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Inform Me When It Matters: Cost Salience, Energy Consumption, and Efficiency Investments

ABSTRACT

This paper investigates whether and why the timing of utility bills leads to salience bias in heat energy demand. In Germany, the 12-month billing period varies across buildings with a significant share of buildings receiving bills during the summer months, when the salience of heating costs is absent or low. Using calendar year billing as the control, I exploit this large-scale natural experiment in utility billing cycles at the building level to identify the salience effect of costs on energy consumption. Results point to new evidence for consumer inattention to energy costs for heating: buildings that are billed during off-winter months demand significantly more heat energy annually. Results suggest that households are paying attention to their heating costs in the first three months of the 12-month billing period. As a result, bills immediately before the winter heating season are most effective, allowing ample opportunity to adjust consumption. This paper further examines whether enduring differences in consumer inattention to energy costs had a long-run impact on thermal efficiency investments by building owners – with implications for the energy-efficiency gap.

PAPER CONTRIBUTION

Test of salience bias in residential heat energy demand.

- Long-term estimates (not a response to one-shot treatment).
- Spillover effect on energy-efficiency investments by building owners.

DATA & SETTING

- Annual heating bills for multi-apartment buildings in 7700+ zip codes, 2008 to 2018, from leading energy metering company (via DIW Berlin*) in Germany.
- Households receive bills once a year. 12-month billing period varies across buildings. Significant share of buildings receive heating bills during off-winter months. Billing cycles not decided by tenants.
- If consumers are attentive (more so after learning and adaptation), then timing of information should not matter.

Table 1: *Heating Needs During the Year*

		Heating Degree Days (HDD)		
Month	Mean Temperature	Monthly	12-month sum	3-month sum
January	0.52	449.0	2426.2	1184.1
February	0.68	404.2	2424.5	911.4
March	4.33	330.9	2414.3	590.1
April	9.26	176.3	2412.0	284.9
May	13.23	82.9	2409.8	118.5
June	16.59	25.7	2414.3	48.2
July	18.60	9.9	2414.3	79.1
August	17.82	12.6	2414.5	245.2
September	14.09	56.6	2414.4	529.0
October	9.40	176.0	2413.6	878.1
November	5.12	296.4	2404.6	1149.3
December	1.92	405.6	2405.8	1247.0
Total	9.30	202.2	2414.0	605.4

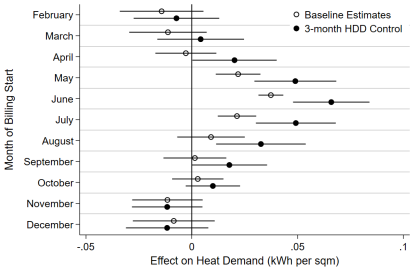
EMPIRICAL STRATEGY

- Main model using subsample of oil buildings
- Calendar year billing (Jan – Dec) as benchmark

$$y_{it} = \alpha_0 + \alpha_m \sum_{m=2}^{12} \mathrm{m}_{it} + \delta \mathrm{price}_{it} + \gamma_{size \times PLZ} + \lambda_t + \epsilon_{it}$$

- y_{it}: ln(kWh per sqm) heat energy consumption by building i in billing year t
- m_{it}: Month in which billing cycle starts. Omitted month January.
- price_{it}: cost per kWh energy incurred
- $\gamma_{size \times PLZ}$: Building size by zip code FE
- λ_t: Bill start year FE
- ϵ_{it}: error term clustered

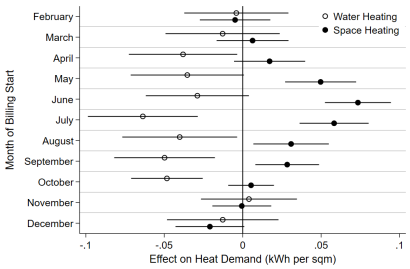
Fig. 1 *Bill Timing = Salience of Energy Costs***



RESULTS

- Temporal gap between bill and winter heating season drives results.
- Estimates are theory-consistent. Reduced salience of energy costs leads to cost misperceptions (downward biased) causing higher consumption.
- Consumers disproportionately adjust water heating to compensate inability to adjust space heating during the summer. Water heating is on average 30% of total heating bill.

Fig. 2 *Consumer response via Water heating***



PERVASIVE SALIENCE BIAS

- All main fuel types (oil, gas, district heating)
- Large Urban Cities (Stuttgart, Munich)
- All socio-economic regions
- Buildings built before 1978
- Buildings that meet WSVO 1995 standards

LONG-TERM SPILLOVERS

- Does consumer inattention have a long term impact on technology choices (energy-efficiency gap)?
- Investment decisions made by building owners, not tenants
- Restrict sample to buildings before energy standards.
- Use data on energy performance certificates to learn about investments in building heat insulation/efficiency.

Table 2: *Differences in Energy Efficiency Investments*

Oil Buildings Built Before 1978

Bill Start	*Dependent variable*: WSVO 1995 Standard						
	Overall	Heater	Roof	Loft	Outer Wall	Windows	Basement
May to July	0.231***	-0.00262	0.0596***	0.0192	0.0546***	0.0917***	0.00560
	(0.0435)	(0.0123)	(0.0151)	(0.0120)	(0.0150)	(0.0144)	(0.00789)
Year Built	-0.0010	-0.0001	-0.0007*	0.0001	-0.0006*	0.0004	-0.0001
	(0.0009)	(0.0002)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0002)
Year of EPC FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# of Apts FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
PLZ FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	7,968	9,183	7,968	7,968	7,968	7,968	7,968
Adj R^2	0.189	0.070	0.135	0.099	0.124	0.173	0.079

Notes: The omitted billing month is January (calendar year billing), the control group. Standard errors clustered at the zip code level. Data is limited to energy performance certificates issued 2014 to 2019. Inclusion of controls such as heating costs (total bill) and total living space does not change the results in the table. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

DISCUSSION

Timing of bills matters significantly for heat demand

- Effectiveness of billing hinges on cost salience.
- Evidence that differences in energy performance scores between buildings reflect limited attention/ consumer behaviour biases.
- Financial incentives for energy-efficiency –- owners invest in insulation to close these perceived gaps in energy performance.

** DIW Berlin = German Institute for Economic Research*
*** 95% confidence intervals shown.*