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Appendix
The Dataset

The German Income and Expenditure Survey

The dataset that has been used in this survey is the German Income and Expenditure Survey 1993 (EVS 93 – *Einkommens- und Verbrauchsstichprobe*). This survey is collected among a large number of around 50.000 households. In addition the collection period is very long, one full year for larger commodity groups until 1993 and three months starting from the EVS 1998. In 1993, smaller commodity groups were recorded in detail for only one month. A serious drawback is the infrequency with which these data are collected, which is every five years. Data sets before 1993 are not generally available as scientific use files. Therefore only three full data sets can be used at the moment, the EVS 1993, 1998 and very recently the EVS 2003. To make matters worse, the data collection scheme has been changed between 1993 and 1998: the length of the survey period has been changed as well as the grouping of commodities. The different survey periods lead to different variances in the data from infrequency of purchase error. The change in variance could be adjusted for, but the change in the grouping of commodities is so far reaching that a combination of both data sets is not possible for the application of sensitive econometric methods, in particular for the estimation of anything that involves price elasticities. Even after very careful adjustment of commodity groups, relative price changes are expected to be smaller than errors from the adjustment between groupings.

Even though it would have been desirable for many of the methods that are applied in this work to combine the data sets, only the EVS 1993 was used alone.

Commodity Groups

The aggregated commodity groups that are given as summary values in the EVS are adjusted, to reach a clearer separation between certain groups. The commodity groups are the following:

Food contains all foodstuffs, drink and food and drink away from home. Alcoholic beverages consumed at home and tobacco which are given as separate goods are excluded as well as food and drink consumed on travels, which is contained in the *travel* composite good.

Clothing contains clothing and shoes for adults and children, as well as outside repairs and changes and rent for clothes and accessories. It does not contain dry cleaning, which is contained in household services.

Housing consists of expenditures on rent and the imposed rent value of owned apartments or houses. It also contains all expenditures on energy, except for transportation.

Home & Furniture comprises of carpets, flooring, home textiles, household equipment, household services, goods and services for renovation and outside household repairs.

Personal Care consists of goods and services for personal care and hygiene.

Transportation includes all transport expenditures, which are not related to travel: Expenditures on bicycles and motorbikes, accessories for cars, repairs, fuel, rent for garages, fees for the general inspection and driving school, and external transportation services. It also includes taxes and insurances for motor vehicles. Transportation costs for travel are contained in the travel group. Expenditures on new and used cars are excluded completely. Curiously, the group also includes telephone and postal services.

Recreation is short for education, entertainment and recreational activities and includes durables and consumption goods for education and entertainment (TV-sets, hi-fi systems, cameras, typewriters[1] and computers, musical instruments, other sports gear, toys, camping gear, collections, art and even motor homes, air planes and boats) as well as books and journals, childcare, tuition, entrance fees to cultural and sports events and activities, flowers, plants and goods for gardening, and domestic animals and goods for their keeping.

Vacation contains holiday accommodation like hotels, vacation rentals, etc. and package holidays. It does not contain separately paid transportation costs on vacations (which are included in the transportation group) nor expenditures on food on vacation, which is not included at all.

Tobacco includes all tobacco products and

[1] This is the EVS of 1993!

Alcohol contains all alcoholic beverages that were consumed at home. Alcohol consumed away from home is not separately recorded and is contained in the food group.

Jewelry contains watches and jewelry.
This category is only used in chapter 3, it is ignored in subsequent chapters due to computational limitations.

Table *A* gives an overview of the commodity groups in Terms of the category numbers used in the EVS.

Health care services are excluded from the estimation, because they are usually paid for by the health insurance. Some households are privately insured. They pay for their health services themselves and are reimbursed later. Those who are in the public health insurance do not pay their bills themselves, therefore their use of health services does not show in the expenditure data. The choice of insurance strongly depends on the income of a household, where households with a higher income usually choose the private insurance and the public insurance is compulsory for lower income households. This dual system leads to a break in the structure of health care expenditures and a kink in the respective Engel curve. It also leads to seemingly higher expenditures for privately insured households, who are reimbursed later. Without an explicit model for this effect it is preferable to exclude health care completely. For the lower to medium income range, where the public insurance is compulsory, the expenses on health insurance do not depend on the number of persons in the household, but only on gross earned income. The effect on the size of estimated equivalence scales is therefore small.

Category		Composition
Food		1... (without 1090, 1990, 1995: food consumed during travel)
	–	1860, 1890 (alcoholic beverages and tobacco)
Clothing		2...
Housing		31.. (rent and the like)
	+	32.0 (energy)
Home & Furniture		4...
Personal Care		56.. + 5700 + 5800 (supplies, durables and services for personal care)
Transportation		6...
	–	6110, 6130 (new and used cars)
	–	6580 (travel expenses with own car)
	–	6790 (external transportation services for travel)
	+	9160, 9350 (auto taxes and insurance)
Recreation		7...
	–	7090 (other vacation expenses)
Travel		83.. (travel accommodation)
	+	85.. (package holidays)
	+	7090 (other vacation expenses)
	+	6580 (travel expenses with own car)
	+	6790 (external transportation services for travel)
	+	1090, 1990, 1995 (food consumed during travel: in hotels and restaurants; bought in shops; paid in a lump sum)
Alcohol		1860
Tobacco		1890
Jewelry		8110 (jewelry, watches)

Table A: *Description of the grouped goods in terms of the EVS code numbers. Code numbers are four digit numbers, a dot signifies any number between 0 and 9.*

List of Symbols and Abbreviations

a_i, b_i, c_i	Parameter of the QES
b_i^s	Scaled Overhead for good i
$\tilde{b}_i^s$	Sum of b_i and b_i^s.
$c(u, \boldsymbol{p}, s)$	Cost function
c^a, c^c	Cost function of adults and children, respectively
$\tilde{\boldsymbol{E}}$	Matrix of compensated price elasticities $\tilde{\varepsilon}_{ij}$.
$F_i(q_i^f, q_i^m)$	Joint consumption function
g_i	Marshallian demand for good i
$\boldsymbol{g}(\mu, \boldsymbol{p})$	Vector of Marshallian demand functions
h_i	Hicksian demand for good i
h_i^s, h_i^r	Hicksian demands for good i by household types s,r
k	Number of children
m_r^s	Equivalence scale of a household of type s relative to a household of type r
m_i^s	(Barten) scale factor for good i and household type s
$\tilde{m}_i^s$	Direct scale factor for good i: $\tilde{m}_i^s = h_i^s(u_0, \boldsymbol{p}^s)/h_i^r(u_0, \boldsymbol{p})$
m_i^{s*}	Virtual scale factor for good i: $m_i^{s*} = h_i^s(u_0, \boldsymbol{p}^s)/h_i^r(u_0, \boldsymbol{p}^s)$
$\boldsymbol{M}$	Diagonal matrix with m_i as diagonal elements
n	Number of commodities
p_i	Price of good i
$\boldsymbol{p}$	Vector of prices
$\boldsymbol{p}^s$	Vector of scaled prices
q_i	Quantity of good i
$\boldsymbol{q}$	Vector of quantities q_i
$\boldsymbol{q}^a, \boldsymbol{q}^c$	Vectors of quantities consumed by adults and by children
q_A, q_C	Quantity of an adult and a children's good
$\boldsymbol{q}^f, \boldsymbol{q}^m$	Vectors of quantities consumed by a woman and by a man
r	Household type index of a reference household
$\boldsymbol{r}$	Vector of demographic characteristics of a reference household
s	Household type index of a compared household

$\boldsymbol{s}$ Vector of demographic characteristics of a compared household
$\boldsymbol{s}^c$ Vector of children's characteristics in a household
t Index of a household in the sample
u Utility
U Direct utility function
V Indirect utility function
w_i Budget share of good i
x_i Expenditures on good i
$\boldsymbol{x}$ Vector of expenditures
x Total expenditures: $x = \sum_{i=1}^{n} x_i$
y Household income (in the Leyden model)
$\boldsymbol{z}$ Vector of demographic characteristics that is common between reference and compared household and does not influence the equivalence scale
β_i^s Gorman Overhead for good i
γ_i Household composition elasticity of the scale factor m_i: $\frac{s}{m_i}\frac{\partial m_i}{\partial s}$
$\boldsymbol{\gamma}$ Vector of γ_i
ε_{ij} Uncompensated (Marshallian) price elasticity of good i with respect to price j
$\tilde{\varepsilon}_{ij}$ Compensated (Hicksian) price elasticity of good i with respect to price j
η_i Income elasticity of good i
θ Estimated linear equation parameters
μ Total expenditure / income
μ^a Total expenditure on adult goods
μ^c Total expenditure on children's goods
μ^f Total expenditure on women's goods
μ^m Total expenditure on men's goods
ϱ Distribution or sharing rule
ϱ^s Expenditure share of a household member of type s.
τ_t^s Household composition elasticity of the expenditure share ϱ^s
ϕ_i Uncompensated household composition elasticity of demand for good i: $\frac{s}{q_i}\frac{\partial q_i}{\partial s}\Big|_{\bar{\mu}}$
ϕ_i^* Compensated household composition elasticity of demand for good i: $\frac{s}{q_i}\frac{\partial q_i}{\partial s}\Big|_{\bar{u}}$
ϕ^* Household composition elasticity of total cost: $\frac{s}{c}\frac{\partial c}{\partial s}\big|_{\bar{u}}$
$\boldsymbol{\phi}$ Matrix of ϕ_i
ω_i^t Share of a person of type t in the total consumption of good i
$\boldsymbol{\Omega}^t$ Diagonal matrix with ω_i^t as diagonal elements
AA, AAC, AACC, AACCC Household types: each A symbolizes an adult, each C a child.
F, M Household types: a single woman and a single man.

ELES	Extended Linear Expenditure System
EVS	Income and Expenditure Survey (*Einkommens- und Verbrauchsstichprobe*)
GESE	Equivalence Scale Exactness (equivalent to IB)
GESE	Generalized Equivalence Scale Exactness
IB	Independent of Base level of utility
IEQ	Income Evaluation Question
IS	Income Satisfaction
LES	Linear Expenditure System
MIQ	Minimum Income Question
OECD	Organisation of Economic Collaboration and Development
QES	Quadratic Expenditure System