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Reference Income Effects in the Determination of Equivalence Scales Using Income Satisfaction Data

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What are Equivalence Scales?

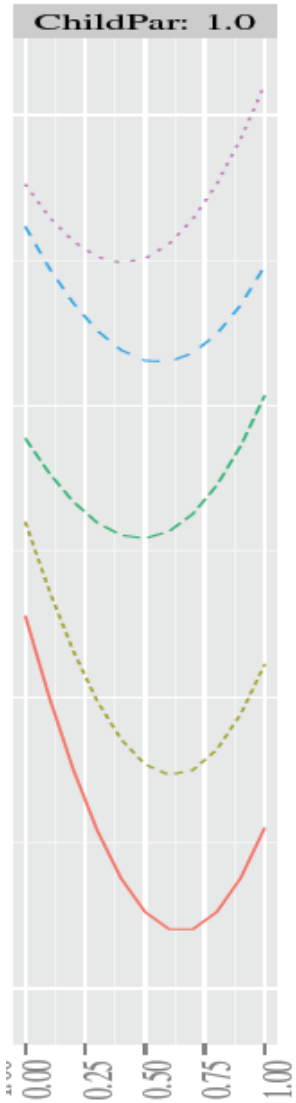
- They represent the cost ratio required to equate the well-being or utility for households with different sizes and compositions.

$$S\left(\underline{p},U_o;A,K\right)=\frac{E\left(\underline{p},U_o;A,K\right)}{E\left(\underline{p},U_o;A_R,K_R\right)}=S\left(A,K\right)$$

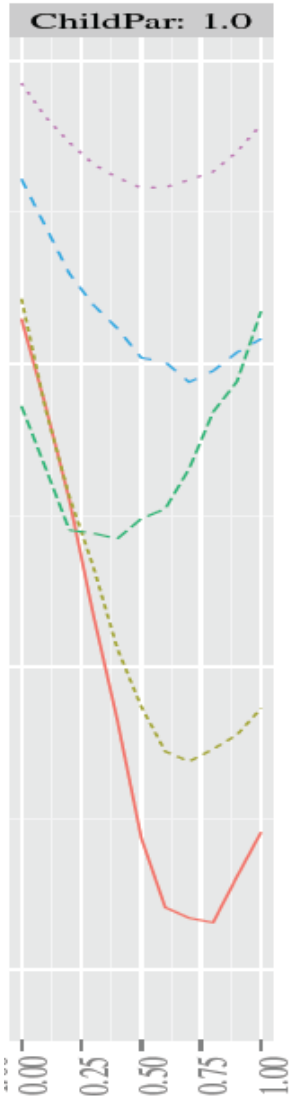
- Key is U_0 = max U(x,A,K)
  subject to px ≤ T
  - That is, U_0 solves T = E(p,U_0,A, K).
- This will only hold for U_0 and is not a "general" equivalence scale. And scale could be different for different levels of U_0.

Equivalence Scales impact both inequality and poverty
Scale elasticity creates U-shape relationship

Gini



Poverty



Types of equivalence scales (Deaton 1999)

- The analysis of behavior -- using the consumption patterns of families to estimate the scale economies.
- Arbitrary but transparent formulas -- using the two-parameter scale.
- Asking people -- using subjective responses related by family size.

Parametric equivalence scales

- Linear scales
  - 1 + aA + cK (OECE a=.5; c=.3)
- One-parameter scale
  - $(M)^e = (M)^{0.5}$

    M = household size
- Two-parameter scale

  $(A+\delta K)^e = (A+0.7K)^{0.7}$

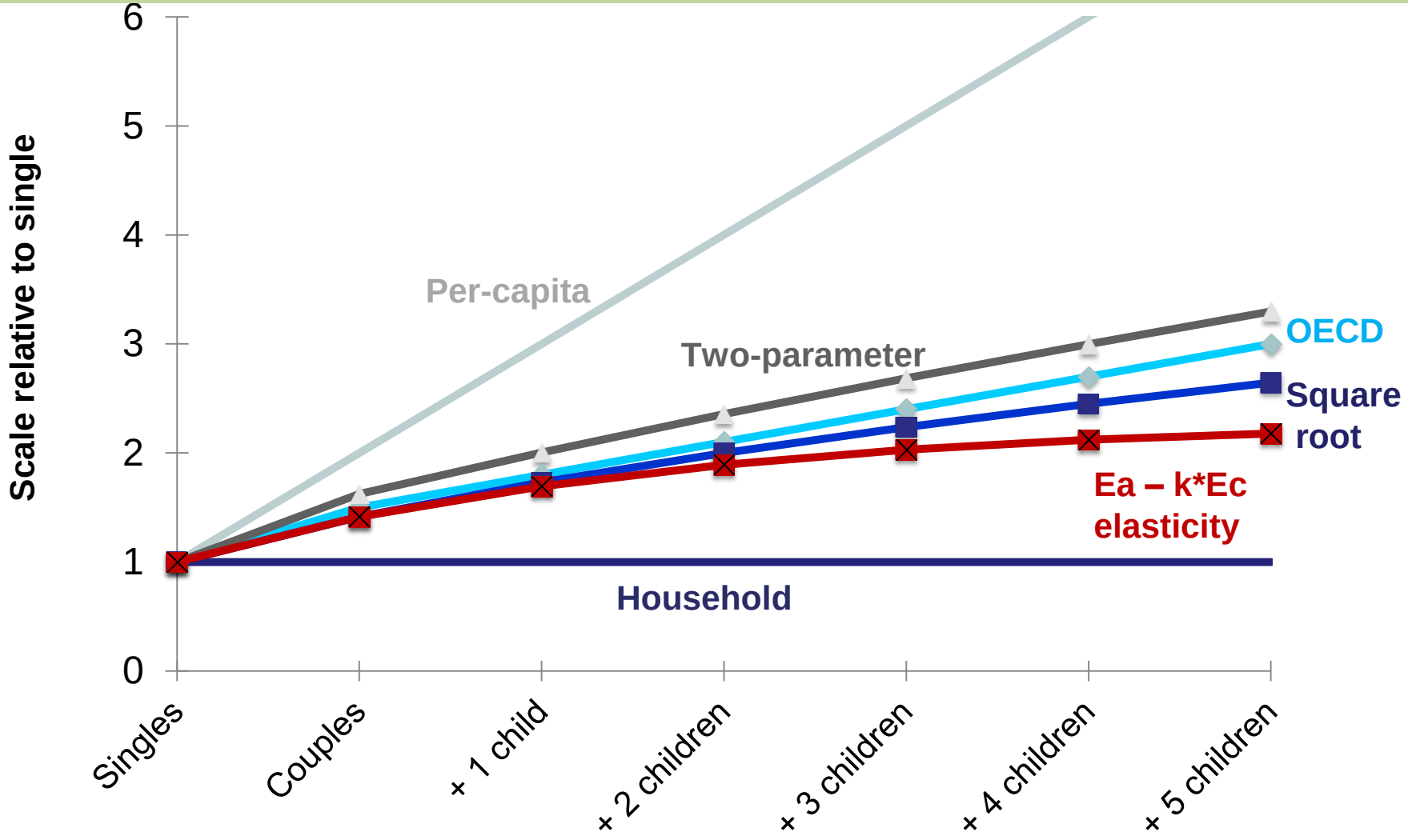
  A = # of adults, K = # of children

- Modified elasticity (Schwarze)

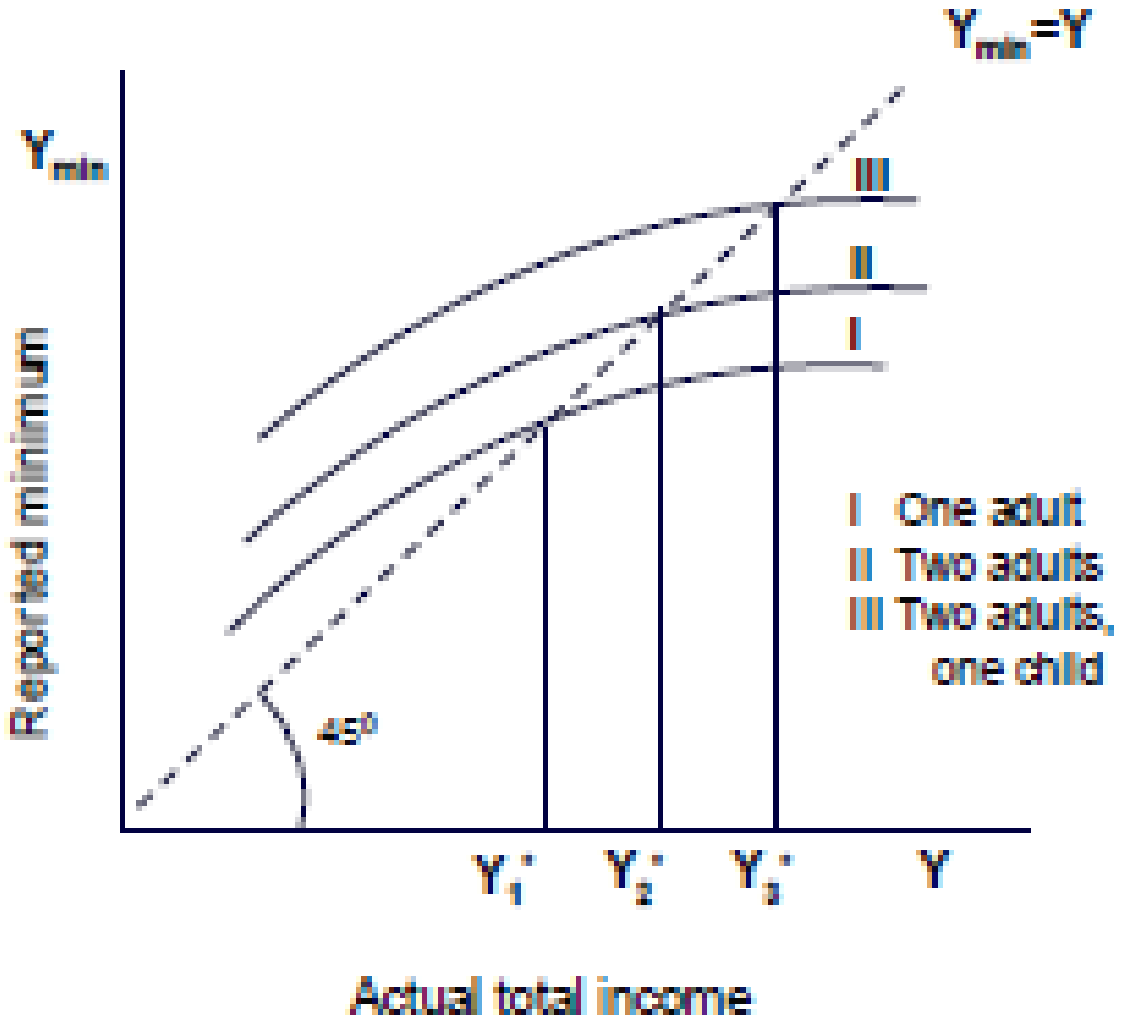
  $(A+K)^{ea-bK} = (A+K)^{0.5-.02K}$

  A = # of adults, K = # of children

Equivalence Scales and Economies of Scale



Subjective Equivalence Scales



Other Scale Estimates using Income Satisfaction method

	2nd Adult	1st Child	2nd Child
Expert Scale			
OECD	0.50	0.30	0.30
Equivalence Scales using Income Satisfaction Data (SOEP)			
Schwarze (2003)	0.34	0.17	0.08
Schwarze (2003) FE	0.28	0.13	0.06
Biewen & Juhasz (2014) OECD-type	0.29	0.11	0.11
Van Praag & Ferrer-i-Carbonell (2004) Deutschland	0.23	0.16	0.10
Bollinger (2102), BHPS	0.15	1.13	0.68

Why do we care about scales

- Adults receive higher weights than children.
  - Weights for children are very low.
- Income satisfaction may be influenced by a variety of factors
  - Satisfaction of genuine needs
  - Income comparisons (Clark et al. 2008)
    - interpersonal or intertemporal
- Equivalence Scales intend to capture differences in needs

Subjective Equivalence Scale Methods

- Basic Approach: Regressing income satisfaction on household income and family size/structure to calculate income compensation needed to hold satisfaction constant
- Schwarze (2003, *RoIW*)

$$S_{it} = \beta_0 + \beta_1 ln\left(\frac{Y_{it}}{h_{it}^{\ e}}\right) + X_{it}'\beta_2 + \varepsilon_{it}$$

$$= \beta_0 + \underbrace{\beta_1 ln Y_{it} - \beta_1 e ln h_{it}}_{e=\beta_1 e/\beta_1} + X_{it}'\beta_2 + \varepsilon_{it}$$

Model specification including children:

$$\left.\begin{aligned} S_{it} &= \beta_0 + \beta_1 ln\left(\frac{Y_{it}}{h_{it}^{\ a-bk_{it}}}\right) + X_{it}'\beta_2 + \varepsilon_{it} \\ &= \beta_0 + \beta_1 ln Y_{it} - \beta_1 a ln h_{it} + \beta_1 bk_{it} ln h_{it} + X_{it}'\beta_2 + \varepsilon_{it} \end{aligned}\right\} \quad a = \frac{\beta_1 a}{\beta_1}, b = \frac{\beta_1 b}{\beta_1}$$

Some examples of relative income

Example 1: A partner joins the household of a previously single adult

- Suppose the income required to satisfy additional consumption needs increases by 60 %
- The reference income is now twice as large
- Income satisfaction will be kept constant only if household income increases by something between 60% and 100%

Example 2: A couple has a child

- Suppose the income required to satisfy additional consumption needs increases by 60 % again
- The reference income increases by only 10%
- An income compensation of something between 10% and 60% will be estimated

- Equivalence weight estimates will be biased, depending on whether an individual's contribution to the household's needs is above or below the contribution its reference income

The impact of relative income

- Assuming that income satisfaction depends additively on the household's equivalence and relative income:

$$S_{it} = \alpha + \underbrace{\beta_1 \; ln\left(\frac{Y_{it}}{HHeq_{it}}\right)}_{needs\ satisfaction} + \underbrace{\beta_2 \; ln\left(\frac{Y_{it}}{Y_{it}^{r}}\right)}_{status\ satisfaction} + \varepsilon_{it}$$

- Illustration using the linear model (Schwarze (2003))

$$\left.\begin{aligned} S_{it} &= \alpha + \beta_1 \, ln\left(\frac{Y_{it}}{h_{it}^{\,e_1}}\right) + \beta_2 \, ln\left(\frac{Y_{it}}{a h_{it}^{\,e_2}}\right) + \varepsilon_{it} \\ &= \underbrace{\alpha - \beta_2 \, ln\, a}_{\text{const.}} + \underbrace{\left(\beta_1 + \beta_2\right)}_{\tilde{\beta}} ln\, Y_{it} - \underbrace{\left(\beta_1 e_1 + \beta_2 e_2\right)}_{\tilde{\beta}\tilde{e}} ln\, h_{it} + \varepsilon_{it} \end{aligned}\right\} \quad \tilde{e} = \frac{\beta_1}{\beta_1 + \beta_2} e_1 + \frac{\beta_2}{\beta_1 + \beta_2} e_2$$

The impact of relative income

- Illustration using the linear model accounting for children (Schwarze (2003))

$$S_{it} = \alpha + \beta_1 \, ln\left(\frac{Y_{it}}{h_{it}^{\,a_1 - b_1 k_{it}}} \right) + \beta_2 \, ln\left(\frac{Y_{it}}{a h_{it}^{\,a_2 - b_2 k_{it}}} \right) + \varepsilon_{it}$$

$$= \underbrace{\alpha - \beta_2 \, ln\, a}_{\text{const.}} + \underbrace{\left(\beta_1 + \beta_2\right)}_{\tilde{\beta}} ln\, Y_{it} - \underbrace{\left(\beta_1 a_1 + \beta_2 a_2\right)}_{\tilde{\beta}\tilde{a}} ln\, h_{it} + \underbrace{\left(\beta_1 b_1 + \beta_2 b_2\right)}_{\tilde{\beta}\tilde{b}} k_{it} \, ln\, h_{it} + \varepsilon_{it}$$

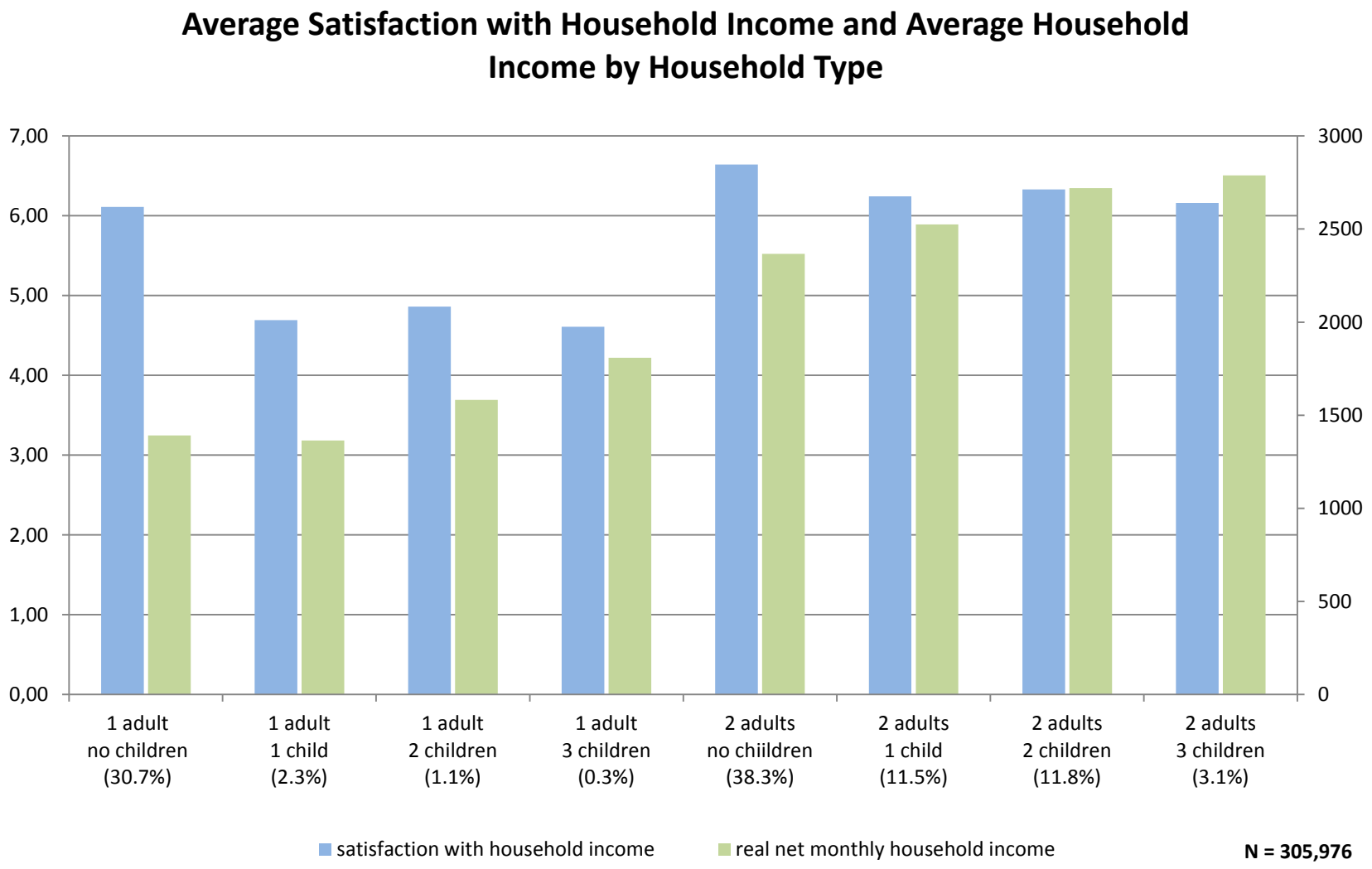
$$\tilde{a} = \frac{\beta_1}{\beta_1 + \beta_2} a_1 + \frac{\beta_2}{\beta_1 + \beta_2} a_2 \; ; \qquad \tilde{b} = \frac{\beta_1}{\beta_1 + \beta_2} b_1 + \frac{\beta_2}{\beta_1 + \beta_2} b_2$$

- for $a_1 < a_2$: Overestimation of additional adults' needs
- for $b_1 > b_2$: Underestimation of children's needs

Data

- SOEP, 1984-2013
- Dependent variable: Satisfaction with household income (on a scale from 0 to 10)
- net monthly household income, adjusted for intertemporal and regional price level differences
  - The first and last percentile of household in each year's income distribution have been dropped
- Every person below the age of 18 is considered a child
- Only one- and two-adult households with or without minor children have been included in our sample
  - The second adult has to be the head of household's partner.
  - Households with adults children are thus ignored.

Satisfaction and Income in the Data



Estimation Model

- Linear model including reference income effects

$$S_{it} = \alpha + \beta_1 \; ln\left(\frac{Y_{it}}{h_{it}^{\,a-bk_{it}}} \right) + \beta_2 \; ln\left(\frac{Y_{it}}{Y_{it}^{r}} \right) + \varepsilon_{it}$$

  - Estimation using Ordered Logit

- Nonlinear model including reference income effects

$$S_{it} = \alpha + \beta_1 \cdot ln\left(\frac{Y_{it}}{1 + a \cdot (adults_{it} - 1) + c \cdot (children_{it})} \right) + \beta_2 \cdot ln\left(\frac{Y_{it}}{Y_{it}^{r}} \right) + \varepsilon_{it}$$

  - Estimation using Nonlinear Least Squares

How to construct Reference Incomes

- Two approaches to constructing an individual's reference income:
  - Average income of people /households with the same characteristics (e.g. Ferrer-i-Carbonell 2005, *JPubE*)
    - Number of adults, age group, education, east/west, with/without children, year
  - Estimation via an earnings regression (e.g. Senik 2008, *Economica*)
    - Linear regression with the following explanatory variables: number of adults and children, age, education, east/west, labor market status, gender, year
    - Extension: Taking the partner's characteristics into account

Results – Linear model

Dependent Variable:	Satisfaction with Household Income			
	No Reference Effect	Cell averages	Individual Mincer	Household Mincer
ln Household Income (β_1)	2.016*** (0.020)	1.548*** (0.072)	1.708*** (0.027)	1.678*** (0.030)
ln Household Members ($\beta_1 a$)	-0.992*** (0.030)	-0.672*** (0.073)	-0.741*** (0.035)	-0.760*** (0.034)
Children * ln Household Members ($\beta_1 b$)	0.040*** (0.009)	-0.012 (0.017)	-0.0032 (0.010)	0.000 (0.010)
ln Relative Income	-	0.640*** (0.069)	0.504*** (0.028)	0.599*** (0.036)
N	316,240	310,363	310,293	296,472
Pseudo R^2	0.054	0.055	0.055	0.055
$e = a - bk$	$0.492^{***} - 0.020^{***}k$	$0.434^{***} + 0.008k$	$0.434^{***} + 0.001k$	$0.453^{***} - 0.000k$

With additional control variables, e = .381 - .026k

Results – non-linear model

Dependent Variable:	Satisfaction with Household Income			
	No Reference Effect	Cell averages	Individual Mincer	Household Mincer
Scale Parameter Adult	0.352*** (0.015)	0.214*** (0.051)	0.240*** (0.018)	0.263*** (0.019)
Scale Parameter Child	0.234*** (0.009)	0.295*** (0.027)	0.262*** (0.011)	0.277*** (0.012)
ln Equivalent Income	2.268*** (0.021)	1.570*** (0.095)	1.835*** (0.030)	1.798*** (0.034)
ln Relative Income	-	0.908*** (0.092)	0.654*** (0.032)	0.774*** (0.041)
N	316,240	310,363	310,293	296,472
adj. R^2	0.204	0.208	0.209	0.209

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Standard errors in parentheses, clustered by households. Standard errors in column 2 clustered by reference groups. Column 3 and 4 report bootstrapped standard errors based on 1000 replications.

Summary

- One approach to estimate equivalence scales is to use income satisfaction data
- Results in the related literature so far:
  - Weights assigned to additional household members are generally low
  - Children are assigned much lower weights than adults
- Possible explanation: reference income effects
  - When reference income effects are taken into account, the estimated needs of adults and children converge
- However: overall weights remain quite low
- Examining by age of child – older children have larger scale

Comments

- As in previous literature, scales are low – how can we reconcile?
- Demonstrate why these differences matter – to poverty or inequality
- Can you include all families – with more than two adults
- Intra-household distribution – who responds to the life-satisfaction questions and are there differences between mothers and fathers?
- Estimate consumption-based scales using GSOEP and compare to satisfaction-based (needs and life satisfaction)
- Estimate life-cycle scales – scales change depending on the place in life-cycle
- Do scales, economics of scale, change over time

Results – Robustness

Results reported for the nonlinear model using two-stage regression using household Mincer earnings

Specification	weight assigned to additional adults	weight assigned to children			observations
Probit-adjusted	**0.290** (0.019)	**0.292** (0.013)			296,472
Including mean relative income	**0.258** (0.019)	**0.280** (0.012)			296,472
Excluding households making payments to children outside the household	**0.263** (0.019)	**0.263** (0.012)			267,581
Asymmetric reference effects	**0.278** (0.019)	**0.291** (0.012)			296,472
Age-dependent weights for children	**0.270** (0.019)	0-5 **0.227** (0.016)	6-13 **0.253** (0.014)	14-17 **0.414** (0.019)	296,472

Standard errors in column 3 clustered by reference groups. Bootstrapped standard errors based on 1000 replications in parentheses, clustered by households.

Equivalence Scales reflect the differences in expenditures of households of different sizes and composition, when all these households „attain the same level of utility or standard of living“ (Lewbel and Pendakur, 2008)

- Applied to make household income comparable whenever welfare is of greater importance than absolute level of income
    - Income inequality and poverty analysis
    - Design of redistributive policies
        - E.g. German social security system provides children with benefits of 60% (under 15) and 80% (above and including 15) of a single‘s benefits
- Different approaches to determine equivalence scales:
        - Expert scales
        - Estimation using objective data
        - Estimation using subjective data