Do Electronic Home Energy Reports Promote Energy Conservation? It Depends

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Energy Conservation in the EU

- Clean generation and energy efficiency/savings as two strands to reduce carbon emissions in energy sector
- The EU Directive on Energy Efficiency sets target of final energy consumption reduction by 20% until 2030 compared to 2005 levels (EU 2018)
- National Energy and Climate Plans by all EU member states outline strategies to reach energy saving targets
  - Economic incentives
  - Non-price-based instruments, e.g. improved information and social comparisons $\rightarrow$ Home Energy Reports (HER)

Energy Conservation and HER

- Considerable electricity savings from HERs found in the US (Allcott 2011; Allcott and Rogers 2014):
  - Reductions in electricity consumption of 1.4-3.3%
  - Persistent effect for about 3 months
- Smaller effect sizes in Europe reduce cost effectiveness:
  - Average energy consumption reduction by 0.7% found in RCT for Germany (Andor et al. 2020) $\rightarrow$ Electronic HERs
- Mixed evidence for electronic HERs from the US & Australia
  - Electronic HERs at least as effective as postal HERs in reducing electricity (Henry et al. 2019)
  - Boomerang effect for households that overestimate their consumption (Byrne et al. 2018)

Research Question

- Do electronic home energy reports in Austria lead to energy savings (such that the intervention is cost effective)?

Our Contribution

- Evaluate the effect of electronic HERs on electricity consumption in Austria, i.e. an European country
- Analyze effectiveness of electronic HERs for customers of eco-electricity provider

Data

- Consumer data from RCT with eco-electricity customers in Austria 2013-2016:
  - 21,088 households before cleansing
  - Four e-mails with social comparisons and energy saving tips
    HER
  - Mails sent on (roughly) quarterly basis between 2015 and 2016
  - 2 periods of interest: Baseline and treatment period
  - Annual consumption converted to daily levels due to different lengths of billing periods
  - 8,660 observations after cleansing

Timeline of Treatment

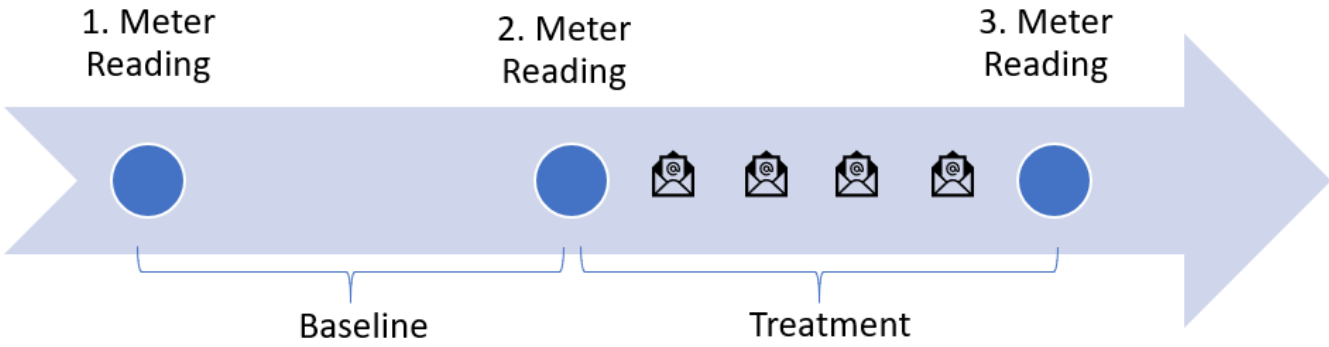

Figure: Timeline for optimal treatment

Balancing

	All	Control	Treatment	t-Statistic
Daily baseline consumption, in kWh	7.74	7.75	7.72	-0.39
Length of baseline period, in days	311.54	311.43	311.65	0.10
Length of treatment period, in days	501.37	503.10	499.62	-0.90
Dummy whether contract is terminated during study	0.16	0.17	0.16	-0.63
Number of households	8,660	4,343	4,317	

Comparison of Average Consumption in kWh between Study Population and Austria by Federal State

	Estimation Sample	Austria	Sample Share (in %)
Wien	2,074	3,261	50.21
Niederösterreich	3,358	4,698	21.22
Oberösterreich	1,336	4,555	9.63
Salzburg	1,961	5,262	0.58
Tirol	2,435	5,146	1.59
Burgenland	2,728	5,408	0.46
Steiermark	2,853	4,832	14.20
Kärnten	3,373	5,190	1.56
Austria	2,422	4,002	

Source for Austrian data: *Statistik Austria*. `https://www.statistik.at/web_de/statistiken/energie_umwelt_innovation_mobilitaet/energie_und_umwelt/energie/energiebilanzen/index.html`.

Number of HER

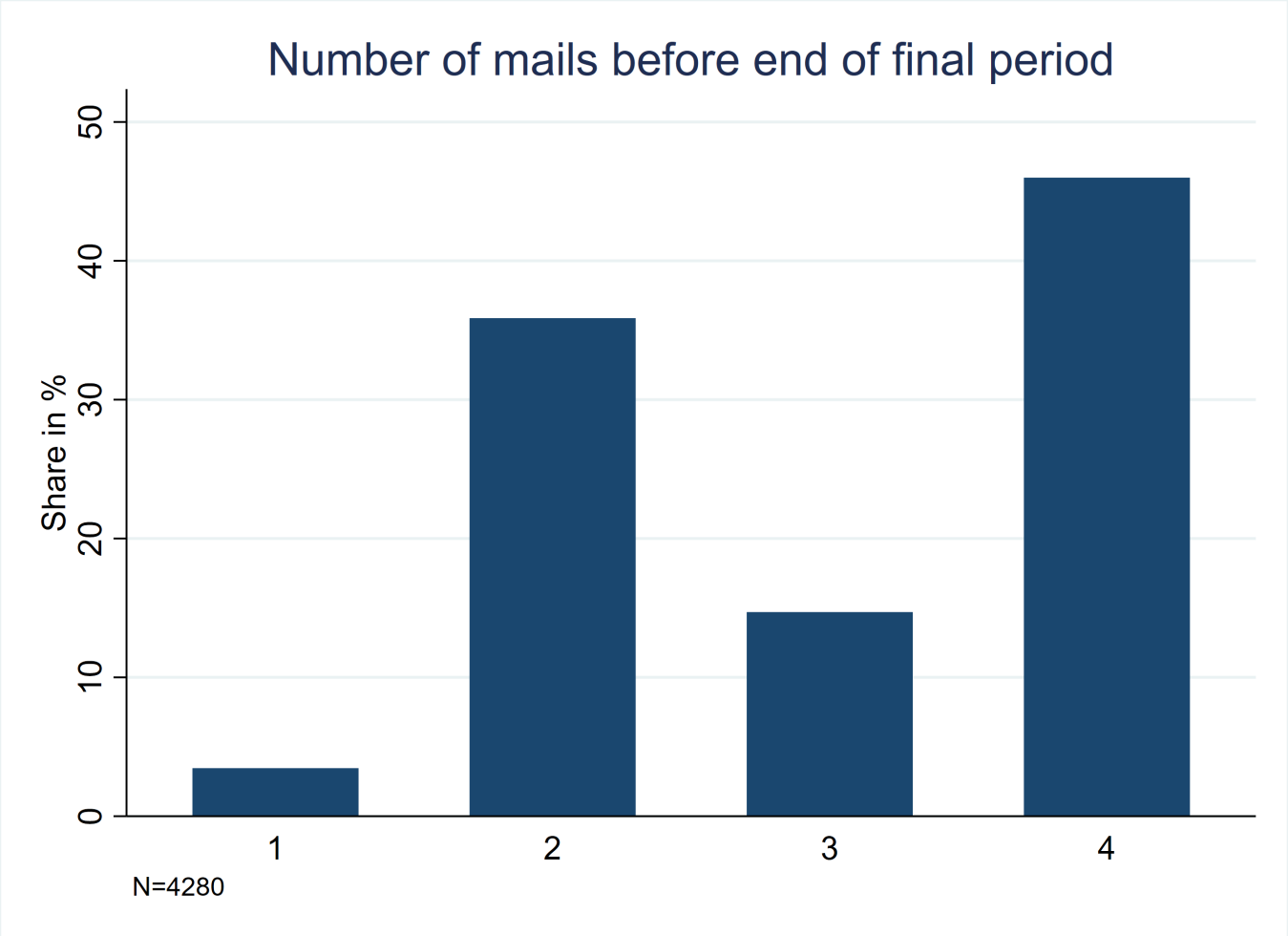

Figure: Number of mails received by treated households until end of study. More

Difference-in-differences (DiD) Estimation

$$\Delta Y_i = \alpha + \beta * T_i + \tau_w + \epsilon_i$$

- $\Delta Y_i = (Y_i^T - Y_i^B)/Y_{i,c}^T$ corresponds to the change in daily electricity consumption of household i before (Y_i^B) and after the HER treatment (Y_i^T), normalized by the average post-period control group consumption ($Y_{i,c}^T$) (see Allcott 2011)
- T_i is the treatment variable
- β is the coefficient that captures the average treatment effect (ATE), expressed as average electricity savings as percentage of the average consumption level
- τ_w includes weekly dummies for both baseline and treatment period
- ϵ_i is an idiosyncratic error term

Definition of Treatment Variable

- Three definitions of treatment variable T_i to look at treatment intensity:
  1. $T_{min.1}$: Treatment variable equal to 1 if household receives at least one mail in treatment period, 0 if in control group
  2. $T_{min.3}$: Treatment variable equal to 1 if household receives at least three mails in treatment period, 0 if in control group
  3. T_{all4}: Treatment variable equal to 1 if household receives all four mails in treatment period, 0 if in control group

ATE on Households' Electricity Consumption

	Min. 1 Mail		Min. 3 Mails		All 4 Mails	
	Coeff./s.e.	Coeff./s.e.	Coeff./s.e.	Coeff./s.e.	Coeff./s.e.	Coeff./s.e.
$T_{min.1}$	0.162	0.141	–	–	–	–
	(0.342)	(0.336)	–	–	–	–
$T_{min.3}$	–	–	1.083***	0.142	–	–
	–	–	(0.408)	(0.456)	–	–
T_{all4}	–	–	–	–	0.739	0.149
	–	–	–	–	(0.452)	(0.531)
Constant	-0.067	4.673	-0.067	0.299	-0.067	6.438
	(0.241)	(8.784)	(0.241)	(8.509)	(0.241)	(7.799)
Week Dummies	No	Yes	No	Yes	No	Yes
R^2	0.0000	0.0874	0.0010	0.0957	0.0004	0.0924
Observations	8,623	8,623	6,940	6,940	6,311	6,311

Notes: Robust standard errors are in parentheses. *** denotes significance at the 1%-level.

Heterogeneity - Deviation from the Mean Baseline Consumption

	Min. 1 Mail		Min. 3 Mails		All 4 Mails	
	Coeff./s.e.	Coeff./s.e.	Coeff./s.e.	Coeff./s.e.	Coeff./s.e.	Coeff./s.e.
Difference	-3.704***	-4.397***	-3.704***	-4.409***	3.704***	-4.399***
	(0.587)	(0.586)	(0.587)	(0.588)	(0.587)	(0.590)
$T_{min.1}$	0.149	0.121	–	–	–	–
	(0.340)	(0.333)	–	–	–	–
$T_{min.3}$	–	–	1.062***	0.135	–	–
	–	–	(0.411)	(0.458)	–	–
T_{all4}	–	–	–	–	0.705	0.176
	–	–	–	–	(0.458)	(0.538)
Difference × $T_{min.1}$	1.204	1.315	–	–	–	–
	(0.886)	(0.873)	–	–	–	–
Difference × $T_{min.3}$	–	–	2.658**	2.682**	–	–
	–	–	(1.105)	(1.093)	–	–
Difference × T_{all4}	–	–	–	–	2.097*	2.340*
	–	–	–	–	(1.245)	(1.238)
Week Dummies	No	Yes	No	Yes	No	Yes
R^2	0.0116	0.1030	0.0110	0.1094	0.0118	0.1074
Observations	8,623	8,623	6,940	6,940	6,311	6,311

Notes: Robust standard errors are in parentheses. *, ** and *** denotes significance at the 10%, 5% and 1%-level, respectively.

Robustness

Conclusions

- On average, households are not found to significantly change their electricity consumption
- Households with an above-average consumption tend to further increase consumption
- Electronic HERs seem to reinforce household behavior of high-consumption households
  - Eco-customers may have feeling of already doing more than enough
  - Overestimation of own consumption?
- Electronic HERs not a suited measure to induce electricity savings with eco-electricity customers in Austria

HER Example

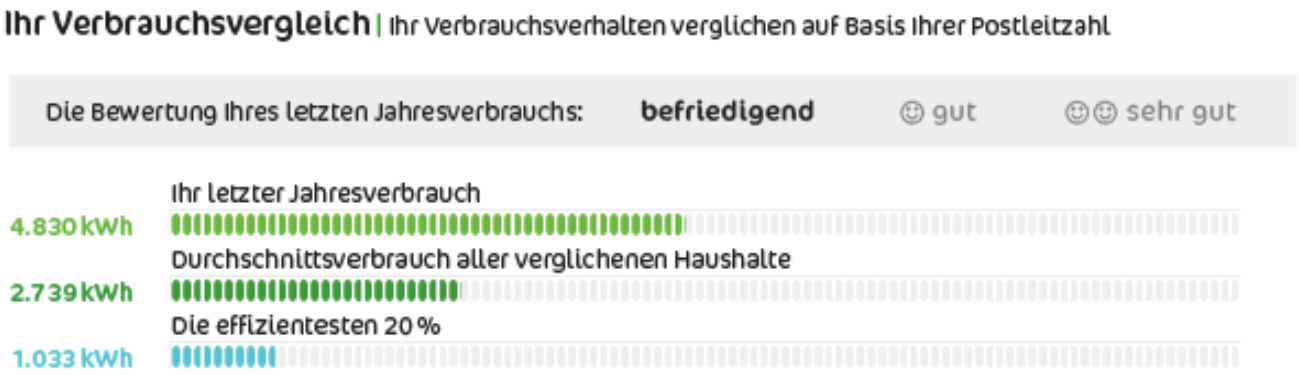

Figure: Social Comparison Element in HER.

Data

Heterogeneity - Below Average Zip Code Baseline Consumption

	Min. 1 Mail		Min. 3 Mails		All 4 Mails	
	Coeff./s.e.	Coeff./s.e.	Coeff./s.e.	Coeff./s.e.	Coeff./s.e.	Coeff./s.e.
Below	4.023***	4.279***	4.023***	4.292***	4.023***	4.281***
	(0.509)	(0.499)	(0.509)	(0.501)	(0.509)	(0.501)
$T_{min.1}$	0.664	0.651	–	–	–	–
	(0.640)	(0.622)	–	–	–	–
$T_{min.3}$	–	–	2.028***	1.148	–	–
	–	–	(0.783)	(0.796)	–	–
T_{all4}	–	–	–	–	1.550*	1.037
	–	–	–	–	(0.870)	(0.904)
Below × $T_{min.1}$	-0.962	-0.983	–	–	–	–
	(0.731)	(0.715)	–	–	–	–
Below × $T_{min.3}$	–	–	-1.771**	-1.777**	–	–
	–	–	(0.887)	(0.870)	–	–
Below × T_{all4}	–	–	–	–	-1.548	-1.549
	–	–	–	–	(0.985)	(0.969)
Constant	-2.346***	-0.821	-2.346***	-0.685	-2.346***	0.249
	(0.443)	(7.542)	(0.443)	(7.392)	(0.443)	(6.781)
Week Dummies	No	Yes	No	Yes	No	Yes
R^2	0.0125	0.1012	0.0122	0.1080	0.0126	0.1056
Observations	8,623	8,623	6,940	6,940	6,311	6,311

Notes: Robust standard errors are in parentheses. *, ** and *** denotes significance at the 10%, 5% and 1%-level, respectively.

Heterogeneity

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