Limited Attention and the Residential Energy Efficiency Gap

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Online Appendix

The survey was administered by GfK Custom Research using the KnowledgePanel®, a probability-based online panel of about 50,000 adults who agree to participate in various surveys. The GfK panel is balanced on geography and various demographic characteristics and is thus made to be statistically representative of the U.S. adult population. We conducted a stratified sampling approach for our survey, first targeting homeowners and then oversampling homeowners who had had home energy audits to ensure that we had a minimum of 500 respondents with audits; this endogenous stratification approach is often used when frequency of an outcome is low (Cosslett 1981, 1993). We focused on the 24 states where our earlier research and other independent studies have shown that audits are more prevalent (Palmer et al. 2013). We collect information on a number of house attributes and household member characteristics. Because audits can take several hours to complete, time costs of homeowners can be an important component of the cost of getting an audit, thus we collect data on whether or not a respondent can work from home, has flexible work hours and if there is someone at home most or all of the day. We use these responses to create an indicator variable of whether someone can be easily at home that takes on a value of one if the response to any of these questions is yes. We also ask a series of questions about environmental attitudes including whether the respondent believes that humans are contributing to global warming, how important environmental protection is to the respondent, and whether the respondent donated to an environmental organization in the past year and use the responses to this

collection of questions to construct an environmental leanings variable that takes on a value of between 0 and 3 depending on the number of positive responses. Basic demographic information as well as income and employment status are available from GfK. The survey is available from the authors upon request.

Our inattention index is calculated from the responses to six questions that reflect the homeowner's knowledge about her energy costs and equipment type and age and a question about whether she regularly (at least once a year) services her heating and cooling equipment. For each of these questions we provide a range of categories for the respondent to select from in order to make it easy to provide at least a qualitative response, thus the bar for a "do not know" answer is set pretty high and so is the bar for scoring high on inattention. The percentage of homeowners who responded that they did not know on each of the equipment and energy bill questions and that they did not service their heating and cooling equipment is shown in Figure S1. The figure makes clear that homeowners who have not had audits are less attentive as they are more likely to report not knowing energy features of their home and less likely to service their equipment.

[insert Figure S1 here]

Table S1 shows summary statistics for the key variables that we use in the logit model.

[insert Table S1 here]

As described in the paper, the inattention index and other behavioral factors have a statistically significant effect on the choice to have an audit. Most of the other explanatory variables have the expected sign and many are statistically significant. The contributions of the different variables associated with higher expected benefits of getting an audit are somewhat mixed. As expected, having older heating and cooling equipment and facing a higher electricity price both have positive and significant

effects and the indicator for planning to sell one's house has a negative effect. However, house size, as measured by number of rooms, and house age are not significant. The costs of getting an audit (and/or following up with the recommended retrofits) is expected to be lower in states with higher per capita expenditures on energy efficiency programs and this is consistent with the positive and significant coefficient on this variable. However the "easily at home" variable, our indicator for low transaction costs, is not significant.

Racial minorities and low income households are more likely to get an audit; while this last finding suggests that our survey could be picking up audits conducted as part of the federal low-income weatherization programs, we find that generally the households that have had audits have incomes that exceed the thresholds for these programs. The negative income coefficient is consistent with Gamtessa (2013), who argues that because energy costs are a lower share of income for high income households, those households are less likely to retrofit their homes.

We have not focused on audit follow-up in this paper, but our survey also included questions about what auditors' recommended and to what extent homeowners followed up on those recommendations. With respect to air sealing and insulation, two of the most frequently recommended actions (Palmer et al. 2013), we found that follow-up appears to be incomplete. Slightly less than 40 percent of households implemented all of the recommendations for air sealing and insulation. Further analysis of these findings is the subject of future work.

Supplemental References

Consortium for Energy Efficiency. 2014. 2013 State of the Efficiency Program Industry: Budgets, Expenditures and Impacts, March 24.

Cosslett, Stephen. 1993. Estimation from Endogenously Stratified Samples, in *Handbook of Statistics*,

Volume 11, Econometrics, ed. C. R. Rao, pp. 1–44, North-Holland.

Cosslett, Stephen. 1981. Efficient Estimation of Discrete Choice Models, in *Structural Analysis of Discrete Data with Econometric Applications*, ed. C. Manski and D. McFadden, pp. 51–111, MIT Press.

Gamtessa, S.F. 2013. "An Explanation of Energy Efficiency Retrofit Behavior in Canada," *Energy Build* 57: 155-164.

Palmer, Karen, Margaret Walls, Hal Gordon, and Todd Gerarden. 2013. "Assessing the Energy-Efficiency Information Gap: Results from a Survey of Home Energy Auditors." *Energy Efficiency* 6 (2): 271–92.

	Households-Audits		Households-No Audits		All Households	
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
Respondent Characteristics						
Dummy=1 if retired	0.265	0.024	0.260	0.015	0.262	0.013
Dummy=1 if married	0.752	0.025	0.780	0.014	0.775	0.013
Dummy=1 if black	0.139	0.020	0.085	0.010	0.089	0.009
Dummy=1 if Hispanic	0.131	0.021	0.105	0.013	0.106	0.011
Dummy=1 if other ethnicity	0.083	0.018	0.059	0.010	0.062	0.009
Age of household head	55.071	0.887	53.381	0.532	53.618	0.481
Annual household income (in $)	87,093	2,920	88,796	1,691	88,682	1,525
Environmental leanings [a]	1.247	0.059	0.924	0.036	0.959	0.032
Variables affecting benefit/cost from audit						
Easily at home [b]	0.804	0.022	0.784	0.015	0.785	0.013
Age of house	40.480	1.547	37.326	0.913	37.715	0.821
Number of rooms in house (excluding bathrooms)	6.838	0.026	6.815	0.017	6.818	0.068
HVAC system equal to or older than 6 years old	0.682	0.026	0.603	0.017	0.614	0.016
Heating degree days [c]	4033.1	178.4	4142.1	107.5	4149.3	96.7
Cooling degree days [c]	7,697.9	263.5	7,309.9	149.1	7,343.8	134.4
Average monthly electricity price (in $/MWh) [d]	115.38	1.40	111.98	0.91	112.43	0.81
2012 Per Capita State Residential EE Expenditure (in $) [e]	7.47	0.40	5.94	0.17	6.13	0.15
Dummy=1 if plan to sell house	0.005	0.002	0.115	0.012	0.102	0.010
Behavioral factors						
Dummy=1 if received home energy report	0.312	0.026	0.212	0.015	0.225	0.013
Dummy=1 if know someone who had audit	0.434	0.027	0.070	0.009	0.112	0.009
Inattentiveness index [f]	0.161	0.010	0.225	0.008	0.217	0.007

[a] Environmental leanings is a categorical variable equal to 0, 1, 2, or 3 depending on answers to three questions about the degree to which humans are causing global warming, how important environmental protection is to the respondent, and whether the respondent donated to an environmental organization in the past year.

[b] Easily at Home is equal to 1 if respondent reported that her job allows her to work from home, she has flexible work hours, or someone is at home all, or most, of the day. See text for more detail.

[c] A heating/cooling degree day is the number of degrees that the mean temperature, taken over an 8-day period, is above/below 65 degrees. There are 635 degree day recordings for each zip code represented in the household survey over the period from 2000 to 2013. Temperature data accessed from the NASA Land Process Distributed Active Archive Center, see https://lpdaac.usgs.gov/products/modis_products_table.

[d] Electricity prices are constructed using the monthly data on revenues ($) and electricity sales (MWh) collected by the Energy Information Administration on form 826. Utility level data are matched to zip codes using utility service area boundary maps.

[e] 2012 U.S. electric and natural gas residential efficiency program expenditures by state from Consortium for Energy Efficiency Annual Industry Report, divided by state population; see http://library.cee1.org/sites/default/files/library/11385/CEE_AIR_Tables_April_04_2014.pdf.

[f] Attentiveness index constructed from 6 questions demonstrating attentiveness on issues related to home energy use. The index is equal to the fraction of the questions with "inattentive" answers. See text for more detail.
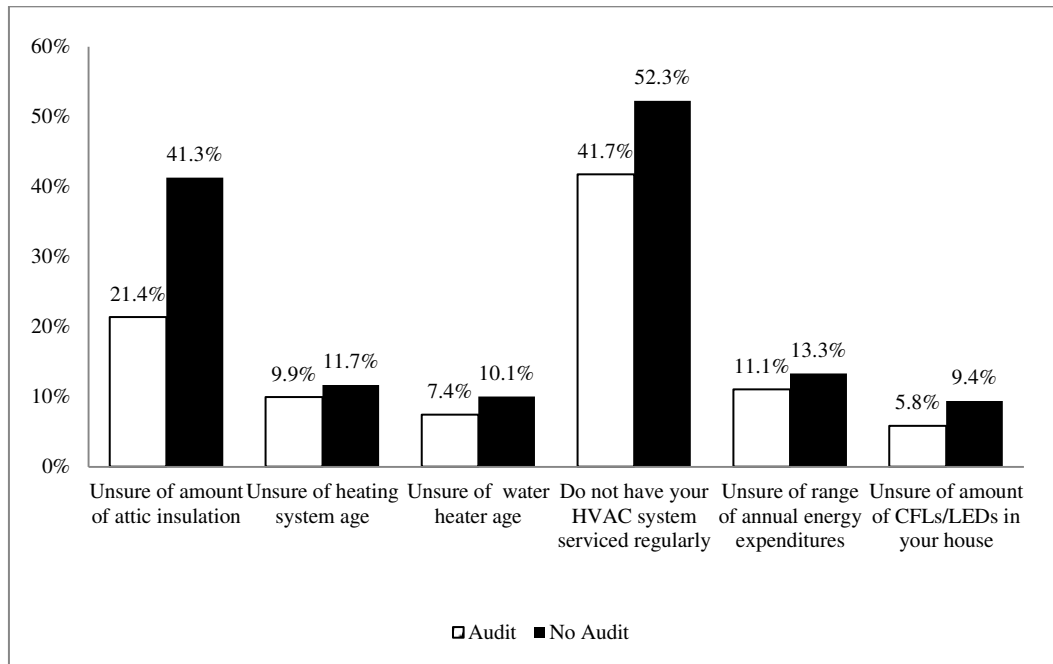
FIGURE S1. AUDIT UPTAKE AND INATTENTIVENESS

Note: Height of the bars represents the percentage of survey respondents.