

Households' technology choices and long-run energy price sensitivity

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Research question

How do persistent energy price differences impact households' energy-consuming capital stock?

- Berndt and Wood 1975, Atkeson and Kehoe 1999, Linn 2008

How do household/individual characteristics relate to technology choice?

Contribution

High quality data

- Credible measure of long-term electricity prices
- Administrative registry data on investments and households

Clear setting for the investment

- Major investment
- Limited set of well-established technologies
- Timing not related to energy prices
- Product characteristics less important

Data sources

Statistics Finland: data on new detached houses

- Annual 90% sample, 2000-2011
- Total amount of houses built by private persons: 113 937

Statistics Finland: individual-level data on house owners

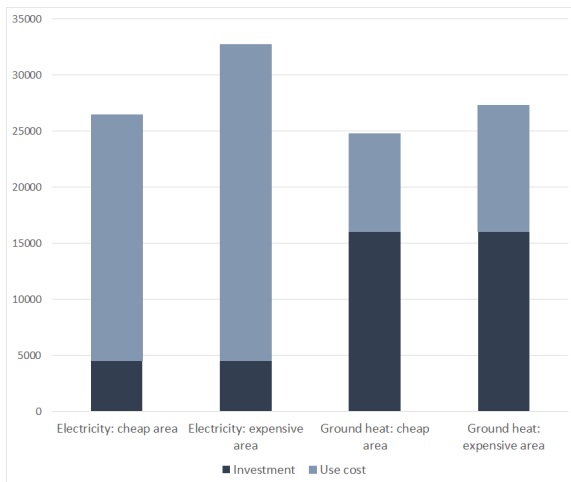
- Owner and spouse matched to each house

Energy Authority: regional electricity retail and distribution prices

- Electricity prices matched to each house based on postal code

Estimation sample: 30 777 observations (2006-2011)

Variation in lifetime heating costs



House size $170m^2$, heat consumption $120 \text{ kwh}/m^2$, discount rate 5%, lifetime 20 years

Modelling heating choice

Standard logit model of discrete choice

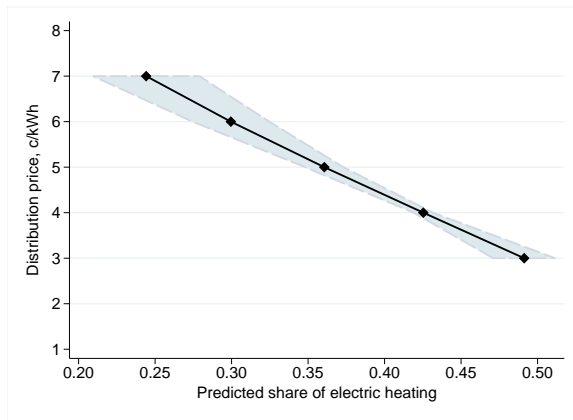
Components:

- Retail price of electricity
- Distribution price of electricity
- House characteristics
- Household characteristics
- Controls: time effects, location-by-region effects, average sales prices

Technology choice and electricity price: average marginal effects

	Electric	Hydroelectric	Ground heat	Wood
Retail price	-0.008	-0.002	-0.000	0.006
Distribution price	-0.058***	-0.004	0.024***	0.032***
Share in estimation sample	0.41	0.16	0.31	0.07

Distribution price and demand for electric heating



Household characteristics and technology choice: average marginal effects

	Electric	Hydroelectric	Ground heat
House ownership	0.047***	0.006	-0.064***
Apartment ownership	0.015*	-0.012*	0.011
Children	-0.013	-0.012*	0.014*
Family size	0.014***	0.005*	-0.010***
Education: bachelor	-0.034***	0.007	0.035***
Education: master	-0.049***	0.012**	0.064***
Share in estimation sample	0.41	0.16	0.31

Conclusions

Energy costs are an important determinant of heating technology choice

- Higher electricity prices have induced substitution from electricity to other sources of heat

Certain household characteristics are systematically related to technology choice

- Income: implies the existence of credit constraints
- Education: can be related to information or financial literacy
- House ownership: can be related to experience or information

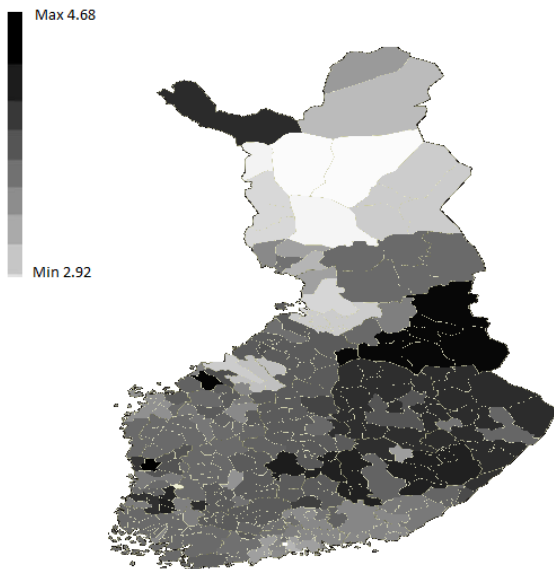
Policy implications

Price instruments can be used to encourage investment into energy efficient technologies and durables

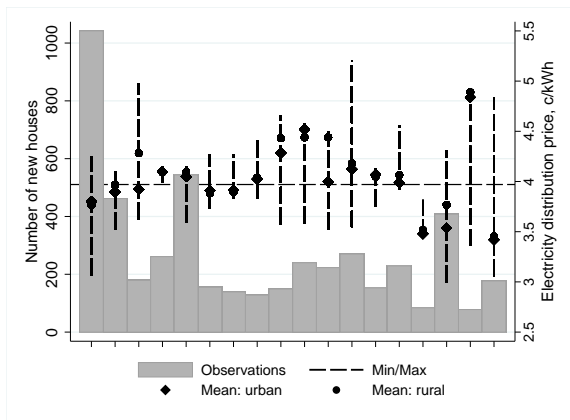
When investment involve large upfront monetary costs, financial instruments could help overcome credit constraints faced by low-income households

Take-up of investments such as house improvements involving complicated technical aspects and financial calculations may benefit from (targeted) information provision

Average distribution prices



Variation in electricity distribution prices

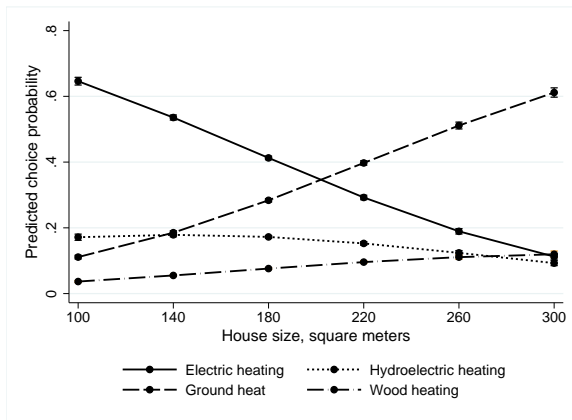


Data from 2008

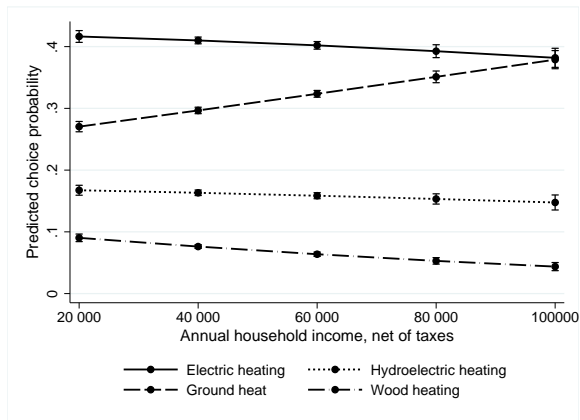
Elasticity of demand for electric heating with respect to distribution price

	Median	Mean	Std.Dev.	95 % Conf.Int.		p-value
				Lower	Upper	
3 c/kWh	-0.37	-0.37	0.08	-0.54	-0.21	0.000
4 c/kWh	-0.63	-0.65	0.19	-0.97	-0.34	0.000
6 c/kWh	-1.57	-1.69	0.58	-2.82	-0.56	0.003

Choice probability and house size



Choice probability and household income



Robustness checks

Impact of observable heterogeneity

- Impact of electricity price is stronger when house/household characteristics are included

Different definitions of electricity prices

- Lags
- Average price over 3 preceding years
- Retail price: minimum price available nationwide

Linear probability models

- Municipality fixed effects

Aggregate-level estimation

Determinants of electricity distribution prices

	OLS results		Summary statistics		
	Apartments	Houses	Mean	Min	Max
Connections per km	-0.044*** (0.012)	-0.049*** (0.009)	8.79	4.29	61.43
100 GWh, 0.4kv grid	-0.234*** (0.029)	-0.068*** (0.010)	417	1.20	5851
100 GWh, 1-70kv grid	0.249*** (0.039)	0.095*** (0.014)	135	0	1871
Ground cables (%)	-0.008*** (0.002)	0.000 (0.001)	43.49	0.01	100
Transformers (unit: 1000)	0.374*** (0.039)	0.126*** (0.014)	1533	0	24047
Power cuts (h), 1. lag	0.021*** (0.006)	0.007** (0.003)	2.98	0	64.78
Personnel (unit: 10)	0.018 (0.017)	-0.023*** (0.007)	30.44	0	439
Constant	5.131***	2.875***			
R^2	0.41	0.32			
Number of observations: 761					