Web Appendix: Social comparisons, household water use and participation in utility conservation programs: Evidence from three randomized trials

Daniel A. Brent*[1], Joseph H. Cook[2], and Skylar Olsen[3]

[1]Department of Economics, Louisiana State University
[2]Daniel J. Evans School of Public Affairs, University of Washington
[3]Zillow Real Estate Research

July 2015

*Corresponding author: Department of Economics, Louisiana State University, Baton Rouge, LA 70803; email:*dbrent@lsu.edu*

Web Appendix

A Additional Figures

WaterSmart Figures

Figure A.1: Home Water Report: Wise

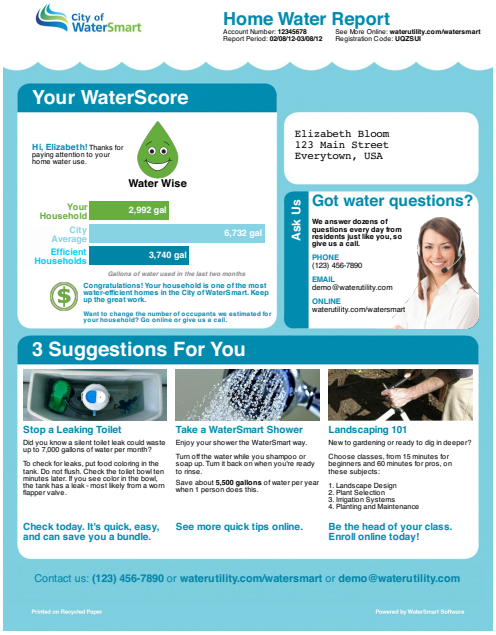
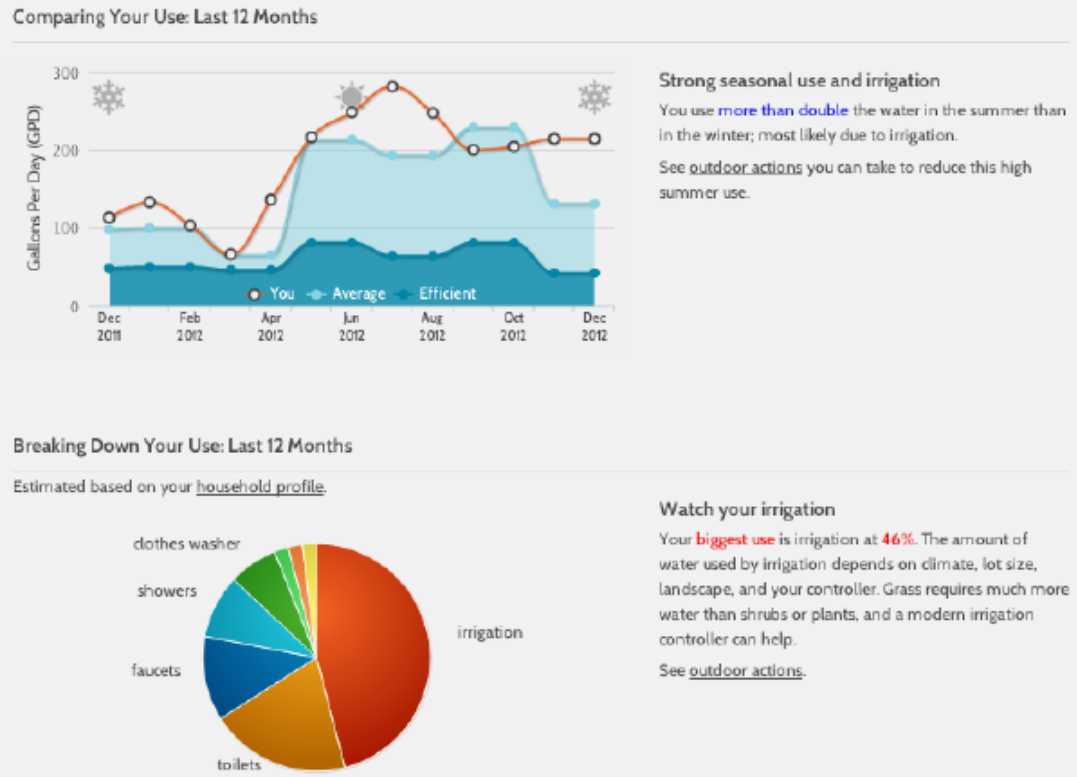


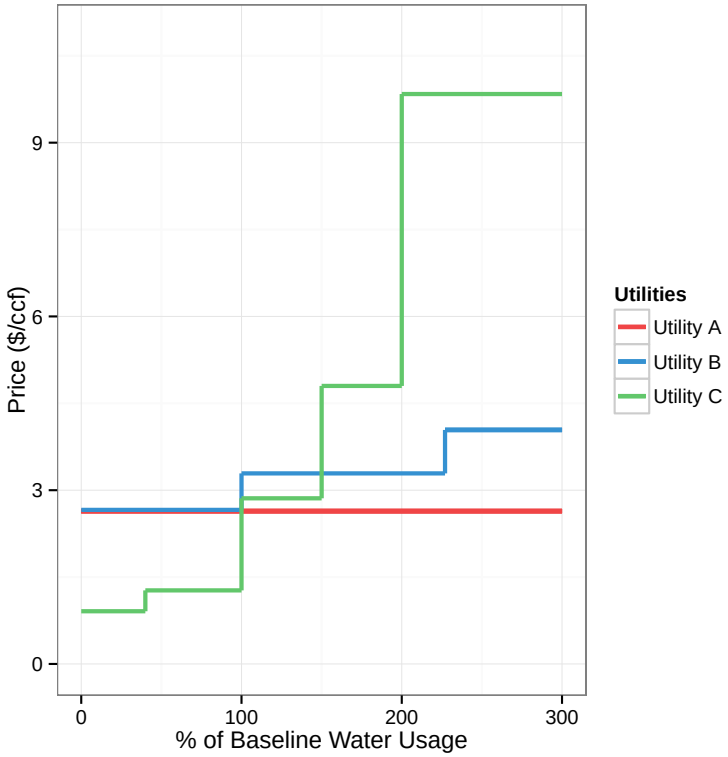
Figure A.2: Home Water Report: Good

Figure A.3: Web Portal



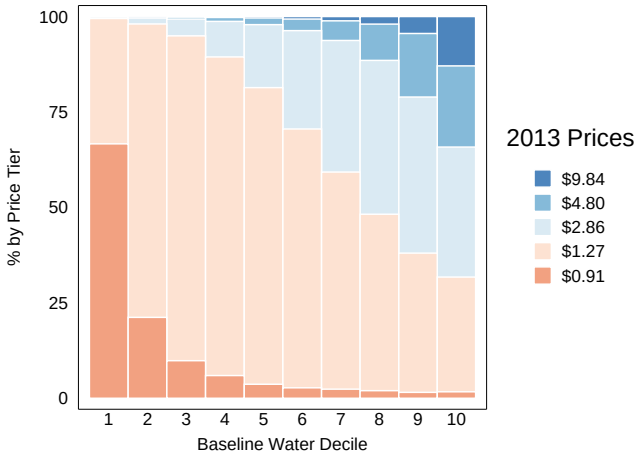
Utility Water Rates

Figure A.4: Water Use by Pilot



Notes: The figure shows the marginal price per ccf of water in each utility. Utility B and Utility C have increasing block rate structures where the marginal price depends on the level of consumption. The baseline level of consumption in Utility B is 172 gallons per day, in Utility C it is an allocation determined at the household level, and in Utility A there is only one tier.

Figure A.5: Water Prices Across Deciles of Baseline Consumption in Utility C



B ATE Robustness Checks

Table A.1: Specifications for ATE - Gallons Per Day

(a) Utility A

	(1)	(2)	(3)	(4)	(5)
Treatment Effect	-16.03**	-11.11***	-10.86***	-11.28***	-10.64***
	(6.90)	(3.13)	(3.15)	(3.10)	(3.19)
Baseline Consumption	No	Yes	No	No	No
Baseline Seasonal Consumption	No	No	Yes	Yes	No
Household Controls	No	No	No	Yes	No
DiD	No	No	No	No	Yes
Household FEs	No	No	No	No	Yes
Year-Period FEs	No	Yes	Yes	Yes	Yes
R^2	0.002	0.568	0.570	0.579	0.082
Households	1,825	1,825	1,818	1,727	1,889
Observations	12,034	12,034	11,998	11,418	38,099

(b) Utility B

	(1)	(2)	(3)	(4)	(5)
Treatment Effect	-16.81*	-17.11***	-16.12***	-16.62***	-16.04***
	(10.14)	(4.31)	(4.04)	(4.06)	(4.36)
Baseline Consumption	No	Yes	No	No	No
Baseline Seasonal Consumption	No	No	Yes	Yes	No
Household Controls	No	No	No	Yes	No
DiD	No	No	No	No	Yes
Household FEs	No	No	No	No	Yes
Year-Period FEs	No	Yes	Yes	Yes	Yes
R^2	0.001	0.631	0.643	0.645	0.071
Households	2,958	2,668	2,612	2,538	3,091
Observations	20,134	18,141	17,776	17,292	85,217

(c) Utility C

	(1)	(2)	(3)	(4)	(5)
Treatment Effect	-7.8633	-4.3650	-5.2108	-3.6358	-4.6628
	(8.6721)	(3.4497)	(3.3907)	(3.5441)	(3.4487)
Baseline Consumption	No	Yes	No	No	No
Baseline Seasonal Consumption	No	No	Yes	Yes	No
Household Controls	No	No	No	Yes	No
DiD	No	No	No	No	Yes
Household FEs	No	No	No	No	Yes
Year-Period FEs	No	Yes	Yes	Yes	Yes
R^2	0.000	0.645	0.649	0.651	0.081
Households	2,300	2,299	2,299	2,045	2,379
Observations	26,533	26,530	26,530	23,684	148,517

Notes: The dependent variable is average daily water consumption in gallons. The columns designate different specifications of the ATE. Columns (1) - (4) use only post-treatment data, whereas column (5) uses observations both pre and post-treatment. Robust Hubert-White standard are clustered at the household level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

C Treatment Effect Heterogeneity

C.1 Specification of Conditional Average Treatment Effects

The regressions take the form

$$w_{it} = \alpha_i + \theta_d \sum_{d=1}^{10} (P_t \times D_d) + \sum_{d=1}^{10} \delta_d (T_i \times P_t \times D_d) + \beta X'_{it} + \tau_t + \xi_{it} \qquad \text{(A.1)}$$

where D_d is the d^{th} decile of either baseline consumption, the GII, or housing values.

Table A.2: Balance Across Baseline Consumption Deciles

(a) Utility A

	Control	N_C	Treatment	N_T	Difference	p-value
Decile 1	46.8	87	51.3	107	-4.51	0.033
Decile 2	83.5	90	83.4	100	0.10	0.920
Decile 3	107.5	95	108.7	95	-1.15	0.271
Decile 4	133.4	81	133.7	109	-0.37	0.758
Decile 5	159.9	90	159.2	99	0.79	0.475
Decile 6	188.4	90	187.6	98	0.78	0.563
Decile 7	221.0	97	221.4	90	-0.40	0.798
Decile 8	261.5	91	265.6	97	-4.04	0.048
Decile 9	320.9	88	326.4	98	-5.54	0.082
Decile 10	527.3	88	489.6	99	37.7	0.176

(b) Utility B

	Control	N_C	Treatment	N_T	Difference	p-value
Decile 1	68.5	157	68.1	159	0.46	0.785
Decile 2	108.7	151	107.0	162	1.75	0.094
Decile 3	138.5	170	139.6	139	-1.17	0.263
Decile 4	169.2	159	171.4	154	-2.14	0.028
Decile 5	201.6	141	203.7	169	-2.15	0.058
Decile 6	241.1	144	241.3	170	-0.22	0.872
Decile 7	291.1	150	290.1	162	1.07	0.558
Decile 8	355.5	163	353.3	142	2.19	0.376
Decile 9	456.3	162	455.0	135	1.22	0.782
Decile 10	773.9	150	802.0	153	-28.1	0.423

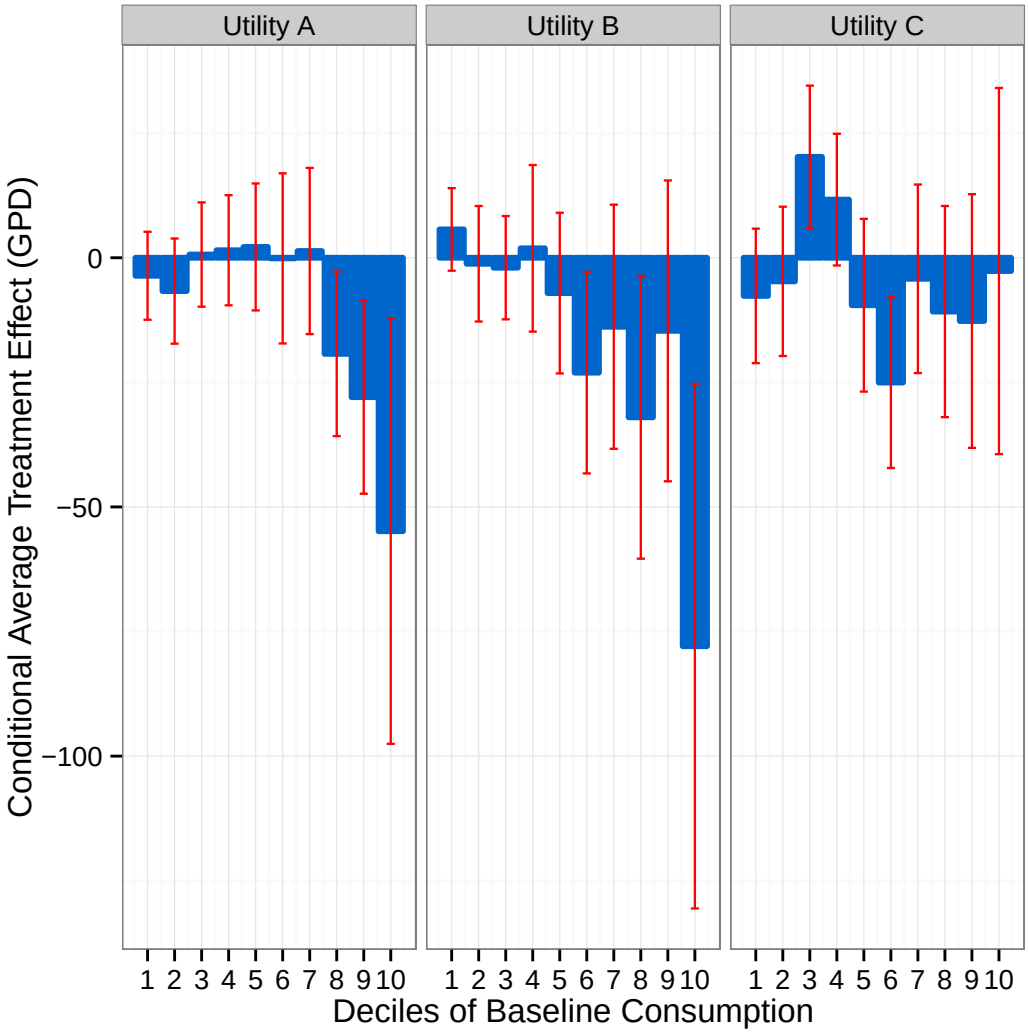
(c) Utility C

	Control	N_C	Treatment	N_T	Difference	p-value
Decile 1	136.2	118	131.1	132	5.08	0.236
Decile 2	205.3	119	205.3	118	0.042	0.982
Decile 3	249.4	130	247.8	110	1.53	0.270
Decile 4	285.3	117	283.7	123	1.63	0.186
Decile 5	315.6	117	314.5	124	1.09	0.303
Decile 6	348.1	113	346.5	122	1.55	0.230
Decile 7	384.5	130	384.6	104	-0.16	0.922
Decile 8	433.3	116	433.8	119	-0.49	0.817
Decile 9	500.5	118	502.3	116	-1.79	0.545
Decile 10	730.2	122	754.7	112	-24.5	0.535

Notes: Balance tests are based on daily average water use in the pre-treatment period by pre-treatment consumption decile. p-value refers to a two-sided t-test.

CATE on Baseline Water Use in Gallons Per Day

Figure A.6: Heterogeneity: Baseline Water Use



Notes: The graphs are created from regressions of daily average water consumption on interactions of the treatment effect with deciles of baseline water consumption using the DiD model. Interactions of deciles of baseline consumption and a post-treatment indicator are included as additional controls. The blue vertical bars are the point estimates and the red error bars represent 95% confidence intervals based on cluster robust standard errors. A separate regression is estimated for each utility.

CATE for Home Value and Environmental Ideology

To create Green Ideology Index (GII) we examine records from the Statewide Database[1] for six votes during the 2008 and 2010 elections: the US Senate race in 2008, the Governor's race in 2010, three "pro-environment" Propositions (7, 10, and 21),[2] and Proposition

[1] http://statewidedatabase.org/.

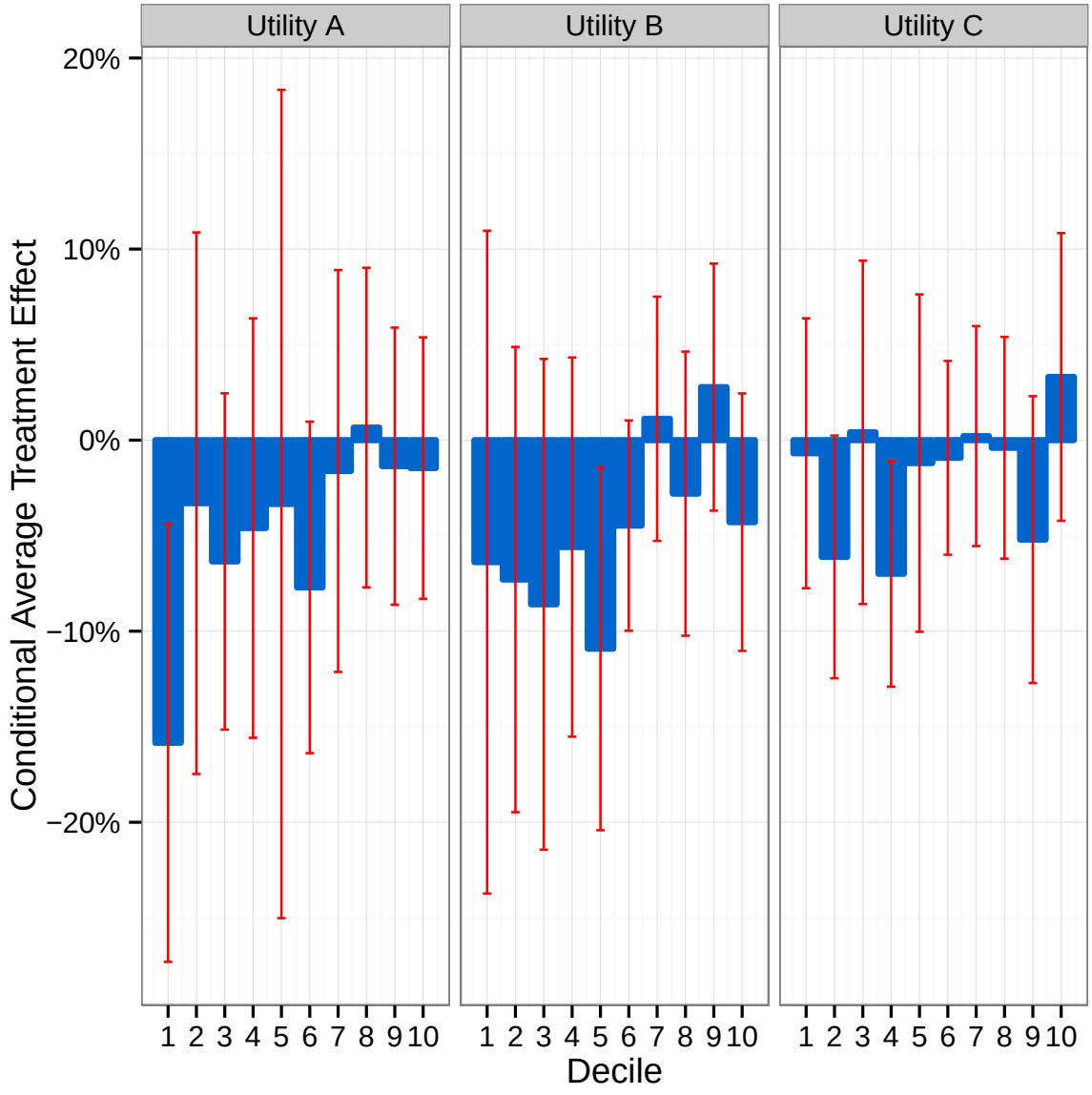
[2] Proposition 7 would have required California utilities to produce half their electricity from renewable resources by 2025. Proposition 10 would have allocated $5 billion as cash incentives for high fuel economy and alternative fuel vehicles and R&D for and education on renewable energy and alternative fuel technologies. Proposition 21 would have increased vehicle license fees in the state by $18 in order to raise $500 million a year dedicated to California State Parks.

23 which would have suspended the state's 2006 Global Warming Solutions Act. For the purposes of the index, a "green" vote is considered a Democratic vote in the Senate and gubernatorial races, a "yes" vote for the three pro-environment propositions, and a vote against Proposition 23. For each measure, we assign a score of 100 to the top 0.1% of blocks with the greatest percentage of individuals voting along green-friendly lines and a score near zero to the least green-friendly census block. Averaging these ordinal scores together yields the index and maintains the 0 to 100 scale across all of California (the greenest areas are consistently green across all votes). We match individual households to the environmental ideology index via their census block as a rough proxy for their own ideology. In order to obtain housing values at the census block group level we access data from Zillows Home Value Index.[3]

This section presents the results for regressions to estimate conditional average treatment effects based on deciles of environmental ideology and housing values. Figures A.7 and A.8 have the same specification as shown in equation A.1 except the interaction is for deciles of GII and housing values respectively. Some results suggest that less environmentally-minded consumers save more water due to social norms. However, this could be confounded with the effect of high water users since those with pro-environment ideology may already be low users and thus less responsive to the treatment. Our statistical power drops in these models because of missing data on the index. In fact, since we drop census blocks without sufficient voting data we may be missing precisely those neighborhoods where contributions to the public good of voting, as well as the public good of water conservation, are low (Bolsen *et al.*, 2014). The CATEs of housing values, a proxy for household income, also do not show a clear pattern indicating that households in census blocks with higher average values are more or less sensitive to the treatment. Utility A has most of the significant CATEs at the high end of the distribution, but Utilities B and C have significant CATEs for both low and high valued homes. One limitation of the results using both ideology and housing values is that we do not have household-level data on these two variables. Another issue is that we are only exploiting intra-pilot variation in ideology and housing values. There is more variation in housing values and ideology across pilots, which may affect the difference in magnitudes of the pilot-level ATEs.

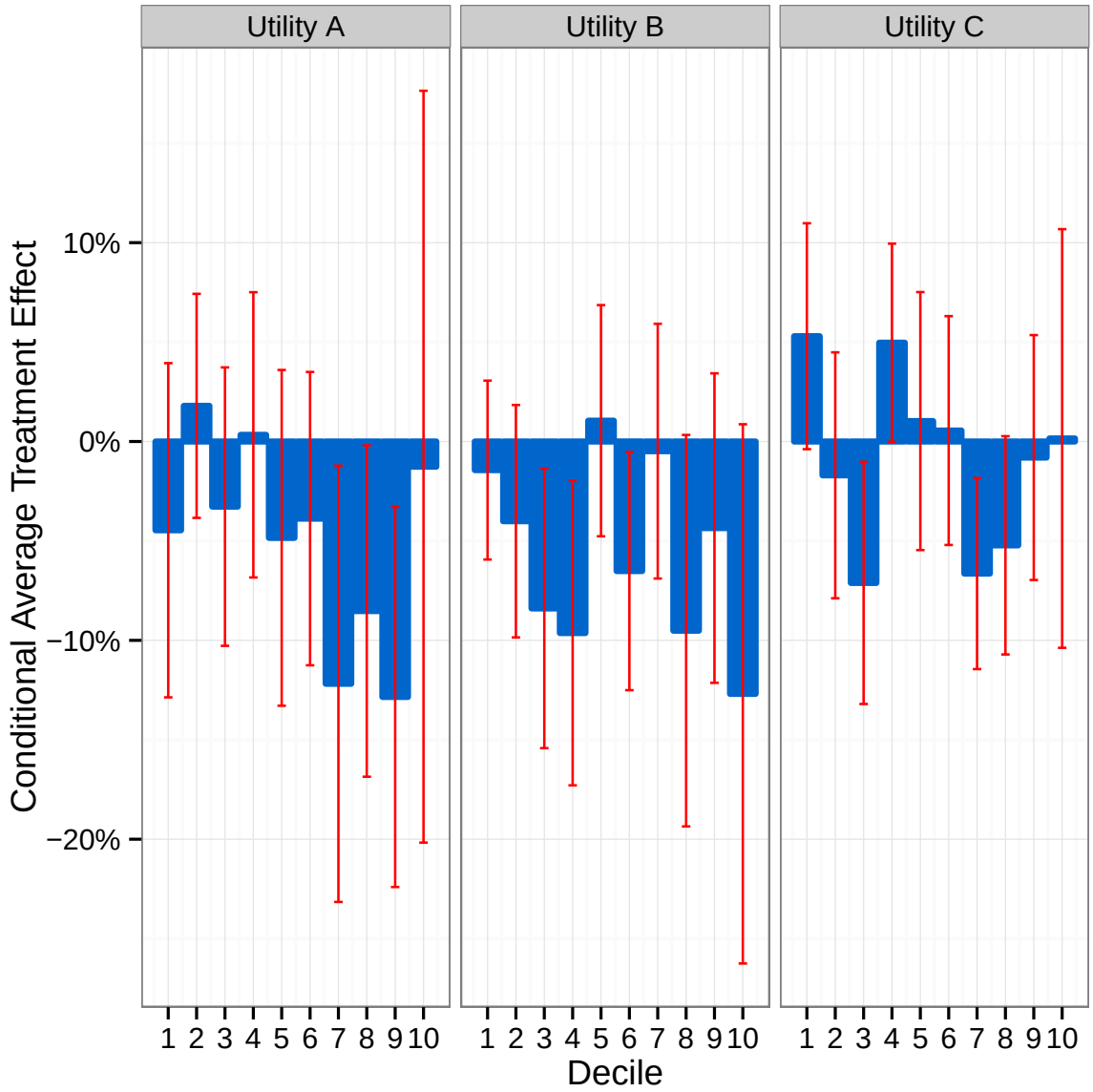
[3]http://www. blog.com/research/2012/01/21/zillow-home-value-index-methodology/

Figure A.7: Heterogeneity: Environmental Ideology



Notes: The graphs are created from regressions of normalized daily average water consumption on interactions of the treatment effect with deciles of the green ideology index using the DiD model. Interactions of deciles of the green ideology index and a post-treatment indicator are included as additional controls. The blue vertical bars are the point estimates and the red error bars represent 95% confidence intervals based on cluster robust standard errors. A separate regression is estimated for each utility.

Figure A.8: Heterogeneity: Housing Values



Notes: The graphs are created from regressions of normalized daily average water consumption on interactions of the treatment effect with deciles of housing values using the DiD model. Interactions of deciles of housing values and a post-treatment indicator are included as additional controls. The blue vertical bars are the point estimates and the red error bars represent 95% confidence intervals based on cluster robust standard errors. A separate regression is estimated for each utility.

D Durability

The specification of the durability regression equation is:

$$w_{it} = \alpha_i + \sum_{h=-3}^{H} \gamma_h (T_i \times P_{t,h}) + \beta X'_{it} + \tau_t + \xi_{it} \tag{A.2}$$

where $h = 1, ..., H$ is a specific treatment period as opposed to the whole course of the program, and negative values refer to the reading periods prior to treatment $h = -3, -2, -1$.

E Interaction with Conservation Programs

Table A.3: Raw Participation in Utility Programs Across Treatment

(a) Utility A

	Pre-Treatment		Post-Treatment	
	Control	Treatment	Control	Treatment
Any Program	123	128	13	98
Any Rebate	90	102	9	16
Audit	33	26	4	82
Toilet	46	55	0	3
Clothes Washer	44	43	7	7
Observations	928	1023	882	1013

(b) Utility B

	Pre-Treatment		Post-Treatment	
	Control	Treatment	Control	Treatment
Any Program	416	429	42	83
Any Rebate	408	421	42	74
Landscape	83	77	0	16
Toilet	68	60	8	15
Clothes Washer	190	203	31	36
Observations	1605	1604	1512	1501

(c) Utility C

	Pre-Treatment		Post-Treatment	
	Control	Treatment	Control	Treatment
Any Program	139	176	160	191
Any Rebate	139	176	158	189
Irrigation	6	7	1	4
Toilet	20	22	20	21
Clothes Washer	112	146	125	154
Observations	978	1083	967	1066

Notes: The tables show the number of participants in utility conservation programs across treatment and control groups prior to and after the start of treatment. "Any Program" pools all programs, and "Any Rebate" restricts programs to rebates for water efficient appliances. Some programs were not included due to very few households participating, but are included in the aggregate variables.

Table A.4: Pre-treatment Participation in Utility Programs Across Treatment

(a) Utility A

	Pre-treatment					
	Treatment	N_T	Control	N_C	Treatment-Control	p-value
Any Program	0.125	1,023	0.133	928	-0.00742	0.625
Any Rebate	0.0997	1,023	0.0970	928	0.00272	0.840
Home Survey	0.0254	1,023	0.0356	928	-0.0101	0.191
Clothes Washer	0.0420	1,023	0.0474	928	-0.00538	0.566

(b) Utility B

	Pre-treatment					
	Treatment	N_T	Control	N_C	Treatment-Control	p-value
Any Program	0.27	1,604	0.26	1,605	0.0083	0.595
Any Rebate	0.26	1,604	0.25	1,605	0.0083	0.593
Toilet	0.037	1,604	0.042	1,605	-0.0050	0.473
Clothes Washer	0.13	1,604	0.12	1,605	0.0082	0.480

(c) Utility C

	Pre-treatment					
	Treatment	N_T	Control	N_C	Treatment-Control	p-value
Any Program	0.163	1,083	0.142	978	0.0204	0.199
Any Rebate	0.163	1,083	0.142	978	0.0204	0.199
Toilet	0.0203	1,083	0.0204	978	-0.000136	0.983
Clothes Washer	0.135	1,083	0.115	978	0.0203	0.165

Notes: The Treatment and Control columns show pre-treatment participation rates in various utility conservation programs. "Any Program" refers to all programs, and "Any Rebate" refers to all rebate programs. Some programs were not included due to very few households participating, but are included in the aggregate variables. p-value refers to a two-sided t-test.

Table A.5: Pre-treatment Utility Communication Across Treatment

(a) Utility A

	Control	N_C	Treatment	N_T	Difference	p-value
Any Contact	0.96	319	0.96	388	-0.0052	0.728

(b) Utility B

	Control	N_C	Treatment	N_T	Difference	p-value
Any Contact	0.96	283	0.98	282	-0.018	0.194
Utility Contact	0.75	280	0.75	274	0.0018	0.961

Notes: "Any Contact" is the proportion of households contacted about water saving resources available from the utility. In Utility A all contact was from the Utility directly. In Utility B some contact was indirect, for example through gardening or appliance stores, and the "Utility Contact" row refers to direct contact from Utility B. p-value refers to a two-sided t-test.

References

Bolsen, Toby, Ferraro, Paul J., and Miranda, Juan Jose. 2014. Are voters more likely to contribute to other public goods? Evidence from a large-scale randomized policy experiment. *American Journal of Political Science*, 58(1):17–30.