On the Income Dependence of Equivalence Scales

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Abstract

Household consumption exhibits economies of scale as the number of household members increases. We collect survey data from two countries, Germany and France, in order to obtain direct subjective estimates of household consumption economies of scale, and, in particular, to examine an additional dimension: whether household consumption economies of scale change as living standards go up. Our data from both countries indicate strongly that household economies of scale increase as the living standard goes up. We discuss the robustness of our survey method and compare our results to these of alternative estimation methods in the literature.

Key Words: equivalence scales, survey method, independence of base

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1. Introduction

As the number of family members increases in a household, the sharing of goods such as housing, furniture, household appliances or private means of transportation, also increases. Thus, in order to retain the same per-capita living standard, households of different size need not have the same per capita income. Sharing opportunities make larger households needing lower per capita income in order to be at the same living standard with smaller households. In other words, there are household consumption economies of scale over the dimension of household size. In this paper we examine an additional dimension: whether household consumption economies of scale change as living standards go up. Our study explores this question through a survey method: we ask people to tell us about the relationship among household income, family demographic composition and the well-being of a household.

We ask our subjects questions as: "which family-income level can make a household with one adult and two children achieve the same well-being as a household with a single adult only and a monthly family income of $2,000, according to your opinion?" In this way we collect a sample of subjective "equivalent incomes": incomes that make the well-being of households with different demographic composition equal.[1] Dividing the income of a household type by the equivalent income of a household with a specific demographic composition (reference household) gives the equivalence scale of the former household type.

In our questionnaire we give to our subjects a specific income level (reference income) for a single-childless-adult household (our reference household). We ask them to think of the well-being of the reference household at this reference income and to give us equivalent incomes for seven other family types, according to their own perception of utility and existing markets. We ask our respondents to repeat the same procedure for five different reference incomes for

[1] By identifying subjective equivalent incomes for many household types, we obtain subjective "equivalent-income functions": functions that give equivalent income for all household types, all household incomes and any given commodity price vector. A significant body of literature attempts to estimate equivalent-income functions using consumer-expenditure data. See, for example, Donaldson and Pendakur (2004).

the imaginary single–childless-adult (reference) household. In this way we collect five sample equivalence scales corresponding to five different reference-income levels. The database we construct provides a range of subjective household welfare evaluations that enables us to test for a possible dependence of equivalence scales on reference incomes, the central issue of this paper.

If equivalence scales are negatively correlated with reference incomes and living standards, then within-household economies of scale in consumption increase with rising household income. For example, according to the model of Barten (1964), the expenditure share on food and clothing may be higher for households with low income. As the number of family members increases, the expenditure share on food and clothing is likely to increase even more for households with lower family income. This may happen because economies of scale in food and clothing consumption are not likely to be important.[2]

As another example, considering housing, rich single adults may have larger houses that will not be congested too much by adding one or two extra people. On the contrary, poor single adults, demanding smaller houses in size, may have to bear high disutility of congestion as household members are added.[3]

On the other hand, if richer single adults have a very high expenditure share on goods with little or no scale economies, like expensive vacation trips, keeping the same high living standard may require that additional household members also spend a lot on traveling. Thus, equivalence scales may remain constant, or even increase, as income and utility increase.

[2] Deaton and Paxson (1998) provide evidence that the food expenditure share decreases as the household size increases, keeping per capita household income constant. Thus, food may contain significant sharing possibilities. In their comment to Deaton and Paxson (1998), Gan and Vernon (2003) argue that, at least compared to housing, in a two-good framework (food and housing) food exhibits increasing expenditure shares with increasing family size, so food has comparatively lower sharing possibilities to housing. Independently from these empirical findings, the main point of our argument about why equivalence scales may decrease with income, is that there might be goods with comparatively low potential for sharing that take the biggest part of total household expenditures in low-income families.

[3] An alternative reasoning for increasing within-household economies of scale with income is that families with low income may be credit constrained. Credit constraints may shift the chosen family consumption bundle towards lower expenditure shares on durables with high within-household sharing potential than otherwise preferred.

So, given a family type, as family income increases, is this extra money directed to larger expenditure shares for shared or non-shared goods in the household? We provide evidence from two countries, Germany and France. We find the same qualitative results in both countries: equivalence scales are significantly decreasing with reference income. Poorer households exhibit a low ability to share compared to richer ones and household consumption economies of scale increase as the living standard goes up. This finding may be important for reconsidering economic fundamentals or key model features in studies where household demographics and within-household sharing possibilities are important, like studies of social security, marriage dynamics and life-cycle consumption.[4]

Our main finding has direct implications for the building of consumer-demand systems that aim at estimating equivalence scales from consumer-expenditure data. So far, a large body of literature estimating equivalence scales through parametric demand systems typically assumes that household expenditure functions across families with different demographic composition are proportional with respect to reference income, hence equivalence scales are a-priori independent from reference income, or "Independent of Base" (IB).[5]

In contrast to the usual IB hypothesis that provides convenience to econometric approaches, our study strongly encourages using parametric or semi-parametric demand systems producing equivalence scales that are decreasing in reference income. An example of an econometric approach relaxing IB is that of Donaldson and Pendakur (2004). In particular, the parametric demand system suggested by Donaldson and Pendakur (2004) introduces a property named "Generalized Equivalence Scale Exactness (GESE)" which implies a linear relationship between the log of equivalence scales and the log of reference incomes. We test this log-log linear relationship using our data, and all our samples provide supportive evidence for the implications of demand systems characterized by GESE. Yet, our estimated

[4] Examples of such studies are Greenwood and Güner (2004), Krueger and Fernández-Villaverde (2002) and Krueger and Perri (2003).
[5] Independence of Base is also named "Equivalence Scale Exactness" (ESE), see, for example, Blackorby and Donaldson (1993).

scales suggest that there is slight space for improvement of this specification.

The plan of the paper is as follows. In section 2 we present and explain the structure of the questionnaire and the samples from the two countries. In section 3 we present the average equivalence scales and tests of IB. In section 4 we test the robustness of our method, by examining the possibility of framing effects, comparing our results with these from questionnaires with slightly different structure. Moreover, we test whether respondents understand the consumption sharing potential of a hypothetical household with a living standard different from their own actual standard of living. In section 5 we compare our findings with these of previous studies and we suggest new directions. In section 6 we conclude.

2. Methodology, sampling, and data

2.1 Structure of the questionnaire

Our questionnaire is divided into two parts. The first part of the questionnaire is the experiment: we give questions to our subjects about hypothetical situations referring to relationships between income, family demographic composition and well-being. In the second part we ask for our respondents' personal characteristics. Our questionnaire appears in the Appendix, in section A1.

In the first part of the questionnaire we ask the respondents to evaluate five different incomes which describe five different welfare levels of the reference household. Each situation corresponds to a separate small table. Within each small table we provide eight hypothetical families of different size and composition (we tell our respondents to assume that adults are of age between 35 and 55, and children between 7 and 11). Only for one of these family types, a single adult without children (our reference household), we provide a monetary value that gives this household's after-tax income (the reference income). We leave gaps next to the remaining seven family types. We ask our respondents to fill in the gaps, putting the after-tax *family* income that brings the other household types to the same living standard as

the one of the single childless adult (with the given reference income), according to their own perception. There are five tables with identical structure, each of them providing a different reference income for the single-adult (reference) household.

We have selected five monetary values that match approximately the income levels of income quintiles for single childless adults at the time of sampling for each country. In particular, the reference-income level of the poorest single-childless adult that we provide is the poverty line and we proceed by adding 150% of the poverty line as we move upwards to a higher reference-income level.[6]

In the second part of the questionnaire we ask our subjects to state several of their personal characteristics: gender, whether they have a partner, the number of children in the household, their after-tax personal income, their educational level (taking into account the differences in educational systems across the two countries), whether they had siblings during their childhood and, finally, their occupation.

2.2 Sampling and Data

Our German sample consists of 167 respondents. We collected this sample in August 1999 mainly from the area of Schleswig-Holstein and especially from the city of Kiel. We approached people directly at their work places (companies, stores etc.) or at their leisure places (e.g. at parks or cafés). All our German subjects responded in written and received a compensation of about $5. We did not hand out the questionnaire in a university classroom.

[6] The definition of our family-income classes for Germany is based on the German Microcensus 1999: it uses the definition of the German poverty line in order to define certain income brackets. In particular, while the poverty line of the single-childless-adult household is about DM1000 per month (which is our starting value for our reference incomes in the questionnaire), the poverty line for a two-adult household in Germany is about DM1750. (See "Übersicht über das Sozialrecht" (Overview of Social Law) 1998). For Germany we provided monthly incomes of DM1000, DM2500, DM4000, DM5500, and DM7000 as reference incomes for single adults belonging to the five quintiles of the income distribution in 1999.

For France, our definition of reference income classes was motivated by our German definitions, in order to make the two databases directly comparable. Thus, we provided the following single-adult reference incomes: FF3000, FF7500, FF12000, FF16500, FF21000 for the year 2002, the amounts that are analogous to these defined for Germany.

If we use the PPP prices from the World Bank, these values correspond to year-2000 US after-tax annual incomes of $7500, $18750, $30000, $41250, and $52500 for single childless adults.

By approaching people in person, we could identify more easily potential respondents with families and children.

Our French sample consists of 223 respondents. The sample is virtually from all regions of France and we collected it in August 2002 through October 2002. A hundred of the respondents from this sample responded in written at a camping place in Bordeaux during their summer vacation time, and received a compensation of about \$5. By sampling at a camping place we were able to locate more easily people in households with more than one adults and with children, originating from many regions of France and from different family-income classes. The other 123 respondents responded electronically to randomly selected e-mails. All subjects who responded electronically participated into a lottery with expected payoff of about \$5.[7]

In Table 1 we present an outline of the personal characteristics of our respondents for both countries. We have collected personal features that could be important in affecting people's perceptions about equivalence scales. In particular, we asked for the respondent's gender and their current family demographic composition.

We present two categories of income classes. The first is the family "after-tax income class" for all families of our data, independently of the family demographic composition. The after-tax income brackets are the same as these used in the German Microcensus for 1999. The income level "P" is the German poverty line for single-childless adults (see "Übersicht über das Sozialrecht" (Overview of Social Law) 1998), and the first after-tax income bracket is below 1.75×P. The 1999 German Microcensus starts from this threshold in order to define the lowest-income class and then adds increments such that the mean of the third income class is about the mean German household income. Each increment is 1.5×P.

[7] The response rate of people who received e-mails was about 1.2%. We have found no statistically significant differences in the responses of the two groups of respondents, (i.e. the 100 respondents from the Bordeaux camping and the 123 people who responded through e-mail). A formal test can be provided by the authors upon request.

The second category of income classes is the "adjusted after-tax income class" which is the family income per equivalent adult. We find each respondent's stated equivalent income for his/her own family type that is closest to his/her own family income.[8] Then, we divide this income with the respondent's stated equivalence scale. In this way we convert each respondent's stated family income to their equivalent childless-single-adult household income. Therefore, this income category reflects our sample's distribution of living standards.

Sample frequencies from studies with larger samples are presented in the two columns named "Pop." of Table 1, next to our own sample's distribution frequencies.[9] For calculating the frequencies of "adjusted after-tax income class," that come from the larger samples on the income distributions of Germany and France (the numbers appearing in parentheses in the column "Pop."), we used the OECD equivalence scales.[10]

In Table 1 we report data on the distribution of occupational and educational characteristics.[11] Finally, we ask our subjects how many siblings they had during their childhood. We examine whether this is an important factor in forming people's perceptions around possible household-production economies of scale. The corresponding distributions are shown at the bottom of Table 1.

[8] We do not ask our subjects to make any explicit statement about their own family when asked about equivalence scales. We find out about it after looking at their personal characteristics.

[9] In all our calculations we adjusted the 1999 nominal values for inflation and PPP changes in order to make the 1999 database comparable to our 2002 sample. For our calculations we fitted a cubic spline in the cumulative German and French distributions.

[10] These are a 0.5 weight for each additional adult and a 0.3 weight for each additional child for all income categories. The fact that in Germany the fifth income category has very few or close to zero observations for most multi-person household types, may come partly from the fact that the German Microcensus provides only the 5 income categories that we define as well. These are very few data points for fitting a cubic spline, so we anticipate some error in the German distribution appearing in parentheses. On the contrary, the French data, provided to us by Francois Bourguignon, are split into 20 different income categories, enabling us to make more reliable calculations.

[11] In France we have a relatively high share (45.7%) of students who mainly responded through e-mail. For forming educational categories, we take into account the differences between the two educational systems.

3. Means of Equivalence Scales, Tests of the IB hypothesis, and a Test of GESE

3.1 Average subjective equivalence scales

A direct way of evaluating our results is to look at the sample means and standard deviations of the equivalence scales we collected. In Table 2 we give an outline of our sample means per hypothetical household composition and reference income.[12] The symbol "A" stands for one adult and "C" for one child in the household.[13] We remind that these sample means correspond to 167 observations for Germany and 223 observations for France, since in both countries our respondents gave a complete set of answers to the hypothetical situations that we asked them to evaluate. Underneath each of the sample means is the corresponding sample standard deviation, appearing in parentheses.

We also give a visual outline of Table 2 in Figure 1, where we plot the average sample equivalence scales against the reference-income classes. The preliminary message of Figure 1 is clear: for all hypothetical household types, in both countries, equivalence scales fall with rising reference income. Moreover, our estimates for both countries are even quantitatively close.

3.2 Tests of the IB hypothesis

It is easily seen by Figure 1 that the most intense decline in average equivalence scales occurs as we move from the lowest income class to the next. Is it the only statistically significant one?

In order to test the statistical significance of the overall picture in Figure 1 we perform tests of differences of means for every two consecutive means for a given household type. Because all values are reported by the same group of individuals, they are not independent.

[12] We index reference incomes by 1, 2.5, 4, 5.5, 7 in order to show how many German single-childless-adult poverty lines each reference income is. Since we have adjusted both countries' income categories to these German income levels, we avoid any reference to country-specific currency units and nominal values.
[13] So, for example, "ACCC" means a household with one adult and three children.

Therefore, the tests we perform are t-tests of differences of pairs of observations.

In Germany, for any given family type, average scales between any two subsequent reference-income levels decline significantly at the 99% level, except from AA and AAC, for which the scale change between the fourth and the fifth reference-income class is statistically insignificant. In France, the difference between the fourth and the fifth class is insignificant for AA and significant at the 95% level for AAC. In all other cases the decline of scales with income is significant at the 99% level.[14]

But what drives these results? Is it that the relative cost of children falls with rising reference income, is it that household economies of scale increase, or both? We borrow some structure from Banks and Johnson (1994) in order to address this question.[15] In particular, in Table 2 we present results from a regression of the form,

$$E_{i,k} = (A + \alpha C)^{\theta} + b_0 PERSONAL\_Y_i + b_1 OTHER\_PERSONAL_i + e_{i,k} \ .$$

$E_{i,k}$ is the equivalence scale stated by respondent "i" and corresponding to reference income "k". Variable A is the number of adults and C is the number of children. So, A and C define the household type, while parameter α captures the relative cost of children, whereas parameter θ captures the extent of economies of scale in household consumption.

The variable PERSONAL_Y$_i$ is the respondent i's net household income. This is *not* the adjusted after-tax income, but the stated family income. Since the adjusted income is derived by dividing family income by the stated equivalence scale of the respondent's demographic situation and income class, there would be a built-in endogeneity between the endogenous variable (equivalence scales) and the explanatory variable (adjusted income). Therefore, we use only family income even though it does not capture perfectly the variation in living standards across households.

[14] We reported these t-tests in a previous version of this paper. All tests are available from the authors upon request.

[15] We are indebted to an anonymous referee for this suggestion.

OTHER_PERSONAL$_i$ is a set of conditioning variables that comprise other personal characteristics of each respondent i. We include in the regression all the personal respondent variables appearing in Table 1: whether respondents live with an adult partner, whether they have children in their household, whether respondents had siblings during their childhood, the respondents' gender, educational level, and occupational characteristics. Finally, $e_{i,k}$ is the error term.

For each reference income, k (= 1, 2.5, 4, 5.5, 7), we run a separate regression and we report the estimates $\hat{\alpha}$ and $\hat{\theta}$ in the last two columns of Table 2 for each country. In all cases, none of the personal characteristics of our respondents appeared as significant or robust. Therefore, we only report the estimators of parameters α and θ. Underneath each coefficient estimate we provide the estimator's standard error. It is obvious that both α and θ fall, i.e. both relative child costs decrease and economies of scale rise as living standards go up. Moreover, it seems that the biggest drop occurs for parameter α, the relative cost of children, as reference income increases.

In Table 3 we present another test for IB. This time, we pool responses across reference incomes for each household type and run the regression of the form,

$$E_{i,j} = b_0 + b_1 \text{Ref. Income Dummies} + b_2 PERSONAL\_Y_i + b_3 OTHER\_PERSONAL_i + e_{i,j} \ ,$$

for each household type and present F-tests on exclusion of reference income dummies for each country. By $E_{i,j}$ we denote the equivalence scale stated by respondent "i" and corresponding to the hypothetical family type "j". We include four income dummies, starting from the income level 2.5 up to level 7. The presence of the constant term, b_0, allows for at most four income dummies. We call the regressions including the income dummies as "unrestricted," presented in columns having the symbol "U" in Table 3. The regressions under the IB restriction, $b_1 = 0$, are presented in columns named "R" in Table 3 (restricted).

In all cases, none of the personal characteristics of our respondents appeared as significant

or robust.[16] Therefore, we only report the estimators of parameters b_0 and b_1. Underneath each coefficient estimate we provide its t-statistic in parenthesis. At the bottom of each household type regression, for each country, we report the F-test statistic on exclusion of reference income dummies.

As we can see, in both countries IB is strongly rejected. An interesting finding is that respondent characteristics do not play an important role for our subjective estimates of equivalence scales, and especially for establishing the negative relationship between equivalence scales and reference income.[17]

3.3 Tests of Generalized Equivalence-Scale Exactness (GESE)

The key implication of GESE, as defined by Donaldson and Pendakur (2004), is that there should be a linear relationship between the log of equivalence scales and the log of reference income. As our estimation method is non-parametric, it can serve as a basis for testing GESE.[18]

In Table 4 we present a specification test of regressions of the log of our respondents' stated equivalence scales against the log of reference income, separately for each household type. We report regressions using the specification,

$$\log(E_{i,j}) = a_0 + a_1 \log(\text{Ref. Income}) + a_2 \text{Ref. Income Dummies} + \\ + a_3 PERSONAL\_Y_i + a_4 OTHER\_PERSONAL_i + e_{i,j} \ .$$

[16] In a previous version of our paper we also reported how much $\bar{\text{R}}^2$ decreases by excluding all personal-characteristics variables and the difference is very small.

[17] This finding contrasts previous conclusions by Kapteyn and van Praag (1976). We have also estimated a SUR-type 7-equation system of the seven non-reference household types, regressing the log of scales against the log of reference income, which allows for several error correlations that could stem from systematic errors due to personal characteristics. For example, if some respondents think that children are cheaper than the average, could possibly report low children costs for all household types with children and exhibit significant negative deviations for such household types. The 7-equation SUR regression could uncover such biases originated by respondent characteristics. Yet, the estimators for parameter b_1 are almost the same as the ones reported in Table 3, so we do not report them in a new table.

[18] Another implication, also suggested by our Figure 1, is a direct relationship between equivalence scales and the reciprocal of income. This direct relationship would be in accordance with "Generalized Absolute Equivalence-Scale Exactness" (GAESE) holding in a consumer demand system, as this is stressed in a previous version of Donaldson and Pendakur (2004). In Koulovatianos et. al. (2001), we show that this direct relationship is not rejected from data obtained by our method.

The variable "Ref. Income" takes the values 1, 2.5, 4, 5.5, 7, for both countries. Like before, none of the personal characteristics of our respondents appeared as significant or robust. Thus, again, we only report the estimators of parameters a_0, a_1 and a_2. Underneath each parameter estimate we provide its t-statistic in parentheses. We call the regressions including the income dummies as "unrestricted," presented in columns having the symbol "U" in Table 4.[19] The regressions under the log-log specification, $a_2 = 0$, are presented in columns named "R" in Table 4 (restricted).

At the bottom of each household type regression, for each country, we report the F-test statistic on exclusion of reference income dummies. Table 4 gives, on the one hand, affirmative evidence that setting up parametric demand systems that comply with GESE is reasonable, as parameter a_1 is always negative and statistically significant. On the other hand, as all F-tests range from 2.64 to 16.3, the log-log specification is not the "best," yet quite close. Moreover, Figures 2.a and 2.b depict scatter plots and the regression lines of this linear relationship between the log of equivalence scales and the log of reference income. Both the F-tests of the model specification and the scatter plots reveal that there is substantial variation around the log-log specification. Yet, the log-log specification does very well in explaining our data, giving a supportive message for GESE.

4. Investigating the robustness of the results

4.1 Tests of Framing Effects

The results of our survey method may be biased due to two specific characteristics of our questionnaire, namely, (i) that the reference household, for which we also pre-specified a reference income, was always a single childless adult household instead of a larger household, and, (ii) that we presented the reference incomes of reference households in an increasing order, starting from the lowest reference income. Ideally, none of these two questionnaire

[19] Since the variable log of reference income is perfectly correlated with 4 income dummies and a constant, we only use 3 income dummies in the "U" regressions.

characteristics should influence the responses in our samples. However, alternative means of representing equivalent choice problems may lead to systematic biases in the responses. In other words, questionnaires with different structure may "frame" respondents' answers towards certain directions (framing effects), even though the questionnaires may pose the same choice problem.[20] In this section we argue that our qualitative results are not generated by such framing effects.

Concerning our questionnaire characteristic (i) above, especially for the lowest reference income level, it may be that respondents are unwilling to state income amounts that yield very low welfare levels of the single households. Respondents may feel sympathetic towards households with low living standards, and try to compensate them by stating higher increments as the family size rises. If such a framing effect is present, it contributes to finding decreasing equivalence scales in reference income. In order to rule out the possibility that this framing effect is generating our findings, we ran an additional survey in Germany (we refer to it as "new survey" in what follows). In the new survey we provided to respondents only the income of the largest household (i.e. two adults with three children) instead of the income of a single adult household (see Appendix A2). If the framing effect we explained above is present, respondents should now be unwilling to subtract too much income at low reference incomes. This would result in higher welfare levels of small households at low reference incomes and, thus, in equivalence scales increasing with reference income. Consequently, if the qualitative results in our original survey are correct, not caused by such a framing effect, equivalence scales should be also decreasing in the new survey.[21]

Concerning characteristic (ii) of our questionnaire that we stress above, it may be possible that the order of presenting reference incomes has influenced our results. In the original survey respondents started the questionnaire by thinking about the costs for additional

[20] Framing effects in research conducted through questionnaires is a subject of formal research in the fields of experimental economics and psychology. For example, see the study by Tversky and Kahnemann (1974).
[21] We thank an anonymous referee for suggesting this alternative questionnaire structure to us.

household members at the lowest reference income. Then, the respondents had to consider all other reference incomes in increasing order. In order to test for a possible order effect, we performed the new survey in two groups, L and H. In group L, we presented reference incomes in increasing order, as in the original survey. In group H, reference incomes were presented in decreasing order, starting from the highest reference income. If the order effect plays a dominant role, the qualitative results should differ in both groups. However, if the qualitative results in both groups are identical, we can conclude that our method is robust with respect to order effects.

The new survey was conducted in December 2003 in Germany, Kiel and Hannover, with 184 respondents, 84 in group L, and 100 in group H. Since the original survey revealed that the influence of personal characteristics can be neglected, we did not aim at a well-balanced sample and recruited solely students as respondents. Each respondent was rewarded with about \$5 (5 Euros) for participating. Further details about the new survey can be found in Appendix A2.

Table 5.a shows the results from pooling both subsamples (L&H). The average equivalence scales are not directly comparable with these of Table 2, because in the new survey the reference household was AACCC. In order to make the results comparable to those of the original survey, we take again the single adult household as reference, instead of the household consisting of two adults and three children. Therefore, we divide the incomes of all other household types by the income of the single adult household that each different respondent stated. Since single-childless-adult reference incomes differ across respondents in the new survey, scale values have a higher standard deviation: comparing to scales of the old survey, the new scales carry an extra noise term in their denominator.

The reference incomes appearing in the first column are the means of stated incomes for the single childless adult (we do not report the standard errors for these average incomes for clarity). It is evident that these averages do not coincide perfectly with our Table's 2

reference incomes (i.e. 1, 2.5, 4, 5.5 and 7). Except from the third and fourth level of welfare, the stated reference incomes are significantly different, but not too far. The same holds for equivalence scales, comparing Tables 5.a and 2. This is indicative, that some influence of framing effects may be present.

In Table 5.b we distinguish subsamples, L and H. The bottom row presents joint F-tests of equality between averages by L and H groups for each family type.[22] All F-test statistics imply that L and H are not equal, for all family types. The two last columns report estimates of coefficients α and θ, from the Banks and Johnson (1994) specification. The F-tests of structural break between subsamples L and H are reported underneath these estimates and their standard errors (we denote them by "$F = ...$"). Strikingly, all estimates of θ are different across L and H, whereas all estimates of α are equal. This is indicative that a framing effect due to the different order of questions posed in L and H drives respondents to perceive and report household consumption economies of scale differently, yet, relative child costs are perceived in a similar way.

In Table 5.c for subgroups L and H, as well as for the pooled sample (L&H), we run linear regressions of log scales versus log stated reference income for the single childless adult household, omitting personal characteristics. For the pooled sample, we include a dummy in the regression (called "Quest. Type"), which equals one for questionnaires of group L and zero for group H. All coefficients of the questionnaire dummy are significant and F-tests of difference of slopes between L and H indicate that slopes are also different, with the sole exception of family type AA.

Table 5.c shows that equivalence scales are significantly decreasing with reference income for all household types and all three samples. Moreover, the slopes are rather similar to

[22]For every given family type, we run a pooled regression of equivalence scales against dummies for each income level and each respondent group, L and H. So, in each family-type column, all averages of the two subcolumns corresponding to L and H are the regression coefficients appearing in Table 5.b. At the bottom, we report the F-statistic of a Wald test of joint equality of the regression coefficients of subcolumn H with the coefficients of subcolumn L.

those obtained in the original survey (see Table 4). We can therefore see that the qualitative results obtained in the original survey are robust in the sense that they have not been caused mainly by the particular characteristics (i) and (ii) of the original survey questionnaires discussed above. In particular, a framing effect of the original survey questionnaire coming from the possibility that respondents feel sympathetic towards the poor and they are framed by a tendency to increase their living standard because they state higher equivalent incomes for the poor, does not seem to generate the negative dependence of equivalence scales on reference income.

However, we cannot claim that framing effects are completely irrelevant in our survey method. First, equivalence scales in group H are always decreasing to a slightly higher extent than in group L. Second, the dummy in the pooled sample shows that there is a slight but significant difference between groups L and H, since the scale values in group H are usually higher. This means that in group H higher income amounts are subtracted.

In summary, we can conclude that framing effects have no influence on our qualitative results. In particular, framing effects do not generate the negative relationship between equivalence scales and reference income. Framing effects related to the order of the given questions do, however, alter the precise scale values slightly. Nevertheless, the small influence of question order is not a general drawback of our survey method, as it can easily be avoided in future studies, for instance, by asking each respondent only about one reference income.

4.2 The Use of Hypothetical Household Setups

The thought experiment that our respondents perform is similar to this of experts in "expert approaches" of calculating scales. Experts use insights from data on needs for households of different income levels, they form insights about these households' needs and they suggest equivalence scales.[23] In our study, a large number of respondents adds more living-standards

[23] See, for example Bradbury (1989) for a review of the "expert" or "budget approach."

experiences and more preference profiles over income compared to expert approaches. Do respondents with specific levels of welfare understand household economies of scale in the same way as the rest of the population?

In order to test this question we restrict our sample by taking into account only the stated equivalence scales for which the reference income is closest to the respondent's adjusted personal income. We therefore consider only 7 stated scales for each respondent (one scale per family type). We call this sample "Welfare Restricted," denoting it as "WR." We call the rest of the sample as "Unrestricted excluding Welfare Restricted" and we denote it as UR\WR. We test whether the responses of people concerning equivalence scales corresponding to their own living standard differ from the responses of people whose living standard is different from this living standard.

In Tables 6.a and 6.b we report the means and standard deviations of the two subsamples of respondents, UR\WR and WR, for each household type and for each reference income level. The tests we perform in Tables 6.a and 6.b are the same as these of Table 5.b. The estimates of parameters α and θ and the tests of equality of these coefficients in the last two columns of Tables 6.a and 6.b indicate that respondents state similar equivalence scales, independently from whether their own welfare level is the same or different from the given hypothetical welfare level. We also report the joint F-tests, pooling responses across columns, in the bottom row. These tests advocate the opposite, yet the α and θ tests are more reliable, since the pooled samples of respondents are independent only across rows and not across columns. Nevertheless, we can conclude that respondents understand satisfactorily well the needs of households with different living standards. Most importantly, the qualitative result of a negative dependence of equivalence scales on reference income holds for both subsamples, WR and UR\WR.

5. Comparison with previous studies and suggested extensions

5.1 Methodological comparisons

Our methodology is borrowed from other experimental literatures that target revealing behaviors blurred by the presence of several statistically unobserved factors. A classic example is literature studying "willingness to pay versus willingness to accept."[24] With respect to previous subjective scale methodologies, as the one pioneered by Kapteyn and van Praag (1976) and outlined by Bradbury (1989), we differ in two aspects: (i) both the stimulus and response variable in our questionnaire is the same (income), as opposed to being two different variables (income and verbal characterizations of well-being); and (ii) we do not use any functional or parametric utility system in order to elicit equivalence-scales from our database.

The Leyden school approach asks people to consider different utility levels (e.g. 1 to 7) and to state income amounts corresponding to the utility level (1 to 7) for their own household type. The equivalence scale is the ratio of these amounts for different household types. Instead of the strong assumption made by the Leyden approach that all respondents understand the same while stating "my utility level is 4," we assume that all our respondents perceive observable household characteristics in the same way and tacitly use their own preference system in order to state equivalent incomes.

About the connection of our approach to the econometric scale estimation methodology, a plausible question is whether our method's equivalence scales also contain information about the fertility preferences of our respondents. Pollak and Wales (1978) argue that equivalence scales obtained by consumer expenditure data are logically distinct from equivalence

[24] As an example, Knetsch and Sinden (1984) use questionnaires similar to ours in order to assess discrepancies between maximum desired payments for avoiding a loss and a minimum desired compensation for accepting the loss. Waldfogel (1993) uses the same methodology for uncovering discrepancies between the personal utility that Christmas gift givers assess for gift receivers and the personal utility experienced by gift receivers, in order to finally estimate the deadweight loss of gift mismatches in the Christmas gift market. In our case, the two key unobserved factors that need to be uncovered is preferences and household consumption economies of scale.

scales that also contain fertility preference information. They call the first category "conditional" equivalence scales and the second "unconditional" scales, arguing that the latter are appropriate for welfare comparisons. A cost function $C(u, p, z)$, depending on *exogenous* household characteristics, z, yields the minimum expenditure for reaching utility level u with a price vector p. The conditional equivalence scale is the ratio $\frac{C(u,p,z)}{C(u,p,\bar{z})}$, where $\bar{z}$ is the exogenous characteristics vector of the reference household. Now, if household characteristics are *endogenous*, a cost function $C(u, p, p_z)$ yields the minimum expenditure for reaching utility level u with a commodity price vector p and a price vector p_z for household characteristics. Here, characteristics are chosen by the household along with the consumption vector. So, an unconditional equivalence scale is given by the ratio $\frac{C(u,p,p_z)}{C(u,p,p_{\bar{z}})}$, with $\bar{z}$ being the endogenous characteristics of a reference household. In the case of endogenous z characteristics, the equivalence scale comes down to a cost-of-living index of price variations and since there is no price variation in our questionnaire, we believe that respondents are treating z as *exogenous*.[25] Our subjects examine a hypothetical situation of others having children as a given fact. We ask: "given that someone has an extra child, how much would they need to reach the same level of well-being?" Our questions are logically distinct from questions of the form "what monetary value would you place on having a child?" Thus, we believe our scales are *conditional*, free from fertility preference information.

5.2 Number comparisons with other studies

How do our results of Table 2 compare to previous studies obtaining objective or subjective scales? Equivalence scales obtained via econometric estimation in Germany appear in the book by Faik (1995). All scales by Faik (1995) that we report are based on the 1983 income and expenditure survey for West Germany, distinguishing households only by the number of household members (number of persons: 1-6). Table 7.a presents the results of Faik (1995),

[25] We thank Krishna Pendakur for guiding us through the literature of conditional versus unconditional scales, and an anonymous referee for making several definitional distinctions about these concepts clear to us.

using different demand-system approaches. Our numbers for Germany are not so far from scales presented in Faik (1995).

On the contrary, previous subjective scales have not been close to ones obtained via consumer-expenditure data. Table 7.b presents results from such approaches for AACCC in Germany and France. Except from Riffault and Rabier (1977) who report a scale 2.23, closer to our findings, all other studies follow the Leyden school approach. The column "income level" states the reference income of the scales. For example, minimal is the poverty line and insufficient is below the poverty line.

Weighing our study's equivalence scales according to each country's income- and household-type distribution, our average scales (not distinguishing among different reference incomes) are close to the equivalence scales stated in studies using consumer-expenditure data and estimating demand systems. Our numbers are also very close to the OECD ones that do not distinguish among different reference incomes (AC=1.3, ACC=1.6, ACCC=1.9, AA=1.5, AAC=1.8, AACC=2.1 and AACCC=2.4). Our income-dependent scales are also close to these of Donaldson and Pendakur (2004) who also report income-dependent scales using Canadian consumer data. In brief, our estimates are closer to these of econometric approaches rather than to these of previous subjective methods.

5.3 Extensions

Estimating parameters capturing household-production/consumption economies of scale is a task of well-known difficulty (see, for example Bradbury (1995) and Pendakur (1999)). One can use a database of subjective scales derived by our method and assume that these are the "true" scales. In a first step, using a plausible household-production parametric form, one can estimate parameters that capture household economies of scale, by regressing subjective scales on household income. In a second step, using consumer-expenditure data and the previously estimated parameters one can best-fit objective equivalence scales to our

scales. If a particular functional-parametric form for household production performs poorly in reproducing our subjective scales, alternative ones can be tried and tested.

These two steps can be a useful iterative procedure that may uncover structural unobserved features of household production/consumption economies of scale. Moreover, fitting objective scales to subjective ones, allows to cross-check the validity of the two approaches.[26] Another point made by Blundell and Lewbel (1991) is that the consumer demand approach can help in identifying the price dependence of equivalence scales across time and price regimes. Yet, the consumer demand approach cannot identify the values of scales in a "base period." Our method serves as a means for identifying scales in the base period.[27]

Our estimates can also be useful for studies using calibration methodologies in order to stress how marriage decisions depend on household economies of scale (see, for example, Greenwood and Güner (2004)) or life-cycle consumption decisions (as Krueger and Fernández-Villaverde (2002) and Krueger and Perri (2003)).

6. Conclusion

We implemented a survey method in two countries, Germany and France and found that economies of scale in household consumption increase as living standards go up. Moreover, we found supportive evidence for a linear relationship between the log of equivalence scales and the log of reference income, a key implication of the generalized equivalence-scale exactness hypothesis of Donaldson and Pendakur (2004). Using an alternative survey in Germany, giving questions in a different order, we concluded that framing effects are not behind our key finding of a negative dependence of equivalence scales on reference income. We suggested ways of combining our method with existing methodologies in future work.

[26] Blundell and Lewbel (1991) also conclude that it would be fruitful to combine demand data with experimental (or, as they say, "psychometric") data.
[27] We thank an anonymous referee for suggesting this point.

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	Germany			France		
	Sample: 167 obs.		**Pop.**	**Sample:** 223 obs.		**Pop.**
Gender	**N**	**%**	**%**	**N**	**%**	**%**
Female	71	42.5	51.1	106	47.5	51.3
Male	96	57.5	49.9	117	52.5	48.7
Partner in the Household						
Yes	97	58.1	58.0	154	69.1	72.4
No	70	41.9	42.0	69	30.9	37.6
Number of Children in the Household						
None	123	73.7	67.7	102	45.7	57.7
One	18	10.8	15.2	45	20.2	19.0
Two	15	8.9	13.1	46	20.6	15.8
More than two	11	6.6	4.0	30	13.5	7.5
Family After-tax Income Class						
1 (Y<1.75P)	32	19.2	18.1	18	8.1	11.2
2 (1.75P≤Y<1.75P+1.5P)	44	26.3	32.6	30	13.5	23.3
3 (1.75P+1.5P≤Y<1.75P+3P)	37	22.2	22.6	41	18.4	19.3
4 (1.75P+3P≤Y<1.75P+4.5P)	37	22.2	12.9	49	22.0	16.2
5 (1.75P+4.5P≤Y)	17	10.2	13.8	85	38.1	30.0
Adjusted After-tax Income Class						
1 (Y<1.75P)	50	29.9	(32.6)	24	10.8	(28.9)
2 (1.75P≤Y<1.75P+1.5P)	64	38.3	(45.6)	92	41.3	(40.8)
3 (1.75P+1.5P≤Y<1.75P+3P)	33	19.8	(16.8)	76	34.1	(17.5)
4 (1.75P+3P≤Y<1.75P+4.5P)	16	9.6	(4.1)	22	9.9	(6.4)
5 (1.75P+4.5P≤Y)	4	2.4	(0.9)	9	4.0	(6.4)
Occupational Group						
Welfare Recipient	2	1.1	3.3	1	0.4	
Unemployed	5	3.0	5.7	6	2.7	
Blue-collar Worker	10	6.0	20.7	6	2.7	
White-collar Worker	83	49.7	29.9	48	21.5	
Pupil, Student, Trainee	34	20.4	---	102	45.7	
Civil Servant	13	7.8	5.0	29	13.0	
Self-employed	7	4.2	5.8	13	5.8	
Pensioner	10	6.0	32.7	6	2.7	
Housewife, Houseman	3	1.8	---	12	5.4	
Education						
Below 9 years of Education	1	0.6		0	0.0	8.8
Completed Extended Elementary School	21	12.6	5.1	13	5.8	10.6
Completed Special Secondary School	39	23.4	18.6	43	19.3	46.9
Completed Secondary School	65	38.9	26.9	37	16.6	8.8
Technical School and University Degree	41	24.6	9.4	130	58.3	24.9
Number of Siblings during Childhood						
None	31	18.6		37	16.6	
One	55	32.9		72	32.3	
Two	47	28.1		59	26.5	
More than two	34	20.4		55	24.7	

Table 1 Breakdown of the Sample

Notes: For both countries we used our database of equivalence scales for calculating the adjusted income distribution in the way we explain in the text. For both countries we used the OECD equivalence scales for calculating numbers appearing in parentheses. Data in the columns "Population" refer to larger official surveys. Data on the non-adjusted German income distribution come from the 1999 German Microcensus. Data on the German gender distribution and data on education are taken from the 2000 official statistics of the German Statistisches Bundesamt. All other data for Germany are taken from the German 1998 Income and Expenditure Survey (EVS98) that is conducted every fifth year. Data on the French income distribution refer to the whole French population (23.3 million households). French education data refer to a sample of 7602 heads of French households. All French population data were provided to us by Francois Bourguignon.

Germany

Reference Income	AC Scale	ACC Scale	ACCC Scale	AA Scale	AAC Scale	AACC Scale	AACCC Scale	$(A+\alpha C)^{\theta}$ estimates	
								$\hat{\alpha}$	$\hat{\theta}$
1	1.570 (0.230)	2.020 (0.398)	2.473 (0.612)	1.753 (0.205)	2.269 (0.325)	2.725 (0.498)	3.174 (0.749)	0.67 (0.03)	0.83 (0.02)
2.5	1.241 (0.114)	1.436 (0.195)	1.629 (0.283)	1.495 (0.266)	1.718 (0.319)	1.919 (0.394)	2.115 (0.474)	0.42 (0.02)	0.63 (0.02)
4	1.174 (0.110)	1.315 (0.181)	1.451 (0.254)	1.460 (0.279)	1.612 (0.329)	1.755 (0.373)	1.887 (0.435)	0.32 (0.02)	0.58 (0.02)
5.5	1.128 (0.089)	1.233 (0.150)	1.339 (0.210)	1.387 (0.265)	1.508 (0.311)	1.615 (0.359)	1.726 (0.416)	0.27 (0.02)	0.51 (0.02)
7	1.112 (0.088)	1.205 (0.146)	1.295 (0.201)	1.389 (0.272)	1.493 (0.317)	1.587 (0.365)	1.677 (0.413)	0.23 (0.02)	0.50 (0.02)

France

Reference Income	AC Scale	ACC Scale	ACCC Scale	AA Scale	AAC Scale	AACC Scale	AACCC Scale	$(A+\alpha C)^{\theta}$ estimates	
								$\hat{\alpha}$	$\hat{\theta}$
1	1.579 (0.266)	2.055 (0.468)	2.487 (0.667)	1.734 (0.277)	2.224 (0.416)	2.670 (0.631)	3.092 (0.876)	0.72 (0.03)	0.76 (0.02)
2.5	1.300 (0.158)	1.539 (0.262)	1.756 (0.369)	1.505 (0.234)	1.763 (0.327)	1.981 (0.431)	2.188 (0.539)	0.51 (0.02)	0.61 (0.02)
4	1.253 (0.162)	1.444 (0.268)	1.614 (0.383)	1.441 (0.241)	1.636 (0.330)	1.806 (0.433)	1.966 (0.534)	0.47 (0.03)	0.52 (0.02)
5.5	1.211 (0.160)	1.370 (0.260)	1.511 (0.358)	1.403 (0.260)	1.569 (0.338)	1.714 (0.431)	1.847 (0.529)	0.42 (0.03)	0.49 (0.02)
7	1.196 (0.158)	1.341 (0.257)	1.473 (0.366)	1.403 (0.266)	1.553 (0.344)	1.683 (0.437)	1.808 (0.545)	0.38 (0.03)	0.49 (0.02)

Table 2 Average equivalence scales (standard errors in parentheses)

Table 3 - F-tests for exclusion of income dummies, Germany (1999) and France (2002)

Regressions for each different family type
Endogenous variable: equivalence scales stated by respondents
Number of observations: 835 (Germany), 1115 (France)
White's Heteroskedasticity correction for covariance matrix
t-statistics in parentheses
p-values of F-tests in brackets

Number of adults		**Number of Children**							
		0		**1**		**2**		**3**	
		A		**AC**		**ACC**		**ACCC**	
		Germany	**France**	**Germany**	**France**	**Germany**	**France**	**Germany**	**France**
		U R	**U R**	**U R**	**U R**	**U R**	**U R**	**U R**	**U R**
1	Constant			1.53 1.20 (62.32) (39.40)	1.47 1.20 (47.53) (36.85)	1.98 1.40 (44.83) (25.78)	1.91 1.40 (36.50) (24.50)	2.47 1.63 (35.22) (20.16)	2.26 1.54 (30.64) (18.70)
	Dummy Ref. Inc.= 2.5			-0.33 -- (-16.76) --	-0.28 -- (-13.66) --	-0.58 -- (-17.32) --	-0.52 -- (-14.57) --	-0.84 -- (-16.37) --	-0.73 -- (-14.63) --
	Dummy Ref. Inc.= 4			-0.40 -- (-20.28) --	-0.32 -- (-15.92) --	-0.71 -- (-21.13) --	-0.61 -- (-17.14) --	-1.02 -- (-20.13) --	-0.87 -- (-17.30) --
	Dummy Ref. Inc.= 5.5			-0.44 -- (-23.36) --	-0.37 -- (-17.99) --	-0.79 -- (-24.20) --	-0.69 -- (-19.35) --	-1.13 -- (-22.85) --	-0.98 -- (-19.64) --
	Dummy Ref. Inc.= 7			-0.46 -- (-24.19) --	-0.38 -- (-18.75) --	-0.81 -- (-25.09) --	-0.71 -- (-20.25) --	-1.18 -- (-23.81) --	-1.01 -- (-20.30) --
	$\overline{R}^2$ **F**			0.61 -0.01 321.96 [0.00]	0.38 0.01 162.78 [0.00]	0.63 0.00 351.76 [0.00]	0.42 0.01 198.37 [0.00]	0.62 0.00 330.69 [0.00]	0.43 0.02 203.65 [0.00]
		AA		**AAC**		**AACC**		**AACCC**	
		Germany	**France**	**Germany**	**France**	**Germany**	**France**	**Germany**	**France**
		U R	**U R**	**U R**	**U R**	**U R**	**U R**	**U R**	**U R**
2	Constant	1.69 1.43 (39.97) (31.40)	1.64 1.41 (37.78) (32.17)	2.17 1.62 (40.81) (25.11)	2.04 1.57 (34.69) (24.39)	2.63 1.83 (38.29) (21.50)	2.40 1.71 (30.52) (19.33)	3.11 2.05 (33.50) (18.90)	2.73 1.82 (27.04) (15.95)
	Dummy Ref. Inc.= 2.5	-0.26 -- (-9.84) --	-0.23 -- (-9.40) --	-0.55 -- (-15.54) --	-0.46 -- (-13.19) --	-0.81 -- (-16.39) --	-0.69 -- (-13.74) --	-1.05 -- (-15.47) --	-0.90 -- (-13.47) --
	Dummy Ref. Inc.= 4	-0.29 -- (-10.94) --	-0.29 -- (-11.93) --	-0.66 -- (-18.33) --	-0.59 -- (-16.82) --	-0.97 -- (-20.18) --	-0.86 -- (-17.27) --	-1.29 -- (-19.26) --	-1.13 -- (-16.87) --
	Dummy Ref. Inc.= 5.5	-0.37 -- (-14.16) --	-0.33 -- (-13.04) --	-0.76 -- (-21.91) --	-0.66 -- (-18.54) --	-1.11 -- (-23.43) --	-0.96 -- (-19.10) --	-1.45 -- (-21.90) --	-1.25 -- (-18.65) --
	Dummy Ref. Inc.= 7	-0.36 -- (-13.89) --	-0.33 -- (-12.89) --	-0.78 -- (-22.11) --	-0.67 -- (-18.83) --	-1.14 -- (-23.87) --	-0.99 -- (-19.58) --	-1.50 -- (-22.65) --	-1.28 -- (-19.06) --
	$\overline{R}^2$ **F**	0.24 0.03 59.05 [0.00]	0.20 0.01 66.39 [0.00]	0.46 0.01 171.42 [0.00]	0.35 0.02 143.69 [0.00]	0.53 0.00 233.73 [0.00]	0.39 0.02 169.03 [0.00]	0.54 0.00 244.66 [0.00]	0.40 0.03 173.09 [0.00]

Table 4 - F-tests for the log(equivalence scale) against log(reference income) specification, Germany (1999) and France (2002)

Regressions for each different family type
Endogenous variable: log of equivalence scales stated by respondents
Number of observations: 835 (Germany), 1115 (France)
White's Heteroskedasticity correction for covariance matrix
t-statistics in parentheses
p-values of F-tests in brackets

Number of adults		**Number of Children**													
		0				**1**				**2**				**3**			
1		**A**				**AC**				**ACC**				**ACCC**			
		Germany		**France**		**Germany**		**France**		**Germany**		**France**		**Germany**		**France**	
		U	**R**	**U**	**R**	**U**	**R**	**U**	**R**	**U**	**R**	**U**	**R**	**U**	**R**	**U**	**R**
	Constant					0.41 (24.58)	0.38 (23.52)	0.37 (17.68)	0.35 (17.29)	0.65 (26.73)	0.61 (25.74)	0.61 (21.10)	0.58 (20.67)	0.85 (27.73)	0.81 (26.95)	0.77 (21.63)	0.73 (21.18)
	log(Ref. Inc.)					-0.17 (-27.92)	-0.18 (-29.20)	-0.14 (-20.69)	-0.14 (-22.34)	-0.26 (-29.75)	-0.26 (-31.43)	-0.21 (-22.97)	-0.22 (-24.92)	-0.32 (-29.84)	-0.33 (-31.66)	-0.26 (-23.29)	-0.27 (-25.59)
	Dummy Ref. Inc.= 2.5					-0.07 (-7.59)	-- --	-0.06 (-5.94)	-- --	-0.09 (-7.09)	-- --	-0.08 (-5.80)	-- --	-0.11 (-6.39)	-- --	-0.09 (-5.40)	-- --
	Dummy Ref. Inc.= 4					-0.04 (-5.13)	-- --	-0.03 (-3.17)	-- --	-0.06 (-4.79)	-- --	-0.05 (-3.19)	-- --	-0.07 (-4.43)	-- --	-0.06 (-3.15)	-- --
	Dummy Ref. Inc.= 5.5					-0.03 (-3.50)	-- --	-0.02 (-2.06)	-- --	-0.04 (-3.32)	-- --	-0.03 (-2.01)	-- --	-0.05 (-2.92)	-- --	-0.04 (-2.01)	-- --
	$\overline{R}^2$					0.63	0.60	0.39	0.37	0.64	0.63	0.44	0.42	0.64	0.62	0.45	0.43
	F					16.30 [0.00]		8.81 [0.00]		14.34 [0.00]		8.42 [0.00]		11.84 [0.00]		7.43 [0.00]	
2		**AA**				**AAC**				**AACC**				**AACCC**			
		Germany		**France**		**Germany**		**France**		**Germany**		**France**		**Germany**		**France**	
		U	**R**	**U**	**R**	**U**	**R**	**U**	**R**	**U**	**R**	**U**	**R**	**U**	**R**	**U**	**R**
	Constant	0.50 (17.56)	0.48 (16.85)	0.48 (17.51)	0.46 (17.18)	0.73 (23.91)	0.70 (22.84)	0.68 (21.74)	0.66 (21.28)	0.90 (27.13)	0.87 (25.98)	0.82 (23.00)	0.79 (22.45)	1.06 (28.65)	1.02 (27.73)	0.93 (23.08)	0.90 (22.57)
	log(Ref. Inc.)	-0.13 (-13.88)	-0.13 (-16.34)	-0.11 (-13.41)	-0.12 (-15.85)	-0.22 (-21.78)	-0.22 (-25.31)	-0.19 (-19.43)	-0.19 (-22.57)	-0.29 (-24.50)	-0.29 (-28.11)	-0.24 (-21.09)	-0.24 (-24.14)	-0.33 (-25.24)	-0.33 (-28.56)	-0.28 (-21.53)	-0.29 (-24.54)
	Dummy Ref. Inc.= 2.5	-0.05 (-3.29)	-- --	-0.04 (-3.00)	-- --	-0.08 (-4.73)	-- --	-0.06 (-3.93)	-- --	-0.09 (-4.95)	-- --	-0.08 (-4.26)	-- --	-0.10 (-4.85)	-- --	-0.08 (-4.23)	-- --
	Dummy Ref. Inc.= 4	-0.02 (-1.12)	-- --	-0.03 (-2.28)	-- --	-0.05 (-2.33)	-- --	-0.05 (-2.94)	-- --	-0.05 (-2.61)	-- --	-0.06 (-3.12)	-- --	-0.06 (-2.83)	-- --	-0.07 (-3.09)	-- --
	Dummy Ref. Inc.= 5.5	-0.03 (-1.65)	-- --	-0.03 (-1.66)	-- --	-0.04 (-2.03)	-- --	-0.03 (-1.83)	-- --	-0.05 (-2.17)	-- --	-0.04 (-1.83)	-- --	-0.05 (-2.04)	-- --	-0.04 (-1.83)	-- --
	$\overline{R}^2$	0.24	0.24	0.20	0.19	0.42	0.41	0.34	0.33	0.49	0.48	0.38	0.37	0.52	0.51	0.40	0.39
	F	2.79 [0.03]		2.64 [0.03]		5.64 [0.00]		4.44 [0.00]		6.37 [0.00]		5.14 [0.00]		6.13 [0.00]		5.03 [0.00]	

Mean Stated Reference Income	AC Scale	ACC Scale	ACCC Scale	AA Scale	AAC Scale	AACC Scale	AACCC Scale	$(A+\alpha C)^{\theta}$ estimates	
								$\hat{\alpha}$	$\hat{\theta}$
1.43	1.44 (0.36)	1.83 (0.66)	2.20 (0.98)	1.57 (0.60)	2.00 (0.88)	2.39 (1.18)	2.77 (1.49)	0.69 (0.06)	0.71 (0.03)
2.76	1.30 (0.21)	1.56 (0.39)	1.81 (0.56)	1.43 (0.35)	1.73 (0.50)	2.00 (0.66)	2.29 (0.87)	0.59 (0.04)	0.60 (0.02)
4.17	1.29 (0.23)	1.53 (0.43)	1.76 (0.58)	1.43 (0.35)	1.71 (0.50)	1.95 (0.66)	2.17 (0.80)	0.57 (0.04)	0.58 (0.02)
5.36	1.25 (0.21)	1.47 (0.37)	1.69 (0.53)	1.40 (0.31)	1.65 (0.45)	1.87 (0.59)	2.10 (0.75)	0.54 (0.04)	0.55 (0.02)
6.61	1.24 (0.20)	1.44 (0.34)	1.65 (0.47)	1.40 (0.32)	1.64 (0.43)	1.86 (0.55)	2.09 (0.69)	0.50 (0.03)	0.56 (0.02)

Table 5.a Average equivalence scales for each demographic composition and for each income level. Data from the whole new sample (Germany 2003, L&H). Standard errors in parentheses.

Mean Stated Reference Income		AC Scale		ACC Scale		ACCC Scale		AA Scale		AAC Scale		AACC Scale		AACCC Scale		$(A+\alpha C)^{\theta}$ estimates			
																$\hat{\alpha}$		$\hat{\theta}$	
L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H
1.51	1.36	1.41 (0.25)	1.48 (0.43)	1.71 (0.39)	1.92 (0.82)	2.02 (0.56)	2.35 (1.20)	1.48 (0.36)	1.65 (0.74)	1.84 (0.48)	2.14 (1.09)	2.15 (0.64)	2.60 (1.47)	2.46 (0.79)	3.03 (1.84)	0.73 (0.07)	0.67 (0.09)	0.61 (0.03)	0.79 (0.05)
																F=0.31 [0.58]		F=8.90 [0.00]	
2.99	2.56	1.24 (0.14)	1.35 (0.25)	1.44 (0.24)	1.66 (0.45)	1.64 (0.36)	1.95 (0.66)	1.35 (0.27)	1.49 (0.39)	1.59 (0.35)	1.85 (0.58)	1.81 (0.46)	2.17 (0.75)	2.02 (0.57)	2.51 (1.00)	0.57 (0.05)	0.61 (0.06)	0.51 (0.02)	0.66 (0.03)
																F=0.26 [0.61]		F=15.64 [0.00]	
4.48	3.91	1.23 (0.16)	1.34 (0.27)	1.43 (0.28)	1.62 (0.50)	1.62 (0.41)	1.87 (0.67)	1.36 (0.32)	1.48 (0.37)	1.59 (0.41)	1.81 (0.54)	1.79 (0.53)	2.08 (0.73)	1.99 (0.66)	2.33 (0.87)	0.54 (0.05)	0.60 (0.06)	0.51 (0.03)	0.62 (0.03)
																F=0.44 [0.51]		F=8.31 [0.00]	
5.63	5.13	1.20 (0.17)	1.28 (0.24)	1.40 (0.32)	1.53 (0.40)	1.60 (0.49)	1.76 (0.55)	1.35 (0.30)	1.44 (0.32)	1.57 (0.40)	1.73 (0.47)	1.77 (0.55)	1.96 (0.62)	1.99 (0.70)	2.20 (0.79)	0.52 (0.06)	0.55 (0.05)	0.51 (0.03)	0.59 (0.03)
																F=0.14 [0.71]		F=4.98 [0.03]	
6.96	6.31	1.19 (0.12)	1.29 (0.23)	1.36 (0.24)	1.51 (0.39)	1.54 (0.36)	1.74 (0.52)	1.34 (0.31)	1.45 (0.32)	1.54 (0.37)	1.72 (0.46)	1.74 (0.46)	1.95 (0.60)	1.96 (0.61)	2.20 (0.75)	0.46 (0.04)	0.53 (0.05)	0.51 (0.02)	0.60 (0.03)
																F=1.13 [0.29]		F=5.77 [0.02]	
Joint F test of difference between L and H		9.74 [0.00]		10.01 [0.00]		9.04 [0.00]		5.48 [0.00]		8.80 [0.00]		8.96 [0.00]		8.69 [0.00]					

Table 5.b Average equivalence scales for each demographic composition and for each income level. Data from the new sample (Germany 2003), distinguishing questionnaire structures L and H, with F tests for differences in the estimates of each questionnaire type. Standard errors in parentheses and p-values of F tests in brackets.

Table 5.c Germany New survey, 2003

Regressions for the German 2003 sample and its subgroups defined by the type of questionnaire
Endogenous variable: log of equivalence scales stated by respondents
Number of observations: L&H 920, L 420, H 500
White's Heteroskedasticity correction for covariance matrix
t-statistics in parentheses
p-values of F-tests in brackets

Number of adults		**Number of Children**											
		0			**1**			**2**			**3**		
		A			**AC**			**ACC**			**ACCC**		
		L&H	**L**	**H**	**L&H**	**L**	**H**	**L&H**	**L**	**H**	**L&H**	**L**	**H**
1	Constant				0.47 (33.46)	0.41 (27.05)	0.48 (25.63) F=10.59 [0.00]	0.76 (43.31)	0.66 (35.38)	0.79 (34.07) F=19.28 [0.00]	0.98 (50.60)	0.86 (38.93)	1.01 (40.37) F=18.92 [0.00]
	Log of Stated Reference Income				-0.16 (-19.09)	-0.15 (-16.12)	-0.18 (-13.69) F=3.69 [0.06]	-0.26 (-24.88)	-0.23 (-20.28)	-0.28 (-18.39) F=8.57 [0.00]	-0.33 (-28.32)	-0.29 (-21.62)	-0.35 (-21.20) F=8.35 [0.00]
	Questionnaire Type L				-0.04 (-4.98)	---	---	-0.06 (-5.59)	---	---	-0.07 (-5.25)	---	---
	$\overline{\mathbf{R}}^2$				0.42	0.42	0.39	0.50	0.50	0.48	0.53	0.50	0.52
2		**AA**			**AAC**			**AACC**			**AACCC**		
		L&H	**L**	**H**	**L&H**	**L**	**H**	**L&H**	**L**	**H**	**L&H**	**L**	**H**
	Constant	0.59 (20.06)	0.52 (23.01)	0.60 (21.82) F=5.89 [0.02]	0.89 (45.44)	0.78 (36.31)	0.91 (35.24) F=14.64 [0.00]	1.01 (55.88)	0.97 (42.06)	1.13 (45.00) F=21.58 [0.00]	1.27 (62.30)	1.13 (44.65)	1.31 (51.07) F=24.39 [0.00]
	Log of Stated Reference Income	-0.19 (-14.65)	-0.17 (-12.28)	-0.20 (-10.30) F=1.29 [0.26]	-0.28 (-23.47)	-0.25 (-18.98)	-0.30 (-17.02) F=4.43 [0.04]	-0.34 (-29.02)	-0.31 (-21.52)	-0.37 (-22.08) F=8.55 [0.00]	-0.39 (-31.79)	-0.34 (-22.51)	-0.42 (-24.77) F=10.73 [0.00]
	Questionnaire Type L	-0.05 (-4.21)	---	---	-0.07 (-5.49)	---	---	-0.08 (-5.55)	---	---	-0.08 (-5.34)	---	---
	$\overline{\mathbf{R}}^2$	0.29	0.25	0.29	0.46	0.42	0.45	0.52	0.47	0.53	0.54	0.47	0.55

Reference Income	AC Scale		ACC Scale		ACCC Scale		AA Scale		AAC Scale		AACC Scale		AACCC Scale		$(A+\alpha C)^{\theta}$ estimates	
															$\hat{\alpha}$	$\hat{\theta}$
	UR\WR	WR	UR\WR	WR	UR\WR	WR	UR\WR	WR	UR\WR	WR	UR\WR	WR	UR\WR	WR	UR\WR WR	UR\WR WR
1	1.57 (0.23)	1.56 (0.22)	2.02 (0.39)	2.03 (0.41)	2.48 (0.60)	2.46 (0.62)	1.73 (0.27)	1.80 (0.20)	2.26 (0.32)	2.30 (0.33)	2.69 (0.49)	2.80 (0.51)	3.14 (0.73)	3.26 (0.78)	0.70 (0.03) 0.62 (0.04) F=1.78 [0.18]	0.81 (0.02) 0.87 (0.03) F=3.42 [0.06]
2.5	1.22 (0.10)	1.27 (0.12)	1.41 (0.18)	1.49 (0.20)	1.59 (0.28)	1.69 (0.27)	1.48 (0.27)	1.52 (0.26)	1.69 (0.33)	1.77 (0.30)	1.87 (0.41)	1.99 (0.35)	2.06 (0.50)	2.20 (0.41)	0.40 (0.02) 0.44 (0.03) F=1.56 [0.21]	0.61 (0.02) 0.65 (0.02) F=2.36 [0.13]
4	1.17 (0.11)	1.18 (0.11)	1.31 (0.18)	1.33 (0.18)	1.45 (0.25)	1.46 (0.25)	1.48 (0.28)	1.38 (0.25)	1.63 (0.33)	1.54 (0.29)	1.77 (0.38)	1.69 (0.33)	1.90 (0.45)	1.81 (0.37)	0.30 (0.02) 0.39 (0.05) F=3.18 [0.07]	0.59 (0.01) 0.50 (0.03) F=7.92 [0.00]
5.5	1.13 (0.09)	1.10 (0.05)	1.24 (0.15)	1.19 (0.11)	1.35 (0.21)	1.27 (0.15)	1.40 (0.26)	1.30 (0.25)	1.52 (0.31)	1.40 (0.29)	1.63 (0.36)	1.49 (0.32)	1.74 (0.42)	1.60 (0.38)	0.27 (0.02) 0.27 (0.05) F=0.00 [0.99]	0.52 (0.01) 0.42 (0.04) F=4.92 [0.03]
7	1.11 (0.09)	1.03 (0.05)	1.21 (0.14)	1.06 (0.10)	1.30 (0.20)	1.09 (0.16)	1.40 (0.27)	1.14 (0.25)	1.50 (0.31)	1.17 (0.30)	1.60 (0.36)	1.20 (0.35)	1.69 (0.41)	1.23 (0.40)	0.24 (0.01) 0.18 (0.17) F=0.13 [0.72]	0.51 (0.01) 0.21 (0.10) F=8.91 [0.00]
Joint F test of difference between UR\WR and WR	4.24 [0.00]		3.57 [0.00]		3.23 [0.01]		2.86 [0.01]		2.52 [0.03]		2.84 [0.02]		2.70 [0.02]			

Table 6.a Old sample (Germany 1999), distinguishing respondent groups UR\WR and WR. Standard errors in parentheses and p-values of F tests in brackets.

Reference Income	AC Scale		ACC Scale		ACCC Scale		AA Scale		AAC Scale		AACC Scale		AACCC Scale		$(A+\alpha C)^{\theta}$ estimates	
															$\hat{\alpha}$	$\hat{\theta}$
	UR\WR	WR	UR\WR	WR	UR\WR	WR	UR\WR	WR	UR\WR	WR	UR\WR	WR	UR\WR	WR	UR\WR WR	UR\WR WR
1	1.58 (0.25)	1.59 (0.34)	2.05 (0.47)	2.10 (0.47)	2.47 (0.66)	2.62 (0.70)	1.73 (0.26)	1.78 (0.40)	2.22 (0.40)	2.27 (0.50)	2.66 (0.62)	2.77 (0.71)	3.07 (0.85)	3.30 (1.03)	0.74 (0.03) 0.74 (0.10) F=0.00 [0.96]	0.78 (0.02) 0.82 (0.05) F=0.50 [0.48]
2.5	1.27 (0.13)	1.34 (0.18)	1.49 (0.22)	1.61 (0.30)	1.69 (0.32)	1.84 (0.41)	1.46 (0.22)	1.57 (0.23)	1.70 (0.30)	1.85 (0.34)	1.90 (0.39)	2.10 (0.46)	2.09 (0.48)	2.32 (0.58)	0.51 (0.03) 0.52 (0.03) F=0.00 [0.98]	0.58 (0.01) 0.67 (0.02) F=14.46 [0.00]
4	1.27 (0.18)	1.22 (0.12)	1.48 (0.30)	1.37 (0.18)	1.67 (0.43)	1.51 (0.24)	1.45 (0.26)	1.41 (0.18)	1.66 (0.37)	1.58 (0.23)	1.85 (0.49)	1.71 (0.27)	2.03 (0.60)	1.83 (0.33)	0.52 (0.03) 0.43 (0.03) F=4.24 [0.04]	0.55 (0.02) 0.51 (0.01) F=3.47 [0.06]
5.5	1.22 (0.16)	1.17 (0.09)	1.38 (0.27)	1.29 (0.15)	1.52 (0.37)	1.40 (0.21)	1.42 (0.26)	1.28 (0.23)	1.59 (0.34)	1.41 (0.27)	1.74 (0.44)	1.52](0.31)	1.87 (0.54)	1.62 (0.37)	0.43 (0.03) 0.50 (0.09) F=0.64 [0.42]	0.52 (0.01) 0.37 (0.03) F=15.55 [0.00]
7	1.20 (0.16)	1.13 (0.12)	1.34 (0.26)	1.25 (0.25)	1.48 (0.36)	1.38 (0.37)	1.41 (0.26)	1.28 (0.31)	1.56 (0.34)	1.40 (0.42)	1.69 (0.43)	1.52 (0.54)	1.81 (0.54)	1.65 (0.64)	0.40 (0.02) 0.43 (0.18) F=0.02 [0.88]	0.51 (0.01) 0.40 (0.09) F=1.61 [0.20]
Joint F test of difference between UR\WR and WR	4.41 [0.00]		5.38 [0.00]		5.67 [0.00]		4.76 [0.01]		5.27 [0.00]		6.04 [0.00]		5.83 [0.00]			

Table 6.b French sample (France 2002), distinguishing respondent groups UR\WR and WR. Standard errors in parentheses and p-values of F tests in brackets.

Table 7.a Equivalence scales for Germany obtained from consumer data

Household Type	Engel[a]	Barten[b]	Translating[b]	Prais and Houthakker[b]	Own Estimates[c]
A	1.00	1.00	1.00	1.00	1.00
AA	1.81	1.48	1.34	1.55	1.50 [1.39 - 1.75]
AAC	2.19	1.73	1.53	1.84	1.72 [1.49 - 2.27]
AACC	2.45	1.89	1.64	2.02	1.92 [1.59 - 2.72]
AACCC	2.77	1.98	1.72	2.17	2.12 [1.68 - 3.17]

Source: Faik (1995) and own estimates.
[a] Equivalence scales for commodity group food.
[b] Equivalence scales for arithmetic mean of income.
[c] Average equivalence scales across all reference-income levels (Germany). In parentheses: equivalence scales of the highest and lowest reference-income level.

Table 7.b Subjective equivalence scales for Germany and France

Source	Country	Income Level	Equivalence Scale for AACCC
van Praag et al. (1980)	France Germany	minimal	1.50 1.83
van Praag et al. (1982)	France Germany	mean	1.22 1.54
van Praag et al. (1988)	France Germany	insufficient	1.51 1.83
van Praag and Flik (1992)	France	mean	1.40 - 1.60[a]
Hagenaars (1985)	France Germany	mean	1.24 1.38
Riffault and Rabier (1977)	France	Mean	2.23
Own Estimates	France Germany	range of highest and lowest reference income	1.81 - 3.09 1.68 - 3.17

Source: van den Bosch (1999) and own estimates.
[a] Equivalence scales vary according to model specification.

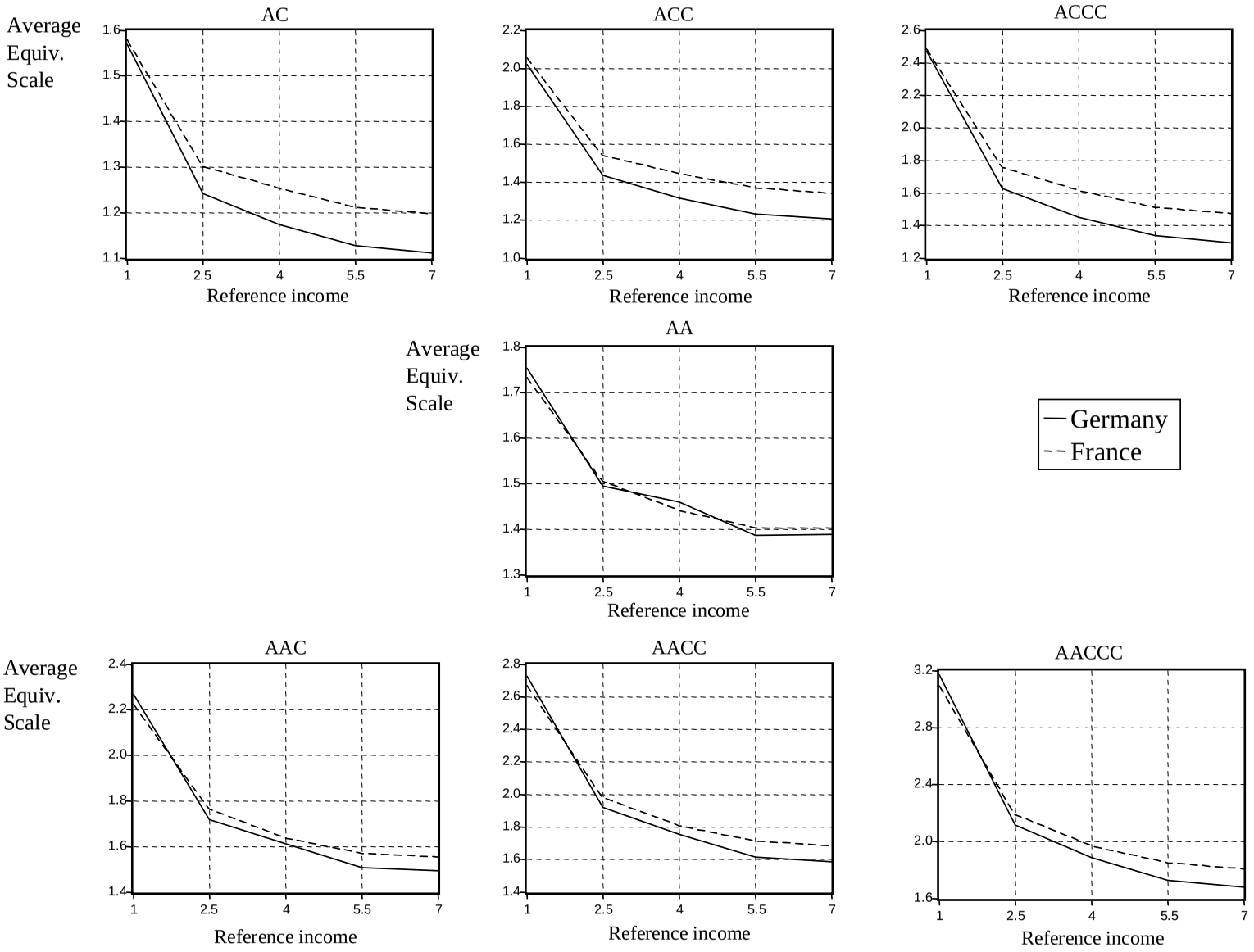

Figure 1 Average Equivalence Scales

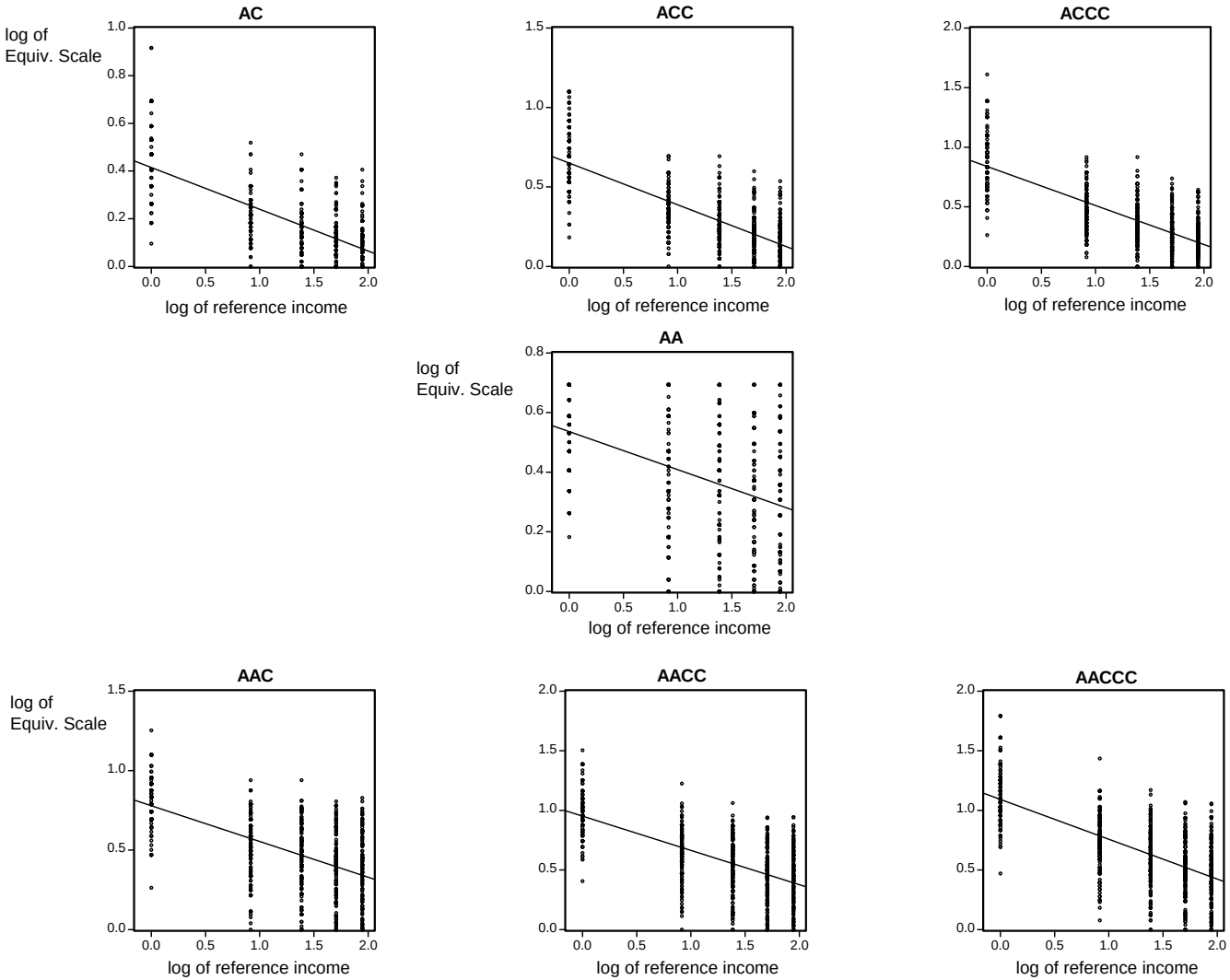

Figure2.a Germany Scatter plots of the log of equivalence scales versus the log of reference income for each family type

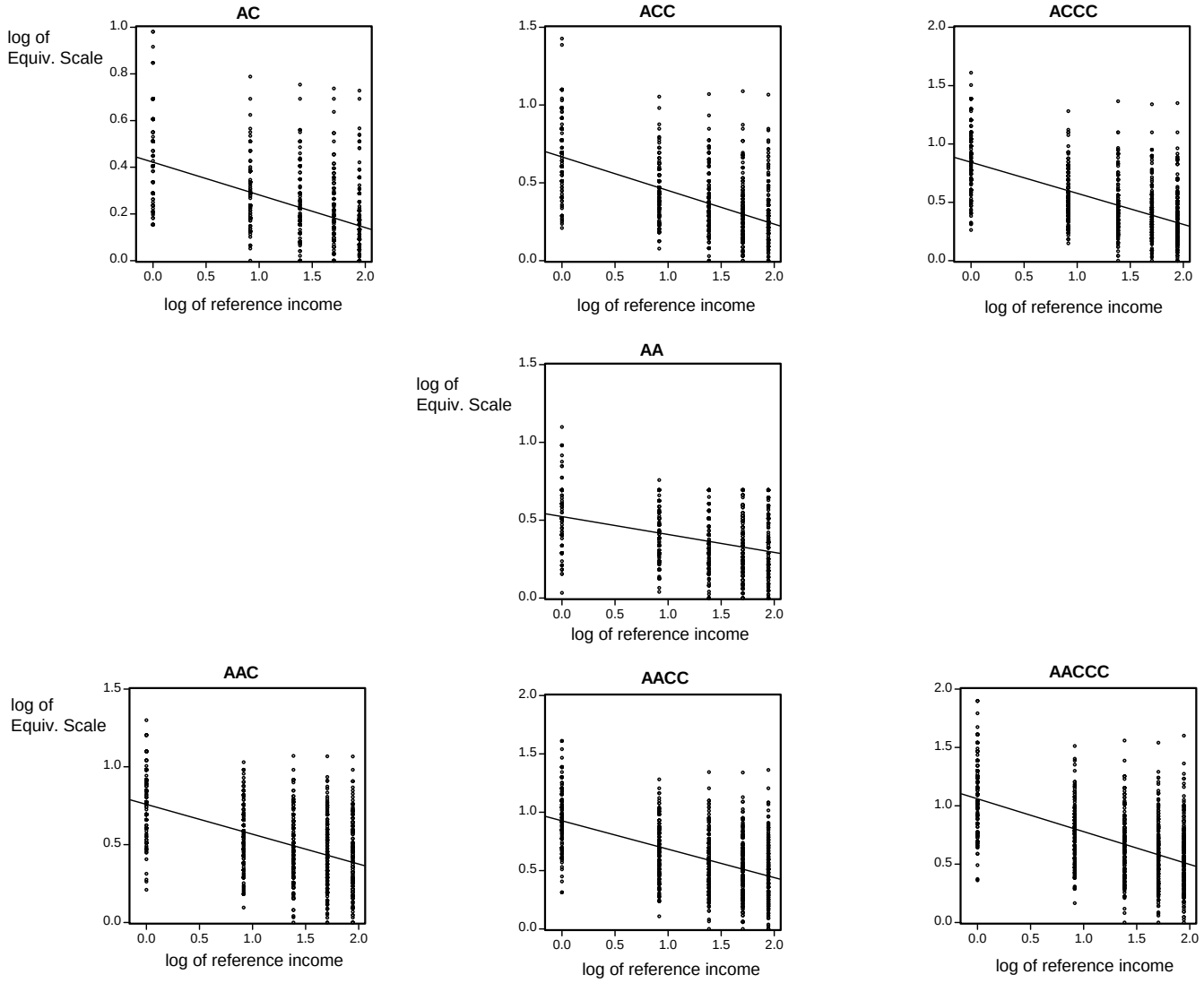

Figure 2.b France Scatter plots of the log of equivalence scales versus the log of reference income for each family type

Appendix

A1 Questionnaire of the original survey

Attention: After filling out this questionnaire, all questionnaires will be immediately put in identical envelopes. This ensures that your responses will be treated anonymously. All collaborators engaged in collecting or analysing data for the present survey are obliged to treat personal data confidentially.

1. Purpose of the survey
In order to determine social assistance levels or tax rates in an equitable way, one has to compare the income needs of households which differ in size or composition. In general, different household types may have different income needs in order to attain a given living standard. Since these income needs are difficult to assess in an objective way, we would like to ask you for your personal evaluation. Please note that in the following questionnaire do not exist objectively "right" or "wrong" answers, which means that your answers should only reflect your personal judgements.

2. Income evaluation questions
In the tables below you shall evaluate five different situations. The situations differ by the pre-specified monthly net income (including all social transfers) of a single adult household. Now consider for each situation separately that the size and composition of the households change according to the table. Which monthly net income would each household type need in order to attain the same living standard as the single adult household with the pre-specified income? You should state precisely this income for each household type in the tables below. Within a given table, all household types should attain an identical living standard. Assume for your assessment that adults are between 35 and 55 and children between 7 and 11 years old.

Single adult household without a child	Reference income=1000 DM	Two adult household without a child	?
One parent household with 1 child	?	Two parent household with 1 child	?
One parent household with 2 children	?	Two parent household with 2 children	?
One parent household with 3 children	?	Two parent household with 3 children	?

We provide 4 additional tables as this above with increasing reference incomes (2500, 4000, 5500 and 7500 DM).

3. Questions pertaining the respondent
Please mark the answers that apply to you. Your answers will be treated confidentially.

1) Please state your gender:
- ☐ male
- ☐ female

2) Do you have a partner living in your household?
- ☐ yes
- ☐ no

3) How many children live in your household?
- ☐ 0
- ☐ 1
- ☐ 2
- ☐ 3 or more

4) In which range is the total net monthly income of your household?

- ☐ below 1750 DM
- ☐ 1750-3249 DM
- ☐ 3250-4749 DM
- ☐ 4750-6249 DM
- ☐ more than 6249 DM

5) Please state your occupation

- ☐ welfare recipient
- ☐ unemployed
- ☐ blue-collar worker
- ☐ white-collar worker
- ☐ civil servant
- ☐ pupil, student, Trainee
- ☐ self-employed
- ☐ pensioner
- ☐ housewife/-man

6) Please state your education level:

- ☐ less than 9 years of education
- ☐ completed extended elementary school
- ☐ completed special secondary school
- ☐ completed secondary school
- ☐ technical school or university degre

7) How many siblings did you have during your childhood?

- ☐ 0
- ☐ 1
- ☐ 2
- ☐ 3 or more

A2 Questionnaire of the new survey

The only difference between the new questionnaire and the old one is that the five tables now have the following form:

Two parent household with 3 children	reference income	One parent household with 3 children	?
Two parent household with 2 children	?	One parent household with 2 children	?
Two parent household with 1 child	?	One parent household with 1 child	?
Two adult household without a child	?	Single adult household without a child	?

In group L of the new survey, reference incomes were, as in the questionnaire of the original survey, presented in increasing order, i.e. starting from 3400 DM and ending with 12550 DM (the closest rounded numbers of averages of the stated equivalent incomes from the first survey), whereas in group H reference incomes were presented in decreasing order, i.e. starting from 12550 DM and ending with 3400 DM. In order to ensure comparability of the original and the new survey, we have chosen as currency for the stated reference incomes, as well as for the responses, German Marks in the new survey as well. However, for the stated reference incomes we also gave, in parentheses, the corresponding amount in Euros.