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Label it and they will buy?
The case of energy efficient class-A appliances

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Objectives

Analyze socio-economic and technical determinants of

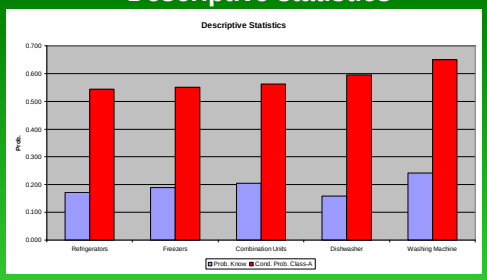
- **Consumer knowledge** of energy efficiency label of major household appliances
- **Choice** of class-A appliance

Data

December 2002 multi-topic cross-section survey of German households

- 15,526 with refrigerators
- 12,943 with freezers
- 6,993 refrigerator – freezer units
- 12,814 with dishwashers
- 19,014 with washing machines

Descriptive statistics



Empirical challenges

Only households aware of energy labeling scheme can respond to questions on appliance energy class

- Households may have purchased class-A, but do not know
- May have purchased appliance before implementation

Positive responders may have different observed and unobserved attributes

- Possible **knowledge-based selection bias** if only positive responders are considered

⇨ **Empirical model needs to address unobserved heterogeneity**

Statistical model

Two latent variables

1) Choice of class-A appliance

$$y_i^* = x_i B + u_{1i}$$

y_i^* latent measure of household preferences for class-A

x_i vector of household characteristics

B vector of parameters to be estimated

$$y_i = 1 \quad \text{if} \quad y_i^* > 0$$
$$y_i = 0 \quad \text{if} \quad y_i^* \le 0$$

2) Knowledge of energy efficiency class

$$s_i^* = z_i \Gamma + u_{2i}$$

z_i latent measure of household knowledge of label class

z_i vector of household characteristics

Γ vector of parameters to be estimated

$$s_i = 1 \quad \text{if} \quad s_i^* > 0$$
$$s_i = 0 \quad \text{if} \quad s_i^* \le 0$$

Joint estimation of two latent variables

$$\prod_{i=1}^{N_1} F_2(x_i B, z_i \Gamma; \rho) \prod_{i=N_1+1}^{N} F_2(-x_i B, z_i \Gamma; \rho) \prod_{i=N+1}^{M} F(-z_i \Gamma)$$

1 to N_1: energy-class of appliance known and class A chosen

N_1+1 to N: energy-class known and class A not chosen

N+1 to M: energy class not known

$u_1 \sim N(0,1)$, $u_2 \sim N(0,1)$, and ρ=corr(u_1, u_2)

Results

Selection-adjusted conditional probability is about 15-20% lower !

Conclusions

Energy label information will diffuse slowly
- Long life span of major appliances
- Little evidence for increases in purchase propensities over time

Consumers' awareness increases with
- **regional power prices**
- PC ownership

Household characteristics have little impact
- Propensity to purchase class-A strongly correlated across appliance types
- Need to identify factors underlying common propensities

Econometric estimation results

		Refrigerator				Freezer				Refrigerator - Freezer Combination				Dishwasher				Washing Machine			
		Know Class		Class-A		Know Class		Class-A		Know Class		Class-A		Know Class		Class-A		Know Class		Class-A	
		Parameter Estimate	Standard Error	Parameter Estimate	Standard Error	Parameter Estimate	Standard Error	Parameter Estimate	Standard Error	Parameter Estimate	Standard Error	Parameter Estimate	Standard Error	Parameter Estimate	Standard Error	Parameter Estimate	Standard Error	Parameter Estimate	Standard Error	Parameter Estimate	Standard Error
Rent residence	yes = 1	0,053 *	0,030	0,087 *	0,053	0,020	0,032	-0,101	0,064	0,086 **	0,043	0,099	0,086	0,145 **	0,033	0,191 **	0,068	0,059 **	0,025	-0,028	0,047
Floor space	residence m^2	0,001 *	0,000	0,001 *	0,001	0,000	0,000	0,002 **	0,001	0,000	0,001	0,001	0,001	0,000	0,000	0,002 *	0,001	0,000	0,000	0,001	0,001
Residence built:	(base = built pre-1985)																				
2002	yes = 1	0,494 **	0,186	0,309	0,281	0,620 **	0,198	0,011	0,340	0,293	0,244	0,990 *	0,553	0,593 **	0,166	0,367	0,308	0,449 **	0,152	0,122	0,232
2001	yes = 1	0,352 **	0,149	0,247	0,229	0,202	0,160	0,000	0,292	0,354 *	0,182	0,332	0,312	0,242 *	0,139	-0,189	0,271	0,282 **	0,124	0,023	0,193
2000	yes = 1	0,398 **	0,125	0,500 **	0,193	0,372 **	0,133	0,030	0,243	0,370 **	0,166	0,027	0,298	0,335 **	0,120	0,264	0,227	0,258 **	0,107	-0,037	0,172
1998-1999	yes = 1	0,088	0,089	-0,053	0,147	0,200 **	0,095	0,004	0,174	-0,072	0,121	0,144	0,231	0,149 *	0,088	0,102	0,167	0,080	0,074	-0,062	0,118
1996-1997	yes = 1	0,002	0,084	-0,053	0,141	0,030	0,090	-0,096	0,166	-0,065	0,107	0,150	0,204	0,027	0,083	-0,185	0,159	0,021	0,067	-0,013	0,108
1993-1995	yes = 1	-0,051	0,056	-0,054	0,096	0,020	0,059	0,156	0,113	-0,097	0,081	-0,019	0,162	-0,178 **	0,061	-0,148	0,130	-0,002	0,047	0,074	0,080
1990-1992	yes = 1	-0,186 **	0,068	-0,010	0,129	-0,146 **	0,071	0,011	0,147	-0,408 **	0,111	0,225	0,325	-0,189 **	0,072	-0,192	0,154	-0,173 **	0,057	0,002	0,110
1985-1989	yes = 1	-0,057	0,053	-0,145	0,094	-0,066	0,057	-0,023	0,114	-0,055	0,079	-0,036	0,148	0,011	0,057	0,111	0,115	-0,022	0,045	0,126	0,081
Post-1997 detached house	yes = 1	0,015	0,088	0,027	0,140	0,019	0,093	0,142	0,163	-0,028	0,120	-0,050	0,216	-0,045	0,086	0,033	0,160	0,003	0,073	0,035	0,114
Retiree	yes = 1	0,221 **	0,045	0,157 *	0,086	0,236 **	0,047	-0,050	0,119	0,216 **	0,066	0,019	0,163	0,272 **	0,053	-0,045	0,142	0,181 **	0,038	0,111	0,077
Number of persons	truncated at 5 persons	0,047 **	0,015	0,008	0,028	0,029 *	0,016	-0,023	0,032	0,025	0,022	-0,052	0,047	0,034 *	0,016	0,044	0,033	0,076 **	0,012	0,044 *	0,024
Children in household	under 6 years = 1	0,053	0,046	0,045	0,076	0,054	0,048	0,092	0,088	-0,005	0,066	0,145	0,119	0,027	0,047	-0,070	0,091	-0,019	0,039	-0,002	0,062
Age	age of main income earner	0,007	0,007	0,029 **	0,012	-0,002	0,008	0,019	0,015	0,001	0,009	-0,021	0,019	0,012	0,009	0,005	0,018	-0,004	0,006	0,003	0,010
Age^2		0,000 **	0,000	0,000 **	0,000	0,000 **	0,000	0,000	0,000	0,000 *	0,000	0,000	0,000	0,000 **	0,000	0,000	0,000	0,000 **	0,000	0,000	0,000
Secondary school	main income earner, yes=1	0,057 *	0,033	0,128 **	0,060	0,078 **	0,035	0,089	0,074	0,113 **	0,050	0,009	0,112	0,052	0,039	0,045	0,082	0,096 **	0,028	0,064	0,054
Management position	senior official, executive, skilled profession=1	-0,071 *	0,041	0,038	0,074	-0,073 *	0,044	-0,032	0,087	-0,065	0,061	-0,091	0,115	-0,032	0,043	0,081	0,088	-0,043	0,035	0,002	0,060
Income class	lowest = 1 and highest = 16	0,012 **	0,004	0,004	0,008	0,007 *	0,004	-0,009	0,009	0,006	0,006	-0,002	0,012	0,003	0,004	-0,001	0,009	0,009 **	0,003	0,012 **	0,006
East Germany	yes = 1	0,068	0,063	0,116	0,093	-0,025	0,074	0,060	0,123	0,226 **	0,076	-0,083	0,161	0,101 *	0,060	-0,154	0,125	0,063	0,055	-0,156 *	0,088
Regional power price	average electric price in Federal State (€cents/kWh)	17,307 **	4,257	3,757	7,900	23,912 **	5,525	-12,795	10,828	9,437	7,486	1,464	9,845	15,797 **	4,731	17,872 *	9,189	10,564 **	3,775	11,710 **	5,823
Own a PC	yes = 1	0,099 **	0,031	0,005	0,060	0,089 **	0,034	-0,100	0,075	0,104 **	0,045	0,052	0,093	0,080 **	0,037	-0,048	0,083	0,061 **	0,026	-0,059	0,051
Own more than one	appliance type	-0,039	0,033	-0,029	0,058	-0,003	0,041	0,016	0,083	0,087	0,092	0,539 **	0,181	0,016	0,140	0,004	0,288	-0,021	0,078	0,012	0,136
Also own Combination	for Refrigerators and Freezers	-0,075 **	0,032	-0,222 **	0,059	0,032	0,033	-0,006	0,065												
Also own Refrigerator or Freezer	for Combination									-0,147 **	0,039	-0,177 **	0,083								
Know power consumption	annual, yes=1	0,193 **	0,027			0,197 **	0,030			0,192 **	0,039			0,213 **	0,031			0,167 **	0,023		
Region class knowledge	share of households in Federal State	2,405 **	1,007			3,145 **	0,971			0,095	1,612			2,260 *	1,308			1,291 *	0,664		
Own other Class-A appliances	yes=1			0,606 **	0,109			0,629 **	0,071			0,580 **	0,110			0,754 **	0,111			0,567 **	0,082
Constant		-4,289 **	0,697	-2,777 **	1,333	-4,917 **	0,924	0,748	1,940	-2,391 **	1,109	-0,523	1,953	-4,032 **	0,724	-4,179 **	1,713	-2,550 **	0,543	-2,674 **	1,035
Rho		0,662 **	0,197			0,237	0,339			0,362	0,464			0,401	0,320			0,557 *	0,223		
Log-likelihood		-8550,1				-7597,3				-4288,4				-6687,8				-12742,5			
No. Observations		15.526				12.943				6.993				12.814				19.014			
No. Uncensored Observations		2.676				2.447				1.428				2.043				4.596			

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