Estimating Flexible Demand Systems for Energy Services: A Distributive Analysis Using German Household Data

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7th Atlantic Workshop on Energy and Environmental Economics
June 27, 2016

Presentation plan

- Motivation
- Literature
- Data and Estimation strategy
- Results

Motivation

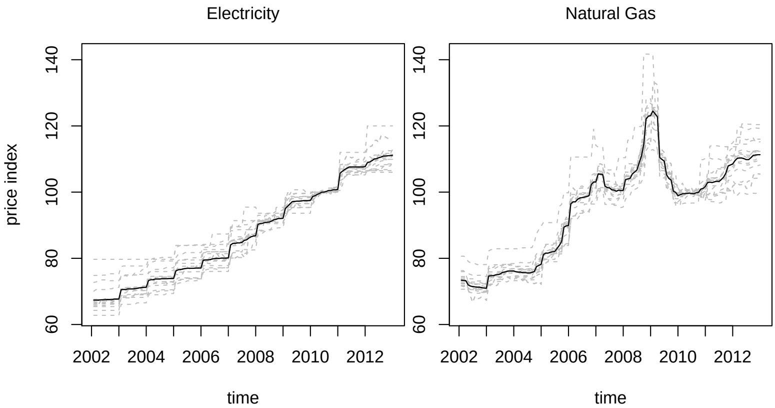

Figure: Consumer price indices for electricity (left) and gas (right) normalised to 100 in 2010. The solid black line depicts the federal index, regional time series are drawn in grey.

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Literature

- The AID system (Deaton and Muellbauer,1980) and its variations (e.g. the QUAIDS (Banks et al., 1997)) impose restrictions on how the households budget constraint.
- The Exact Affine Stone Index (EASI) demand system proposed by Lewbel and Pendakur (2009) can overcome this limitation
- Application of this methodology anlaysing distributional effects of environmental taxes is particularly scarce
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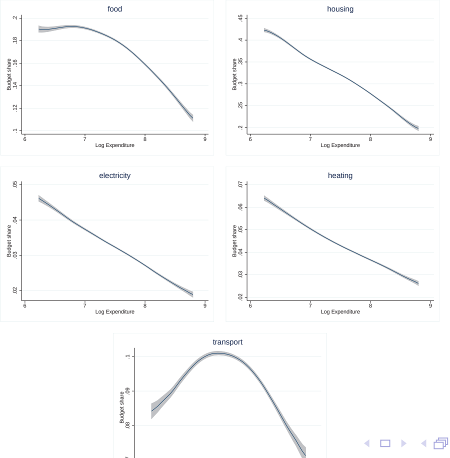
Continuous household budget survey (LWR)

For Germany, the literature in this area is particularly scarce. The reason lies in particular in data availability.

- LWR:Sample size 70,000 observations covering the years 2002-2012
- LWR:Household characteristics such as size, age, number of children, education, etc.
- LWR: Dwelling characteristics, equipment with type of heating system, appliances, etc.
- Lewbel (1989)'s prices are used to introduce further price variation

Non-parametric Engel curves: Expenditure share over log income



The Exact Affine Stone Index

Developed by Lewbel and Pendakur AER, 2009.

- Household demand is expressed in budget share form:

$$w_i = \sum_{r=0}^{R} b_r \log(y)^r + \sum_j a_{ij} \log(p_j) + \sum_l d_{il} z_l \log(y) + \sum_l g_{il} z_l$$

with

- w_i the budget share of good i. **Food, housing, electricity, heating, transportation and communications, education and leisure, and other goods.**
- p_j the price of good j
- y implicit utility function which depends on: budget shares, prices and a-parameters
- z_l dummy variables for socioeconomic characteristics

In all the scenarios a 20% increase in the commodity prices are explored as follows:

(a) Only electricity prices increase
(b) Only heating prices increase
(c) Both, electricity and heating prices increase.
(d) Only transport and communications prices increase
(e) Only the price for housing (rents and related services) increases

Table: Equivalent variation estimates in % of income (Δ Electricity prices)

household type	1^{st}	2^{nd}	3^{rd}	4^{th}
Single +65	0.49	0.32	0.24	0.16
Single no children	0.51	0.28	0.19	0.13
Single with children	0.58	0.43	0.31	0.22
2 adults +65 no children	0.58	0.40	0.30	0.21
2 adults no children	0.61	0.40	0.30	0.20
2 adults one child	0.60	0.42	0.31	0.22
2 adults two children	0.64	0.47	0.36	0.25

Table: Equivalent variation estimates in % of income (Δ Heating prices)

household type	1st	2nd	3rd	4th
Single +65	1.26	0.94	0.77	0.60
Single no children	1.15	0.74	0.58	0.42
Single with children	1.20	0.92	0.70	0.49
2 adults +65 no children	1.18	0.95	0.82	0.64
2 adults no children	1.22	0.87	0.69	0.51
2 adults one child	1.18	0.82	0.67	0.51
2 adults two children	1.24	0.87	0.71	0.54

Table: Inequality and Social Welfare over different scenarios (Δ indicates difference w.r.t. the reference scenario).

Based on AID system

Scenario	Gini	Δ Gini in %	Mean equiv-alised income	Sen's index (SW)	Δ SW(Euro)
Electricity	0.2983	0.30	3064.81	2150.43	-16.52
Heating	0.2984	0.34	3061.71	2148.13	-18.82
Energy	0.2993	0.64	3042.36	2131.73	-35.22
Housing	0.3056	2.76	2881.93	2001.15	-165.80
Transport	0.2989	0.50	3047.45	2136.52	-30.43

Based on EASI demand system

Electricity	0.2981	0.24	3074.21	2157.83	-9.12
Heating	0.2985	0.37	3060.03	2146.57	-20.38
Energy	0.2992	0.61	3049.88	2137.42	-29.53
Housing	0.3018	1.48	2979.72	2080.45	-86.50
Transport	0.2986	0.40	3051.29	2140.04	-26.91

We explore three possible counteractive policies for the scenario where both electricity and heating prices increase.

(a) Policy 1: Flat allocation for all households

(b) Policy 2: Flat allocation only for households in the first quartile of the income distribution

(c) Policy 3: a decrease of 10% in electricity and heating prices for the first quartile of the income distribution

Table: Inequality and Sen's Index for Social Welfare (monthly, per household and in 2012 prices) for different compensating policies (Δ indicates difference w.r.t. the scenario of an increase in electricity and heating prices).

Scenario	Gini	Δ Gini in %	Mean equivalised income	Sen's index (SW)	Δ SW
Elec.+Heating	0.2992		3049.88	2137.42	
Policy 1	0.2981	-0.37	3064.74	2151.29	13.87
Policy 2	0.2938	-1.80	3079.31	2174.64	37.22
Policy 3	0.2979	-0.43	3056.74	2146.09	8.67

Policy 1: Flat allocation for all households;

Policy 2: Flat allocation for low income households;

Policy 3: Reduction in electricity and heating prices for low income households

(a) The regressivity of an energy price increase is remarkable large in relation to the small budget share these goods account for.

(b) Flat transfers to all households have only small counteractive distributional effects.

(c) Flat transfer is structurally comparable to a form of "social tariffs" that have been put forward in Germany as a means of increasing social equity of the energy transition.

(d) Ignoring nonlinearities in the demand system estimation might lead to a substantially biased evaluation of the distributive effects of consumer price changes in general.

Thanks

Project founded by the German Ministry of Education and Research (BMBF) and the MannheimTaxation (MaTax) ScienceCampus