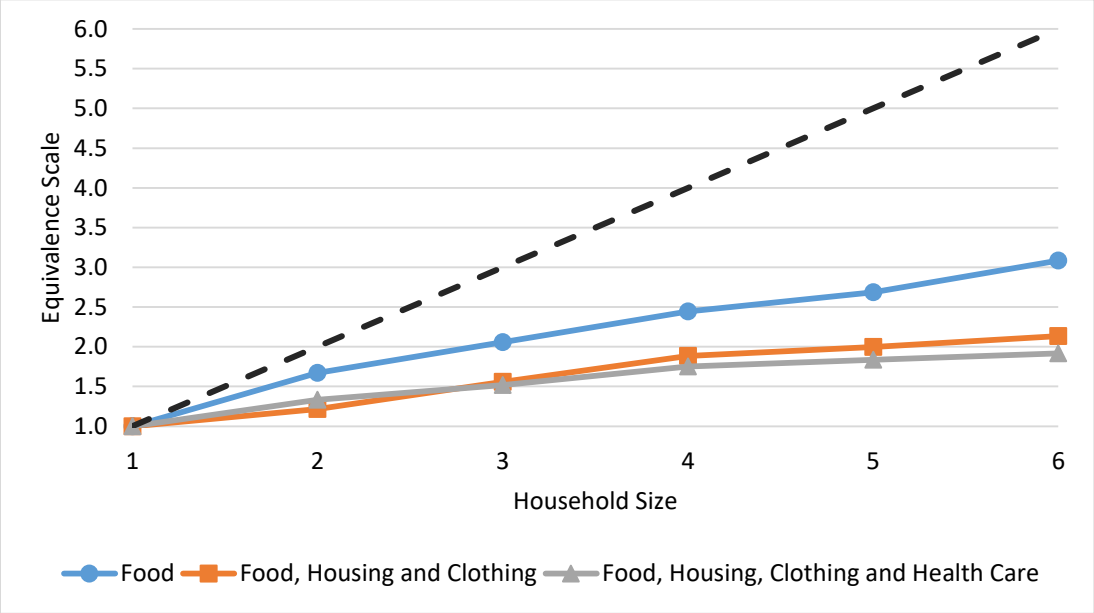
Figure 1. Equivalence Scales by Household Size for Canada



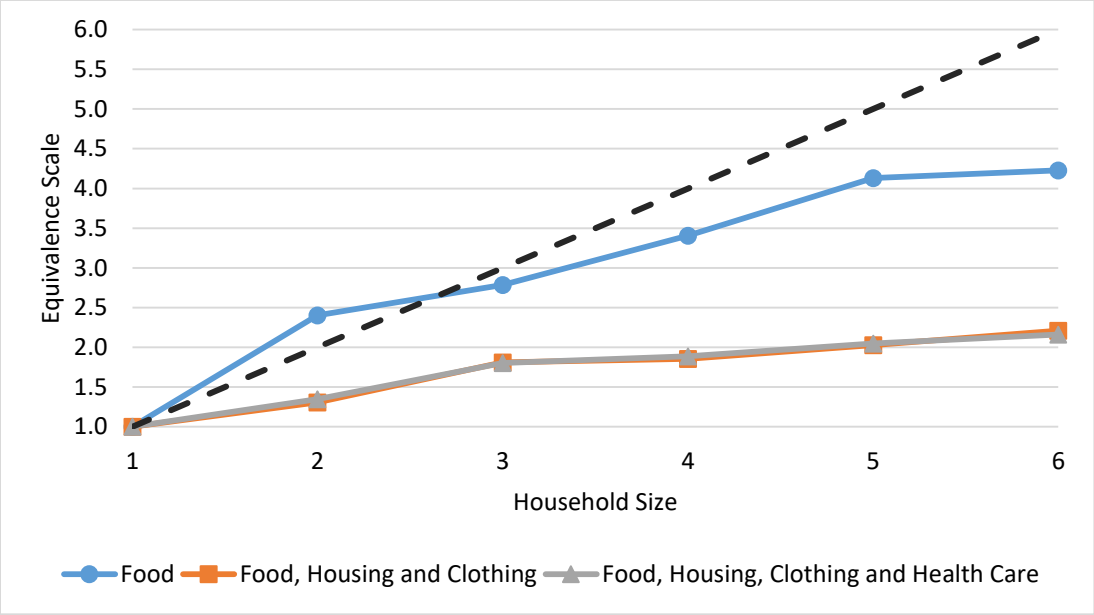
Note: The 45-degree dotted line indicates no economies of scale. Source: Survey of Household Spending.

Figure 2. Equivalence Scales by Household Size for the US



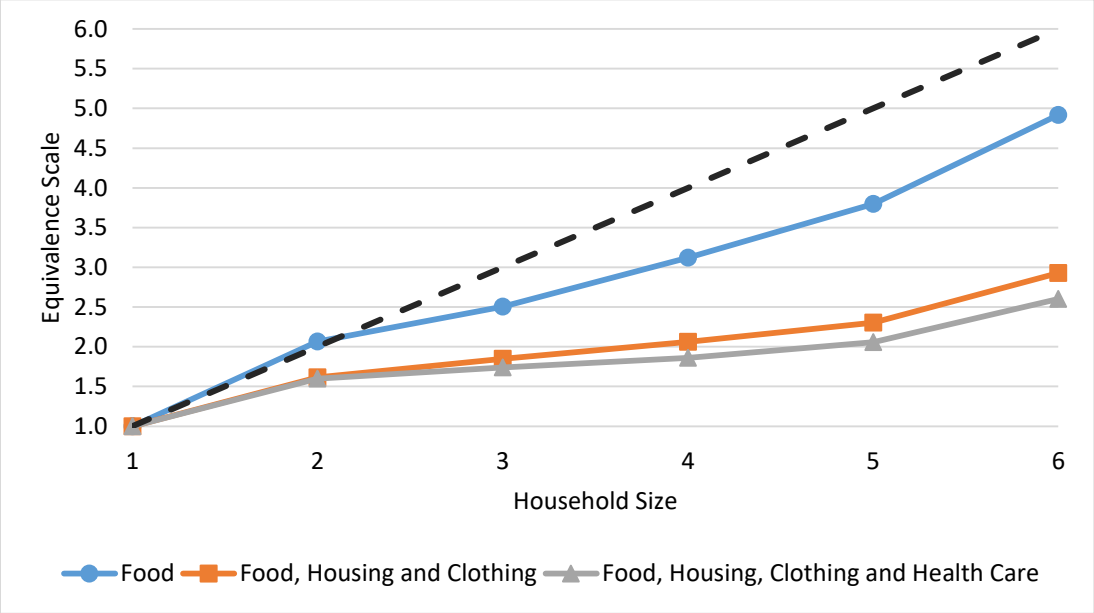
Note: The 45-degree dotted line indicates no economies of scale. Source: Consumer Expenditure Survey.

Figure 3. Equivalence Scales by Household Size for France



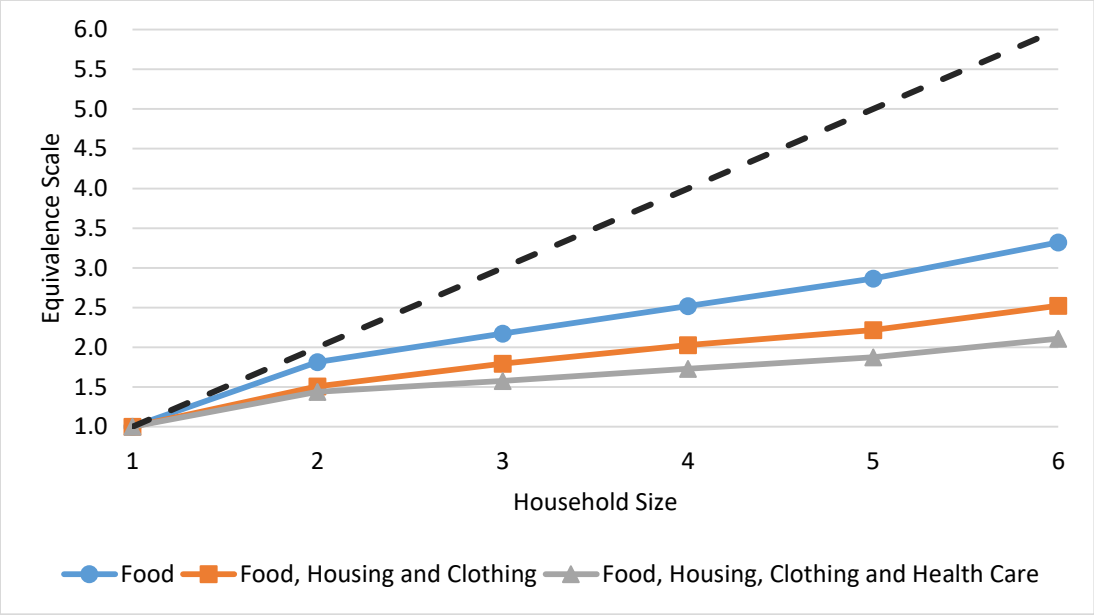
Note: The 45-degree dotted line indicates no economies of scale. Source: LIS Data Center.

Figure 4. Equivalence Scales by Household Size for Israel



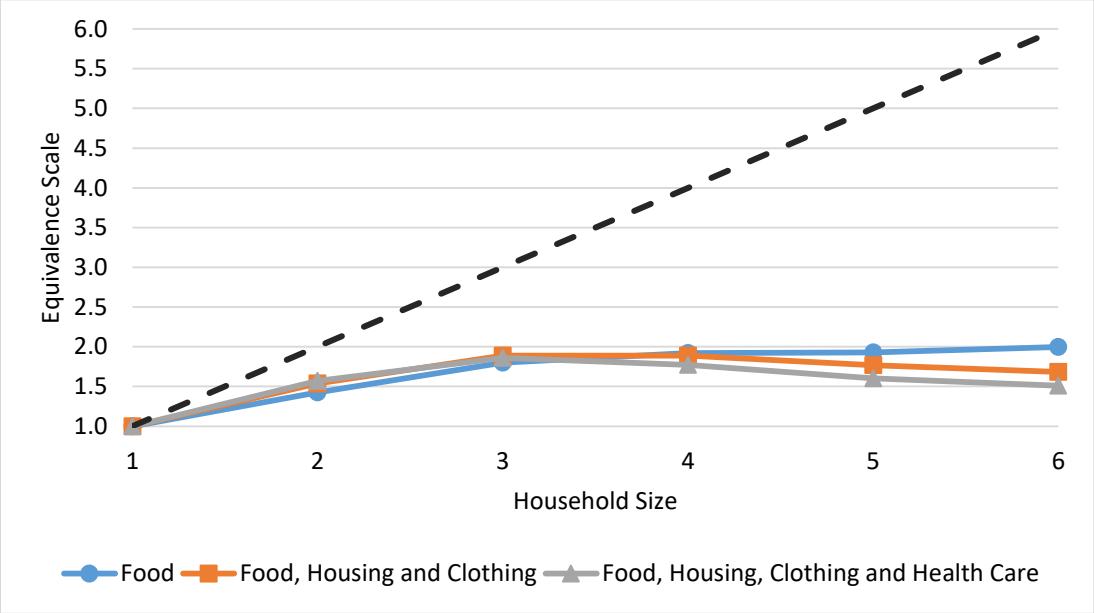
Note: The 45-degree dotted line indicates no economies of scale. Source: LIS Data Center.

Figure 5. Equivalence Scales by Household Size for Poland



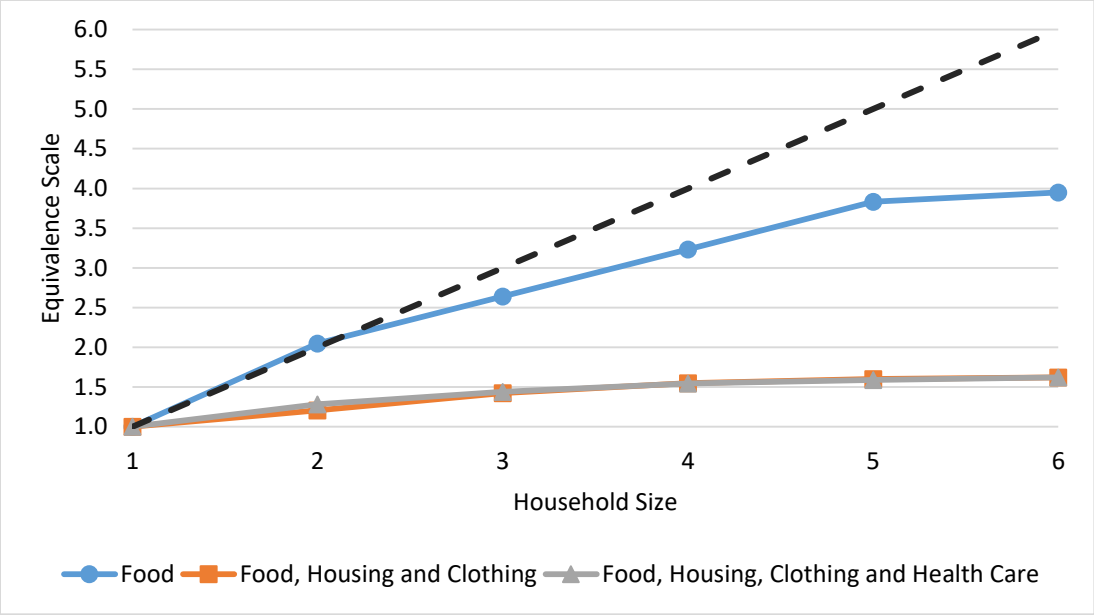
Note: The 45-degree dotted line indicates no economies of scale. Source: LIS Data Center.

Figure 6. Equivalence Scales by Household Size for South Africa



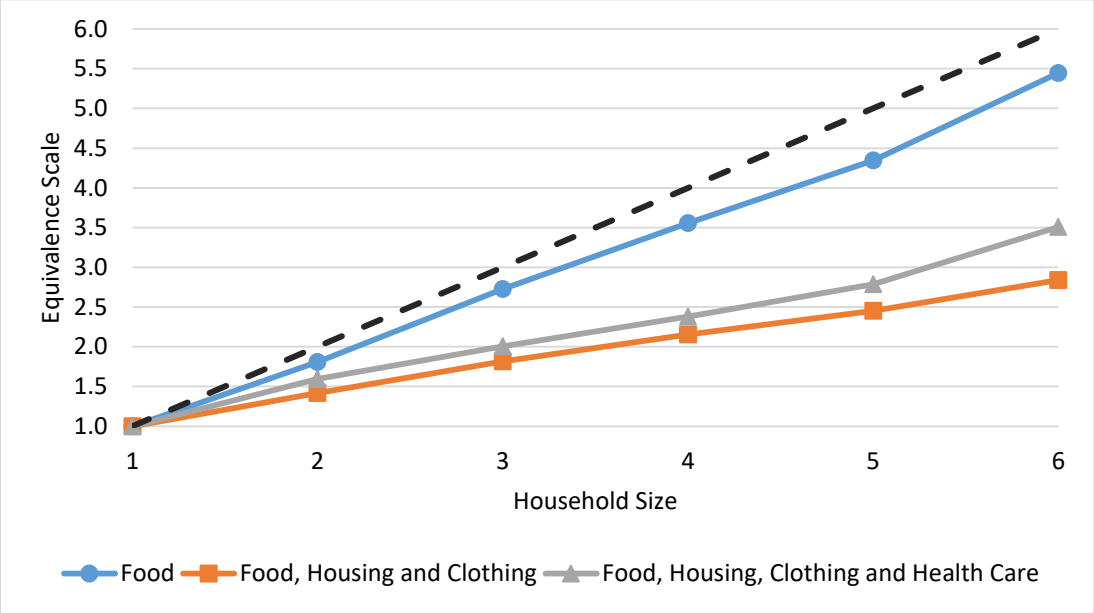
Note: The 45-degree dotted line indicates no economies of scale. Source: LIS Data Center.

Figure 7. Equivalence Scales by Household Size for Switzerland



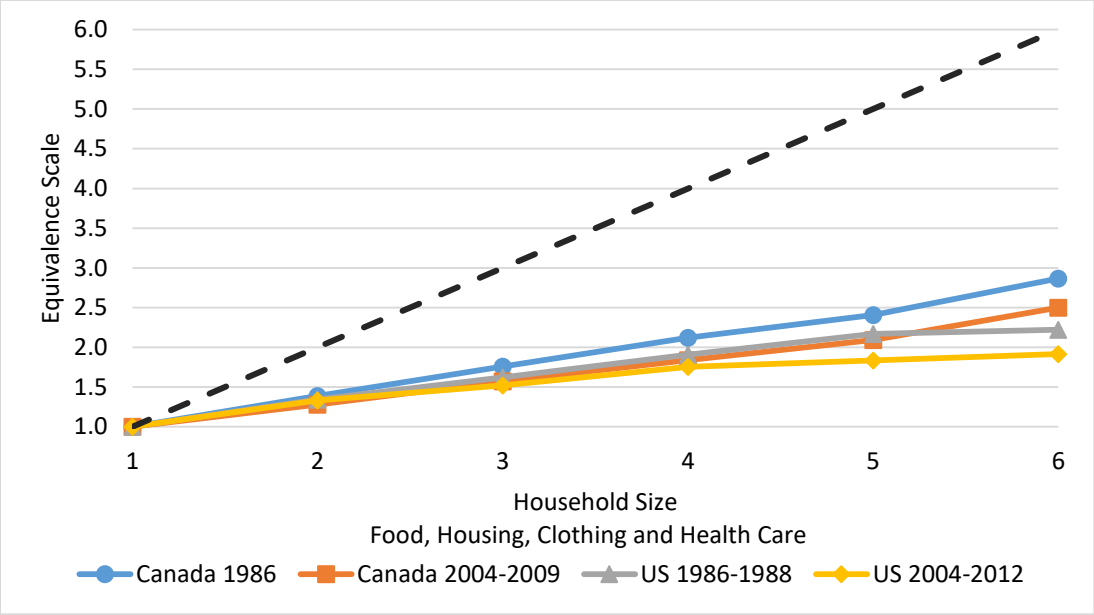
Note: The 45-degree dotted line indicates no economies of scale. Source: LIS Data Center.

Figure 8. Equivalence Scales by Household Size for Taiwan



Note: The 45-degree dotted line indicates no economies of scale. Source: LIS Data Center.

Figure 9. Equivalence Scales by Household Size for Canada and the US across Time



Note: The 45-degree dotted line indicates no economies of scale. Source: Survey of Household Spending, Consumer Expenditure Survey, Phipps and Garner (1994).

Table 1. Source and Availability of Data by Country

Country	Source	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Canada	Survey of Household Spending						X	X	X	X	X	X			
France	Family Budget Survey via LIS Data Center		X					X							
Israel	Household Expenditure Survey via LIS Data Center			X						X			X		
Poland	Household Budget Survey via LIS Data Center	X					X			X			X		
South Africa	National Income Dynamics Study via LIS Data Center										X		X		
Switzerland	Income and Consumption Survey via LIS Data Center		X		X		X								
Taiwan	Survey of Family Income and Expenditure via LIS Data Center		X					X							
US	Consumer Expenditure Survey						X	X	X	X	X	X	X	X	X

Table 2. Share of Income Spent on Necessities by Country

Country	Food	Housing	Clothing	Health Care
Canada (n=64,733)	10.308 (0.039)	23.194 (0.077)	3.750 (0.018)	3.274 (0.021)
France (n=18,228)	15.964 (0.078)	11.324 (0.153)	5.698 (0.056)	3.487 (0.055)
Israel (n=16,991)	16.693 (0.116)	10.903 (0.105)	3.231 (0.045)	3.647 (0.054)
Poland (n=128,957)	25.877 (0.037)	16.637 (0.035)	3.984 (0.017)	4.385 (0.018)
South Africa (n=9,749)	26.669 (0.326)	8.232 (0.200)	2.029 (0.110)	1.705 (0.094)
Switzerland (n=10,433)	8.741 (0.060)	15.045 (0.139)	2.871 (0.043)	3.717 (0.088)
Taiwan (n=25,115)	18.968 (0.052)	20.029 (0.067)	2.738 (0.011)	8.451 (0.052)
US (n=34,836)	9.811 (0.037)	25.585 (0.077)	1.913 (0.011)	6.128 (0.039)

Note: Standard errors are reported in parentheses. Source: Survey of Household Spending, LIS Data Center, Consumer Expenditure Survey.

Table 3. Single-Parameter Equivalence Scales

Country	Time	Food			Food, Housing and Clothing			Food, Housing, Clothing and Health Care		
		Coefficient on Income	Coefficient on Size	Equivalence Scale	Coefficient on Income	Coefficient on Size	Equivalence Scale	Coefficient on Income	Coefficient on Size	Equivalence Scale
Canada (n=64,733)	Pooled	0.287 (0.006)	0.539 (0.008)	0.755 (0.009)	0.453 (0.004)	0.260 (0.004)	0.475 (0.006)	0.462 (0.003)	0.248 (0.004)	0.460 (0.006)
	2004	0.257 (0.011)	0.566 (0.015)	0.763 (0.015)	0.444 (0.008)	0.266 (0.010)	0.479 (0.015)	0.451 (0.008)	0.455 (0.010)	0.465 (0.014)
	2005	0.265 (0.010)	0.545 (0.014)	0.741 (0.016)	0.426 (0.007)	0.265 (0.009)	0.461 (0.013)	0.438 (0.007)	0.252 (0.009)	0.449 (0.013)
	2006	0.265 (0.012)	0.595 (0.015)	0.809 (0.019)	0.447 (0.007)	0.277 (0.009)	0.502 (0.014)	0.438 (0.007)	0.264 (0.008)	0.488 (0.013)
	2007	0.285 (0.012)	0.529 (0.015)	0.739 (0.018)	0.470 (0.008)	0.251 (0.010)	0.473 (0.016)	0.479 (0.008)	0.237 (0.009)	0.456 (0.015)
	2008	0.322 (0.016)	0.515 (0.021)	0.760 (0.025)	0.469 (0.010)	0.248 (0.011)	0.467 (0.018)	0.475 (0.009)	0.235 (0.011)	0.448 (0.018)
	2009	0.322 (0.024)	0.487 (0.034)	0.718 (0.035)	0.455 (0.010)	0.256 (0.012)	0.470 (0.018)	0.463 (0.010)	0.246 (0.011)	0.459 (0.017)
France (n=18,228)	Pooled	0.471 (0.011)	0.461 (0.012)	0.871 (0.020)	0.433 (0.015)	0.227 (0.015)	0.399 (0.023)	0.475 (0.014)	0.237 (0.015)	0.451 (0.023)
	2000	0.451 (0.016)	0.498 (0.017)	0.908 (0.030)	0.331 (0.026)	0.268 (0.028)	0.401 (0.036)	0.397 (0.025)	0.288 (0.027)	0.479 (0.038)
	2005	0.503 (0.016)	0.418 (0.016)	0.842 (0.029)	0.392 (0.010)	0.315 (0.011)	0.518 (0.015)	0.425 (0.010)	0.300 (0.010)	0.522 (0.016)
Israel (n=16,991)	Pooled	0.281 (0.009)	0.572 (0.012)	0.796 (0.015)	0.346 (0.007)	0.338 (0.008)	0.517 (0.012)	0.374 (0.007)	0.291 (0.008)	0.465 (0.012)
	2001	0.219 (0.015)	0.614 (0.020)	0.786 (0.024)	0.297 (0.013)	0.398 (0.015)	0.566 (0.019)	0.333 (0.013)	0.346 (0.015)	0.519 (0.020)
	2007	0.302 (0.015)	0.558 (0.023)	0.799 (0.029)	0.348 (0.011)	0.316 (0.014)	0.484 (0.019)	0.376 (0.011)	0.264 (0.014)	0.424 (0.020)
	2010	0.323 (0.014)	0.547 (0.019)	0.809 (0.028)	0.382 (0.013)	0.312 (0.015)	0.504 (0.023)	0.403 (0.013)	0.272 (0.014)	0.455 (0.023)
Poland (n=128,957)	Pooled	0.335 (0.002)	0.435 (0.002)	0.654 (0.003)	0.502 (0.002)	0.252 (0.002)	0.506 (0.004)	0.523 (0.002)	0.196 (0.002)	0.411 (0.004)
	1999	0.364 (0.004)	0.403 (0.005)	0.633 (0.006)	0.521 (0.005)	0.230 (0.005)	0.480 (0.008)	0.535 (0.005)	0.183 (0.005)	0.393 (0.008)
	2004	0.381 (0.004)	0.429 (0.005)	0.693 (0.007)	0.530 (0.004)	0.240 (0.004)	0.512 (0.008)	0.559 (0.005)	0.177 (0.004)	0.402 (0.009)
	2007	0.362 (0.005)	0.404 (0.005)	0.633 (0.007)	0.511 (0.005)	0.248 (0.005)	0.507 (0.008)	0.531 (0.005)	0.190 (0.005)	0.405 (0.008)
	2010	0.335 (0.005)	0.404 (0.005)	0.608 (0.006)	0.500 (0.005)	0.238 (0.005)	0.476 (0.008)	0.517 (0.005)	0.189 (0.005)	0.392 (0.008)

Table 3 (Continued). Single-Parameter Equivalence Scales

Country	Time	Food			Food, Housing and Clothing			Food, Housing, Clothing and Health Care		
		Coefficient on Income	Coefficient on Size	Equivalence Scale	Coefficient on Income	Coefficient on Size	Equivalence Scale	Coefficient on Income	Coefficient on Size	Equivalence Scale
South Africa (n=9,749)	Pooled	0.458 (0.010)	0.193 (0.016)	0.355 (0.028)	0.595 (0.010)	0.109 (0.017)	0.270 (0.041)	0.657 (0.010)	0.084 (0.017)	0.246 (0.050)
	2008	0.447 (0.013)	0.210 (0.019)	0.380 (0.032)	0.593 (0.014)	0.133 (0.021)	0.326 (0.050)	0.669 (0.014)	0.106 (0.021)	0.319 (0.061)
	2010	0.472 (0.015)	0.182 (0.024)	0.345 (0.046)	0.599 (0.015)	0.094 (0.026)	0.235 (0.065)	0.648 (0.016)	0.073 (0.027)	0.208 (0.076)
Switzerland (n=10,433)	Pooled	0.159 (0.014)	0.717 (0.013)	0.852 (0.013)	0.274 (0.012)	0.223 (0.011)	0.308 (0.013)	0.288 (0.012)	0.219 (0.011)	0.308 (0.013)
	2000	0.164 (0.021)	0.708 (0.020)	0.847 (0.022)	0.269 (0.020)	0.223 (0.017)	0.305 (0.021)	0.285 (0.020)	0.226 (0.018)	0.316 (0.021)
	2002	0.147 (0.019)	0.723 (0.022)	0.848 (0.022)	0.282 (0.019)	0.220 (0.018)	0.307 (0.022)	0.303 (0.019)	0.214 (0.018)	0.307 (0.023)
	2004	0.166 (0.030)	0.719 (0.026)	0.862 (0.022)	0.274 (0.022)	0.225 (0.020)	0.310 (0.024)	0.277 (0.022)	0.216 (0.020)	0.299 (0.024)
Taiwan (n=25,115)	Pooled	0.284 (0.004)	0.656 (0.005)	0.916 (0.005)	0.403 (0.004)	0.340 (0.004)	0.570 (0.006)	0.354 (0.004)	0.386 (0.004)	0.598 (0.005)
	2000	0.282 (0.006)	0.652 (0.006)	0.909 (0.008)	0.401 (0.005)	0.340 (0.006)	0.568 (0.008)	0.347 (0.005)	0.383 (0.006)	0.586 (0.007)
	2005	0.289 (0.006)	0.658 (0.007)	0.925 (0.008)	0.402 (0.005)	0.340 (0.006)	0.569 (0.009)	0.362 (0.005)	0.390 (0.006)	0.611 (0.008)
US (n=34,836)	Pooled	0.236 (0.004)	0.476 (0.005)	0.623 (0.006)	0.480 (0.003)	0.226 (0.004)	0.434 (0.007)	0.478 (0.003)	0.193 (0.004)	0.370 (0.007)
	2005	0.223 (0.013)	0.515 (0.017)	0.663 (0.018)	0.502 (0.010)	0.220 (0.013)	0.442 (0.022)	0.491 (0.009)	0.187 (0.011)	0.368 (0.020)
	2006	0.242 (0.009)	0.476 (0.013)	0.628 (0.016)	0.496 (0.009)	0.213 (0.011)	0.423 (0.019)	0.490 (0.009)	0.180 (0.011)	0.353 (0.019)
	2007	0.244 (0.009)	0.485 (0.013)	0.642 (0.016)	0.496 (0.010)	0.217 (0.013)	0.433 (0.022)	0.487 (0.009)	0.188 (0.012)	0.365 (0.021)
	2008	0.233 (0.009)	0.483 (0.013)	0.631 (0.016)	0.485 (0.010)	0.230 (0.012)	0.447 (0.021)	0.476 (0.009)	0.207 (0.012)	0.396 (0.020)
	2009	0.227 (0.010)	0.480 (0.013)	0.621 (0.015)	0.455 (0.009)	0.237 (0.013)	0.435 (0.020)	0.457 (0.009)	0.206 (0.012)	0.379 (0.020)
	2010	0.249 (0.009)	0.447 (0.013)	0.595 (0.016)	0.480 (0.009)	0.209 (0.012)	0.403 (0.021)	0.481 (0.008)	0.173 (0.011)	0.334 (0.020)
	2011	0.246 (0.009)	0.442 (0.013)	0.587 (0.015)	0.468 (0.009)	0.237 (0.011)	0.447 (0.019)	0.474 (0.008)	0.202 (0.011)	0.384 (0.018)
	2012	0.226 (0.010)	0.480 (0.012)	0.621 (0.015)	0.451 (0.010)	0.244 (0.012)	0.445 (0.019)	0.464 (0.009)	0.204 (0.011)	0.380 (0.019)

Note: Standard errors are reported in parentheses. Standard errors of equivalence scales are calculated using the methodology outlined by Phipps and Garner (1994). Source: Survey of Household Spending, LIS Data Center, Consumer Expenditure Survey.

Appendix Table 1. Equivalence Scales by Household Size

Country	Variable	Food		Food, Housing and Clothing		Food, Housing, Clothing and Health Care	
		Coefficient	Equivalence Scale	Coefficient	Equivalence Scale	Coefficient	Equivalence Scale
Canada (n=64,733)	Income	0.283 (0.006)	--	0.460 (0.004)	--	0.466 (0.003)	--
	Size = 2	0.425 (0.010)	1.810 (0.023)	0.110 (0.005)	1.225 (0.011)	0.131 (0.005)	1.279 (0.011)
	Size = 3	0.603 (0.011)	2.317 (0.033)	0.247 (0.007)	1.581 (0.018)	0.242 (0.006)	1.573 (0.017)
	Size = 4	0.756 (0.012)	2.870 (0.041)	0.339 (0.007)	1.872 (0.021)	0.326 (0.007)	1.841 (0.020)
	Size = 5	0.855 (0.021)	3.296 (0.083)	0.411 (0.009)	2.139 (0.033)	0.394 (0.009)	2.093 (0.032)
	Size = 6	1.007 (0.022)	4.071 (0.116)	0.501 (0.012)	2.528 (0.057)	0.489 (0.012)	2.501 (0.055)
France (n=18,228)	Income	0.456 (0.011)	--	0.365 (0.014)	--	0.411 (0.013)	--
	Size = 2	0.476 (0.016)	2.401 (0.068)	0.171 (0.020)	1.309 (0.039)	0.1 89(0.019)	1.347 (0.040)
	Size = 3	0.557 (0.019)	2.784 (0.087)	0.377 (0.023)	1.810 (0.058)	0.374 (0.023)	1.803 (0.061)
	Size = 4	0.666 (0.019)	3.406 (0.107)	0.393 (0.024)	1.857 (0.061)	0.404 (0.023)	1.887 (0.063)
	Size = 5	0.771 (0.022)	4.132 (0.163)	0.449 (0.029)	2.027 (0.086)	0.456 (0.028)	2.048 (0.089)
	Size = 6	0.784 (0.035)	4.228 (0.267)	0.504 (0.040)	2.211 (0.133)	0.490 (0.037)	2.161 (0.128)
Israel (n=16,991)	Income	0.277 (0.009)	--	0.344 (0.007)	--	0.372 (0.007)	--
	Size = 2	0.525 (0.023)	2.065 (0.064)	0.314 (0.016)	1.615 (0.039)	0.308 (0.016)	1.598 (0.040)
	Size = 3	0.664 (0.025)	2.504 (0.080)	0.402 (0.018)	1.846 (0.047)	0.364 (0.017)	1.741 (0.046)
	Size = 4	0.824 (0.025)	3.122 (0.095)	0.476 (0.018)	2.062 (0.051)	0.408 (0.017)	1.862 (0.048)
	Size = 5	0.966 (0.026)	3.799 (0.122)	0.557 (0.018)	2.302 (0.059)	0.474 (0.018)	2.058 (0.055)
	Size = 6	1.152 (0.025)	4.917 (0.161)	0.705 (0.018)	2.928 (0.077)	0.628 (0.018)	2.603 (0.071)
Poland (n=128,957)	Income	0.348 (0.002)	--	0.511 (0.002)	--	0.530 (0.002)	--
	Size = 2	0.388 (0.004)	1.814 (0.010)	0.202 (0.004)	1.510 (0.010)	0.179 (0.003)	1.442 (0.010)
	Size = 3	0.506 (0.004)	2.173 (0.012)	0.286 (0.004)	1.794 (0.012)	0.224 (0.004)	1.579 (0.011)
	Size = 4	0.603 (0.004)	2.519 (0.014)	0.346 (0.004)	2.027 (0.014)	0.269 (0.004)	1.732 (0.012)
	Size = 5	0.687 (0.005)	2.866 (0.019)	0.390 (0.005)	2.219 (0.019)	0.308 (0.005)	1.876 (0.016)
	Size = 6	0.783 (0.006)	3.323 (0.025)	0.453 (0.005)	2.524 (0.025)	0.365 (0.006)	2.108 (0.021)

Appendix Table 1 (Continued). Equivalence Scales by Household Size

Country	Variable	Food		Food, Housing and Clothing		Food, Housing, Clothing and Health Care	
		Coefficient	Equivalence Scale	Coefficient	Equivalence Scale	Coefficient	Equivalence Scale
South Africa (n=9,749)	Income	0.456 (0.010)	--	0.593 (0.010)	--	0.655 (0.010)	--
	Size = 2	0.193 (0.034)	1.425 (0.090)	0.176 (0.039)	1.539 (0.149)	0.184 (0.040)	1.571 (0.183)
	Size = 3	0.319 (0.034)	1.798 (0.122)	0.259 (0.037)	1.887 (0.169)	0.253 (0.038)	1.859 (0.201)
	Size = 4	0.355 (0.035)	1.921 (0.124)	0.259 (0.039)	1.887 (0.179)	0.233 (0.040)	1.771 (0.204)
	Size = 5	0.358 (0.039)	1.930 (0.140)	0.232 (0.042)	1.766 (0.182)	0.192 (0.043)	1.601 (0.196)
	Size = 6	0.376 (0.033)	1.996 (0.121)	0.212 (0.036)	1.683 (0.148)	0.167 (0.037)	1.508 (0.159)
Switzerland (n=10,433)	Income	0.138 (0.014)	--	0.276 (0.012)	--	0.282 (0.012)	--
	Size = 2	0.617 (0.017)	2.047 (0.034)	0.136 (0.015)	1.207 (0.023)	0.181 (0.015)	1.284 (0.025)
	Size = 3	0.837 (0.021)	2.641 (0.053)	0.257 (0.018)	1.426 (0.033)	0.264 (0.019)	1.441 (0.035)
	Size = 4	1.011 (0.020)	3.233 (0.062)	0.317 (0.017)	1.549 (0.032)	0.314 (0.017)	1.543 (0.033)
	Size = 5	1.158 (0.024)	3.832 (0.095)	0.341 (0.022)	1.601 (0.046)	0.336 (0.023)	1.591 (0.047)
	Size = 6	1.184 (0.042)	3.950 (0.185)	0.350 (0.034)	1.621 (0.075)	0.349 (0.036)	1.620 (0.080)
Taiwan (n=25,115)	Income	0.288 (0.004)	--	0.404 (0.004)	--	0.360 (0.004)	--
	Size = 2	0.422 (0.009)	1.808 (0.022)	0.207 (0.008)	1.416 (0.019)	0.278 (0.008)	1.594 (0.019)
	Size = 3	0.713 (0.009)	2.725 (0.032)	0.355 (0.009)	1.815 (0.025)	0.415 (0.008)	2.007 (0.024)
	Size = 4	0.903 (0.009)	3.556 (0.040)	0.457 (0.009)	2.155 (0.028)	0.516 (0.008)	2.378 (0.027)
	Size = 5	1.045 (0.009)	4.345 (0.051)	0.535 (0.009)	2.453 (0.033)	0.610 (0.009)	2.785 (0.033)
	Size = 6	1.206 (0.010)	5.443 (0.070)	0.622 (0.010)	2.840 (0.040)	0.747 (0.009)	3.506 (0.044)
US (n=34,836)	Income	0.228 (0.004)	--	0.484 (0.003)	--	0.475 (0.003)	--
	Size = 2	0.396 (0.007)	1.671 (0.014)	0.100 (0.006)	1.214 (0.014)	0.148 (0.006)	1.333 (0.014)
	Size = 3	0.557 (0.008)	2.058 (0.020)	0.228 (0.008)	1.557 (0.021)	0.216 (0.007)	1.519 (0.019)
	Size = 4	0.689 (0.008)	2.443 (0.024)	0.326 (0.008)	1.883 (0.025)	0.290 (0.007)	1.753 (0.022)
	Size = 5	0.762 (0.010)	2.685 (0.034)	0.357 (0.009)	1.997 (0.034)	0.313 (0.009)	1.835 (0.029)
	Size = 6	0.869 (0.012)	3.086 (0.047)	0.391 (0.011)	2.134 (0.042)	0.336 (0.010)	1.917 (0.036)

Note: Standard errors are reported in parentheses. Standard errors of equivalence scales are calculated using the methodology outlined by Phipps and Garner (1994). Source: Survey of Household Spending, LIS Data Center, Consumer Expenditure Survey.