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Do Extrinsic Incentives Undermine Social Norms? Evidence from a Field Experiment in Energy Conservation

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Abstract Policymakers use both extrinsic and intrinsic incentives to induce consumers to change behavior. This paper investigates whether the use of extrinsic financial incentives is complementary to intrinsic incentives, or whether financial incentives undermine the effect of intrinsic incentives. We conduct a randomized controlled trial that uses information interventions to residential electricity customers to test this question. We find that adding economic incentives to normative messages not only does not strengthen the effect of the latter but may reduce it. These results are consistent with recent theoretical work that suggests a tension between intrinsic motivation and extrinsic incentives.

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1 Introduction

The use of normative appeals as a means to induce prosocial behavior has garnered considerable interest amongst academicians and policymakers alike. Existing research has documented the effects of prosocial messages in a wide range of settings including energy and water conservation, charitable giving, retirement savings, and the provision of public goods to name only a few.[1] Importantly, this literature highlights that prosocial messages provide policymakers with an extended set of tools to change behavior.

Standard neoclassical models yield Pigouvian prescriptions for policy that affect extrinsic incentives. For example, consider the case of electricity or water consumption. Normative prescriptions call for setting prices that reflect the marginal social cost of consumption in order to induce households to choose the socially optimal level of consumption. Yet existing research shows mixed results regarding the impact of price changes on subsequent consumption levels (e.g. Ito 2014; Jessoe and Rapson 2014; Kahn and Wolak 2013)—a finding that many believe reflects the lack of salience over both prices and quantity consumed.[2]

However, the behavioral economics literature offers other policy instruments. Recent work shows that messaging customers with information about their relative consumption leads to notable and persistent reductions in consumption.[3] The theoretical literature proposes two mechanisms through which this type of information can encourage conservation: by increasing the moral cost of consumption (an intrinsic incentive) or by highlighting potential economic benefits to the individual of reducing consumption (an extrinsic incentive).[4] Despite the growing literature on the effects of norm-based initiatives, additional research is needed to understand the importance and interactions of intrinsic versus extrinsic incentives.

An important question is whether the policy tools of prices and normative appeals are *complements* or *substitutes*. The main goal of this paper is to explore whether and how the effects of normative comparisons are impacted by including information that makes explicit the potentially large extrinsic benefits of conservation. In this regard our approach builds upon Gneezy et al. (2011) who argue that "…the discussion should not be whether incentives negatively affect contributions to public goods, but when incentives do and do not work…" As we discuss below, this relates to theoretical predictions in models such as Benabou and Tirole (2006) whereby pro-social acts that were motivated by intrinsic motives are subsequently incentivized and, under certain conditions, crowded out.

In order to study this question, we partner with the electric utility that serves residential customers in Quito, Ecuador-Quito Electric Company (EEQ, for its Spanish acronym) to conduct a randomized control trial that informs customers about how their historical monthly

[1] For example, see Allcott (2011) on energy conservation, Ferraro and Price (2013) on water conservation, Frey and Meier (2004) on charitable giving, and Duflo and Saez (2003) on retirement savings.

[2] Attari et al. (2010) highlight a related concern-incorrect beliefs about the relative energy intensity of various appliances within the home and the tendency to underestimate the amount of energy used when operating dishwashers or central air conditioning units relative to that used by a standard incandescent lightbulb.

[3] For example, see Allcott and Rogers (2014).

[4] For an illustrative model of moral costs, see Levitt and List (2007) which provides a framework that outlines how factors such as social norms and salience can be used to promote prosocial behaivor. Under this setup, messages that frame conservation as a social norm should trigger added "costs" of consumption and hence reductions in use.

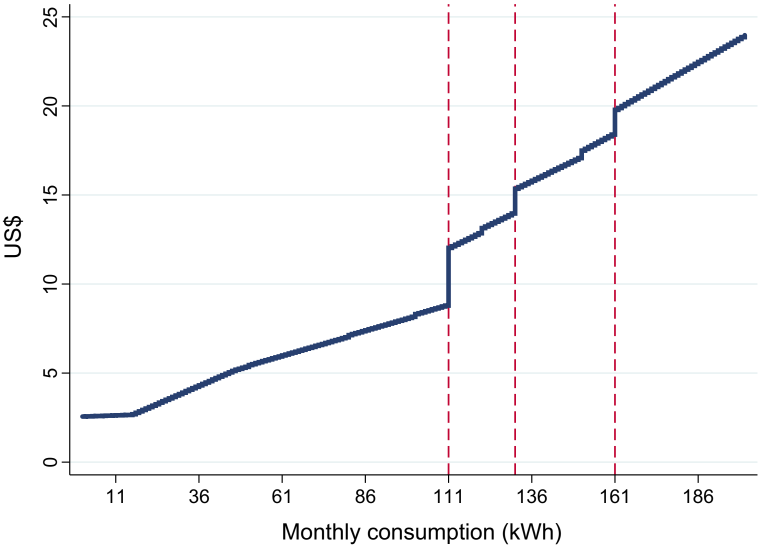

Fig. 1 Sample tariff function for EEQ residential customers. December, 2013

electricity consumption compares to their neighbors. The modal level of monthly consumption among EEQ customers is 110 kilowatt-hours (kwh) per month. In our baseline treatment, we inform customers whose average monthly consumption during the past years was above just 110 that they consume X percent more than the typical household. This information intervention parallels the social comparisons conducted in the well-known Opower experiments.[5] Messages were attached to paper bills and delivered in March 2014.

In addition to the baseline social comparison treatment, we exploit a unique institutional feature that allows us to layer an extrinsic monetary incentive on top of this normative message. The EEQ monthly tariff has a large *notch* at 111 kwh which is illustrated in Fig. 1. As shown in the figure, households with monthly consumption of 110 kwh pay around $8.50, whereas households consuming 111 kwh—just one kilowatt-hour more—pay approximately $12. While the marginal price of one kwh at most points on the tariff function varies between 3-7 *cents*, the 111th kwh costs households around 3.5 *dollars* and represents an approximate 41 percent increase in monthly energy expenditures.

Surprisingly, this notch does not appear to be salient to most households as we observe no excess bunching around or below the 110 kwh threshold. This provides the opportunity for an information intervention that makes the price notch and associated scope for savings salient. Our second treatment targets households with historical consumption above 110 kwh and augments the social comparison to include information that reducing consumption below the 110 price notch can substantially reduce their electricity bill. As a result, the second treatment group is simultaneously providing both intrinsic and extrinsic incentives to reduce consumption.

We find that receipt of the social comparison letter (the intrinsic incentive) leads to substantial reductions in monthly electric consumption. Households in our baseline treatment consume approximately 1.3 kwh less per month in the post-intervention period than do coun-

[5] Data from the baseline treatment are used in a companion paper (Pellerano et al. 2015) which provides a comparison of this treatment with an alternative information intervention that makes salient the underlying tariff schedule.

terparts in the control group—a difference that is significant at the $p < 0.05$ level. However, the treatment that augments the social comparison by providing information on the expected savings, and thus highlights *both* intrinsic and extrinsic incentives, has no added impact on the amount of energy conserved. Households in our second treatment consume approximately 0.7 kwh less per month in the post-intervention period than do counterparts in the control—a difference that is not statistically different from zero. In fact, our data suggest that attempts to highlight the extrinsic benefits of conservation may backfire. Households in our second treatment consume approximately 0.6 kwh *more* per month than do counterparts in the social comparison treatment—a difference that is not statistically significant at meaningful levels.

These findings are consonant with a developing body of work suggesting a potential tension between intrinsic motivation and extrinsic incentives (see, e.g., Mellström and Johannesson 2008; Lacetera et al. 2012, 2014; Catherine et al. 2015). However our setting, in which public visibility is unlikely to be present, does not suggest a need for public visibility of economic incentives to affect subsequent pro-sociality, as in Ariely et al. (2009). Moreover, our findings call into question the sentiment from Gneezy et al. (2011) that monetary incentives are better suited for contributions to public goods (such as investments in energy savings) that are less visible to others.

Our paper also contributes to research that studies the role of non-price mechanisms to affect energy consumption. For example, the impacts of social comparisons used in the Opower Home Energy Reports have been widely studied (e.g see Schultz et al. 2007; Allcott 2011; Costa and Kahn 2013; Ayres et al. 2013). Ito et al. (2015) use a randomized controlled trial to measure the short-run and persistent effects of moral suasion interventions as compared to dynamic pricing for residential electricity customers.[6] (Ferraro and Price 2013) study the relative effects of prosocial messages and social comparisons in a field experiment of water consumption. Importantly, our paper differs from this prior work in that we are the first to explore the impact of normative appeals on consumption in the context of a developing country and amongst low user groups.

The remainder of the paper is organized as follows. Section 2 describes our data set and experimental design. Section 3 presents and discusses the main empirical findings. Section 4 concludes.

2 Experimental Design and Data

We partner with Quito Electric Company (Empresa Eléctrica Quito - EEQ) to conduct a randomized control trial that uses an information intervention to target residential electricity customers in Quito. EEQ has a tariff function which is quite different from many tariffs in North America and Europe. In designing the experiment, we make use of this unique feature which enables us to make salient a significant extrinsic monetary incentive with an information intervention. Many tariffs in the U.S. have “kinks” so that the marginal price of an additional kilowatt-hour may rise from, say, seven to ten cents per kwh when the monthly

[6] There are several key distinctions between our paper and Ito et al. (2015). First, Ito compares behavior across treatments that rely upon moral suasion (intrinsic incentives) only and critical peak pricing (extrinsic incentives) only. In contrast, our study explores the outcome when one augments messages that include a social comparison (intrinsic incentive to conserve) with possible extrinsic benefits (lower energy bills) of conserving energy. Second, in our study extrinsic benefits are discontinuous while the incentives to conserve in Ito are continuous during peak periods. Finally, the moral suasion message in Ito is an appeal to use energy wisely while our study uses a social comparison.

consumption crosses a threshold. In contrast, the EEQ tariff has large "notches" so that a single kilowatt-hour can cost several *dollars*!

Figure 1 provides an example of the EEQ tariff for December 2013 which includes several notches. The largest notch occurs at 111 kwh as a result of a subsidy called the "Dignity Tariff" (Tarifa de la Dignidad).[7] Households with a monthly consumption of 110 kWh pay around \$8.50, whereas households consuming 111 kWh pay approximately \$12. For households that consume in this range, this 1 kWh difference corresponds to around 0.5% of disposable monthly income, so there are large benefits for households just above the notch of reducing consumption by small amounts.

Importantly, this notch does not appear to be salient to customers prior to our information intervention. As shown in Pellerano et al. (2015) (hereafter, PPPS), historical patterns of consumption are consistent with households being unaware of the notch. Specifically, if households were aware of and responsive to the notch, one would expect to see either (1) a discontinuity in the density of monthly household consumption just below 111 kWh, or (2) "excess mass" of the density of monthly consumption around 111 kWh. Using tests developed by McCrary (2008) and Chetty et al. (2011), PPPS reject that households alter their consumption in response to the price notch. The insalience of the price notch is not particularly surprising because monthly electricity bills contain no information about the fact that bills discretely rise at 111 kWh (see a sample bill in "Appendix 2"). Because the notch appears not to be salient to customers, we believe that informing households about its existence can serve as an extrinsic financial incentive to reduce consumption.

A second institutional feature facilitates a social comparison at the same benchmark level of consumption. The modal level of consumption occurs at the same level of consumption where the notch occurs, as shown in Fig. 2.[8] We take advantage of these institutional features to test whether prices and normative appeals are complements or substitutes.

In our field experiment, we identify households who historically consumed levels close to the 110 kWh notch prior to our information intervention. Specifically, we identify households with average consumption between 100 and 125 kWh/month in the previous year and randomly assign them into either one of two treatment groups or a control group.[9] We focus on households with these levels of historical consumption because they are near the modal level of consumption. This tight window captures households with similar consumption patterns while balancing the concern of sample size for statistical power. These households lie in the lower end of the consumption distribution—100 kWh/month corresponds to the 37th percentile while 125 kWh/month corresponds to the 50th percentile. And as shown in Fig. 2, the consumption distribution is right skewed, so these customers fall below the mean level of consumption. Relative to households in prior studies, those in our sample are "lower users" that would have likely been excluded from the experiment.[10]

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[7] The size of the notch varies slightly month-to-month, but the notch always occurs at 111 kWh and is always several dollars during the period of our study. The size of the notch depends on monthly cross-subsidies which are collected from households with consumption above 160 kWh in a given month (10% surcharge) and distributed to households with consumption below 130 kWh in the following month.

[8] One might worry that the presence of the notch drives the mode of consumption to be 110, however that does not appear to be the case. The 110 price notch was instituted in 2007, yet the 110 mode of consumption existed prior to 2007, as shown in "Appendix 3".

[9] A third treatment group only received information about the existence of the price notch. However, this arm of the experiment is the topic of Pellerano et al. (2015), so we do not discuss it in this paper.

[10] For example, average daily consumption for the various experiments in Allcott (2011) was approximately 4 to 15 times greater than that observed in our study (about 3.3 to 4.1 kWh per day). Also Ferraro and Price (2013) do not send letters to and exclude from the analysis any household whose consumption in the pre-intervention period was in the lower quartile of the use distribution.

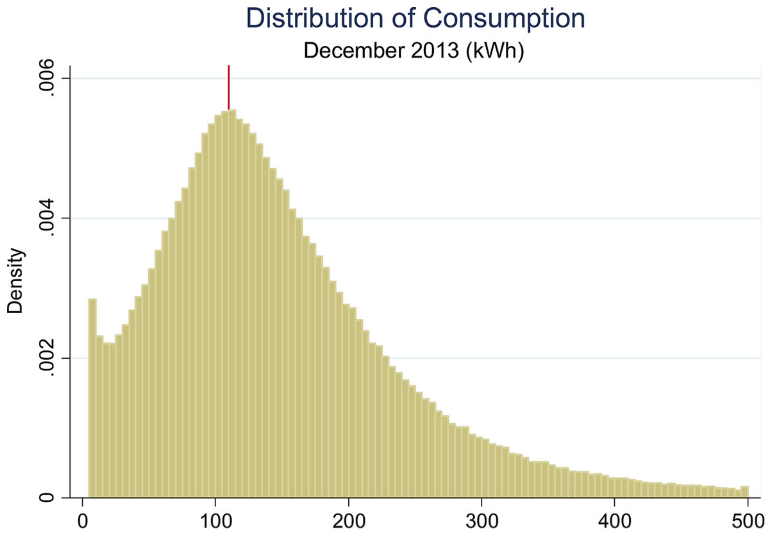


Fig. 2 Distribution of consumption: mode coincides with price Notch (December 2013)

Each of the treatment groups received an additional paper of information attached to their March 2014 monthly bill. The first treatment group receives information that provides a social comparison between own consumption and that of a benchmark neighbor. As our referential consumption level, we had several possible metrics of central tendency to choose among, including mode, mean, and median. We chose to use the mode of 110 because it also happens to correspond to the location of the price notch. The utility partner was particularly interested in focusing information interventions around the price notch, so the use of mode as the metric of central tendency was favored.

The flyer includes information stating that “The average household like you consumes: 110 kWh”. A sample Social Comparison letter is shown in “Appendix 1” (both in Spanish and English). A household with 2013 pre-treatment average consumption of 115 kWh is told that:

> “Your average monthly consumption was: 115 kWh”
> “The average household like you consumes: 110 kWh”

This information is followed by three energy savings tips that target the three largest end-uses of electricity for similar households in Quito (ENERINTER—Asesoría Energetica Internacional, 2012). Importantly, this letter makes no mention of the potential economic benefits of reducing consumption to the reference level. The incentives to conserve induced by this letter are purely intrinsic as triggered by the social comparison.

The second treatment group receives information that layers financial incentives on top of the social comparison. This letter includes all of the information included in the Social Comparison letter plus additional text that provides a description of the price notch and how it impacts monthly expenditures. Specifically, the letter adds that (translated to English):

> The electric tariff established by CONELEC is progressive. What this means for you is that there is a large increase in your monthly bill should you consume more than 110 kWh.... Over the past year, this means that you have paid around **US$ XX** a month for the electricity you use (**US$ XXX** per year). If you were to reduce your electricity

use by **X kWh** per month (around **X,XX%** of your current consumption), you would reduce your monthly energy bill by nearly **XX,XX%** and would save approximately **US$ XX per year.**

A sample letter for this "social comparison and price salience" letter is shown in "Appendix 1". The messaging on this letter is designed to highlight both intrinsic and extrinsic incentives to reduce electricity consumption. Our goal is to trigger extrinsic motives and to explore whether and how they interact with the intrinsic motives triggered by the normative appeal.

By design the flyers are very simple. They only include the information described above along with the logo of the utility. We do not add any design features or information suggesting that energy conservation is a pro-social act. These flyers were part of a one-time information intervention corresponding with the March 2014 electric bills. In this regard our experiment differs from those conducted by Opower which rely upon repeat messaging (see, e.g., Allcott 2011; Costa and Kahn 2013; Ayres et al. 2013) but mirrors the approach in Ferraro and Price (2013) who rely upon delivery of a single message.

3 Results

We use post-treatment consumption to test for whether the inclusion of language highlighting extrinsic incentives enhance or undermine the intrinsic incentives triggered by a social comparison. In doing so, we focus on the subset of households with historical consumption *above the 110 price notch*. As part of a broader research agenda, our information intervention targeted households with historical consumption levels both above and below the notch—2013 average consumption between 100 and 125. Our companion paper (PPPS) investigates the full set of customers to study the relative power of price versus non-price mechanisms to induce conservation. Interestingly, we find no evidence of the so-called "boomerang" effect whereby households provided information that they consume less than the referential neighbor subsequently increase consumption.

To address the research question that motivates the current paper, we focus only on those households with historical consumption between 111 and 125 kwh per month.

3.1 Balance and Tests for Randomization

We randomize 27,634 households into two treatments and a control group. To ensure that there are no systematic differences across geographic areas, we randomized treatment within the 74 sectors and 24 urban parishes in which EEQ divides the metropolitan area. We conducted the randomization ourselves and sent EEQ the household accounts assigned to each group.[11]

To test that the groups are balanced, we compare historical consumption levels across the three groups in Table 1. The top panel shows that each group has a similar mean, median, and variance of consumption. The bottom panel tests for differences in means of each pairwise comparison. As noted in the table, we fail to reject the null hypothesis that the groups have the same level of average monthly consumption prior to treatment.[12]

[11] Given the level at which randomization occurred, it is possible in principle that spillovers exist across treatment and control households. We believe this to be unlikely in practice because it would require neighbors to show each other and discuss electric bills. However, if any meaningful spillovers exist, our estimates would be downward biased and the true impact of treatment would be larger.

[12] Unfortunately we have no demographic information on the households, so we are unable to test for differences in other household characteristics.

Table 1 Pre-treatment balance across groups: household yearly average in 2013 monthly consumption (kWh) sample of households historically above the notch

	Count	Average	Median	SD
Panel A: Summary statistics				
Control	9,425	117.42	117.42	4.34
Social comparison	9,359	117.37	117.33	4.37
Social comparison + Price	9,381	117.35	117.33	4.38
	Difference	Difference (%)	SE	*p* value
Panel B: Test of differences				
Social comparison versus Control	−0.048	−0.04	0.064	0.45
SC+P versus Control	−0.071	−0.06	0.064	0.26
SC+P versus Social comparison	−0.023	−0.02	0.064	0.72

The notch that defines the sample is 110 kWh/month as explained in the text. Panel A reports summary statistics of the pretreatment variable—average 2013 monthly consumption—for each household in the treatment groups. Panel B reports tests of differences in means of the pretreatment 2013 average monthly consumption across the households in each of the treatment groups. We report *p* values of tests of the null hypothesis that the means are equal for each pairwise comparison using White standard errors

3.2 Estimated Treatment Effects

In order to test the effects of treatment on consumption, we analyze household-level monthly electricity consumption in April–June 2014—the three months following receipt of our information intervention. We select the three post-treatment months because, consistent with the literature, the effect of non-pecuniary interventions wanes over time (see, for example, Gneezy and List 2006; Landry et al. 2010; Ferraro and Price 2013).

In our analysis, the dependent variable is the average monthly consumption standardized to 30 days. To measure this, we use data on the consumption and number of days between meter reads to calculate average daily consumption and multiply this value by 30.42 (=365/12).[13] This allows us to interpret our estimates as the effect of our interventions on a month of consumption.

Table 2 provides summary statistics showing average monthly consumption in both the pre- and post-intervention periods for our various experimental groups. As noted in Panel B of the table, for the sample above the notch, the difference in the change in consumption between the control group and the social comparison group is approximately 1.25 kWh, whereas the corresponding difference between the control group and combined treatment is around 0.7 kWh. The table also shows the same calculations for the whole sample in Panel A; however, as mentioned above, in this paper we focus our attention on the households in Panel B.[14]

To test if the differences in Table 2 are statistically significant, we use regression analysis. Because treatment is randomized, we can use several empirical strategies to estimate average treatment effects. First, we can estimate the average treatment effect using cross-sectional variation in post-treatment consumption across treatments for April to June 2014. This empirical strategy essentially compares a month of post-treatment consumption for

[13] In our sample, meter-read windows range from 28 to 32 days.

[14] Panel C shows that we find no evidence of a boomerang effect.

Table 2 Mean and standard deviation of monthly consumption (kWh) across treatments: pre-treatment versus post-treatment

	Pre-treatment (A)	Post-treatment (B)	Difference (B–A)
Panel A: All sample			
Control	112.77	117.55	4.77
	(34.70)	(45.43)	
Social comparison	112.80	116.86	4.06
	(34.14)	(45.05)	
Social comparison + Price	112.81	117.03	4.22
	(33.33)	(45.12)	
Panel B: Above notch			
Control	117.85	122.18	4.33
	(34.76)	(45.03)	
Social comparison	117.74	120.81	3.08
	(34.38)	(45.28)	
Social comparison + Price	117.82	121.42	3.59
	(33.54)	(45.63)	
Panel C: Below notch			
Control	105.33	110.77	5.44
	(33.24)	(45.18)	
Social comparison	105.66	111.14	5.48
	(32.49)	(44.10)	
Social comparison + Price	105.53	110.67	5.14
	(31.62)	(43.59)	

The reported variable is a month of consumption, which is the average daily consumption during the meter-read window multiplied by 365/12. The table reports the mean consumption across treatments in the pre-treatment period (2012 Jan–March 2014) and the post-treatment period (Apr–Jun 2014), and their difference. The standard deviation of consumption is in parenthesis. In this paper we focus the empirical analysis on those households with historic consumption above 110 kwh (Panel B) which is a subset of all households included in our experiment

treatment versus control groups after controlling for month of sample. We augment this basic specification to include added controls that are orthogonal to treatment—historical consumption—to improve the precision of our estimates. We include controls for monthly consumption for the corresponding quarter in the year before the experiment (i.e. April–June, 2013).

An alternative identification strategy exploits the panel nature of our data to compare differential changes in pre- and post-treatment consumption data across households in our various treatment groups. Using a panel of consumption from January 2013 to June 2014, we follow two strategies. First, we use a difference-in-difference estimator that models treatment as being "as good as random" and estimates the effect of treatment based upon differential changes in average consumption in the pre- and post-intervention periods across the treatment and control groups. Second, we use a model with household and month-by-year fixed effects and estimate treatment effects based on within-household variation in consumption that is induced by (randomly assigned) treatment. For all specifications, we estimate standard errors clustered at the household level.

Table 3 Estimates of average treatment effects first quarter after the intervention

	(1)	(2)	(3)	(4)
Social comparison	−1.362**	−1.238**	−1.250**	−1.245**
	(0.599)	(0.581)	(0.527)	(0.527)
Social comparison + Price	−0.760	−0.704	−0.733	−0.729
	(0.607)	(0.590)	(0.532)	(0.533)
Constant	121.988***	–	–	–
	(0.441)	–	–	–
Post-treatment indicator	No	No	Yes	No
Year-by-month fixed effects	Yes	Yes	No	Yes
Household fixed effects	No	No	No	Yes
Consumption Apr–June 2013	No	Yes	No	No
N	82,602	82,602	495,762	495,762

The dependent variable is a month of consumption, which is the average daily consumption during the meter-read window multiplied by 365/12. The sample includes all households who had pre-treatment average annual consumption above 110 kWh. Specifications (1)–(2) use post-treatment observations for the period April–June 2014 in a cross sectional setting. Specifications (3) and (4) use a panel setting with data ranging from January 2013 to June 2014. The treatment effects in (3) are estimated with a difference-in-difference specification and in (4) are estimated with a fixed effects specification. Robust Standard Errors clustered at the household level are in parentheses

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Each of these empirical strategies yields unbiased estimates of the average treatment effect given the identifying assumption that treatment is random. We use multiple empirical strategies because some may yield more precise estimates and base identification on different sources of variation.

Treatment Effect of Social Norm Alone Our main results are shown in Table 3. The first two columns show estimates using the cross-section of post-treatment data. Both models include controls for month-of-sample along with indicators for our three treatment groups. The second model augments this baseline specification to include controls for pre-intervention consumption. Columns 3 and 4 show estimates using the full panel of pre- and post-treatment consumption data, estimated with either difference-in-differences or household-level fixed effects along with controls for month-of-sample.

Across the different specifications, we find robust evidence that the social comparison alone induces households to reduce monthly electricity consumption in the three months following treatment. For example, as noted in column 1, average monthly use for those in the social comparison group is approximately 1.36 kWh lower than that observed for counterparts in the control group. We observe similar impacts across the other specifications; the social comparison reduces consumption relative to the control group by approximately 1%.

For perspective, the observed treatment effects correspond to behavioral adjustments such as turning off a 60 Watt lightbulb for about one-half hour per day. This effect, while small in percentage terms, is significant because the treatment merely involves a low-cost, one-time information treatment. As a basis of comparison, studies of Opower Home Energy Reports find consumption reduction in the range of 2–3% (Schultz et al. 2007; Allcott 2011; Costa and Kahn 2013; Ayres et al. 2013). However, it is important to note that such effects are less pronounced for low use households. Moreover, households in the various Opower experiments receive HERs on a continual basis—typically monthly—and there is a documented tendency for the effects following receipt of the initial report to be lower than that observed over the entirety of the experiment.[15] As average daily consumption for households in our study (about 3.3 to 4.1 kWh) is around 75 to 93% less than the average daily consumption for households in Allcott (2011) and our treatment is based upon receipt of a single letter, we would thus expect to see smaller effects than those observed in the prior literature. We thus believe that our results accord well with this work and show the promise of social comparisons as a policy tool in developing countries.

Treatment Effect of Social Norm Coupled with Extrinsic Financial Incentives Next, we test whether and how the impact of our normative appeal is impacted when we augment the comparison by adding information noting that there are also potentially large private benefits of conserving power. The second row of Table 3 shows the estimated treatment effects of the combined social comparison and price salience treatment. Under each of the four identification strategies, the estimated treatment effect is smaller than the treatment effect of the social comparison alone. For example, as noted in model 1, the effect of the combined treatment (−0.760) is approximately 44 percent lower than that observed in our norm only treatment. In fact, the point estimate of the combined treatment is only about 60% the size of the social comparison effect in each specification.

We do not have sufficient precision to reject that the combined effect is different from the social comparison alone. However, the 95% confidence interval for the marginal effect of our extrinsic incentive includes a large range suggesting that the added incentive crowds out the effect of the social comparison and only a small range suggesting that it enhances such effects. For example, in specification 1, the marginal effect of the added extrinsic incentive ranges from *increasing* consumption relative to the social comparison by 1.78 kWh/month to reducing consumption by an additional 0.58 kWh/month. Hence, while we can rule out that the additional financial incentives significantly enhanced conservation, we cannot rule out that it undermines all of the conservation induced by the social comparison and the resulting intrinsic motives to conserve.

This finding suggests that pro-social acts that are subsequently incentivized by intrinsic motives can be crowded out under certain conditions. Our setting differs slightly from the setting envisioned by Benabou and Tirole (2006). In the standard Benabou and Tirole setting, the underlying intrinsic motivation is a desire to signal pro-sociality to either oneself and/or others. In our setup, the intrinsic motivation is the desire to avoid moral costs brought about by a social comparison/normative appeal. To test for crowding out, it is thus necessary to overlay an extrinsic incentive in an environment where intrinsic motivations have been identified. We do this by introducing a social comparison and showing that monthly consumption for households in this treatment is lower than that observed by counterparts in the control group. We then ask, what happens when we augment the social comparison letter by introducing an extrinsic incentive—information about the financial benefits of conservation—and show that subsequent reductions in energy use are less than that observed in the social comparison treatment.

[15] For example, Allcott and Rogers (2014) use high frequency data on use to document a pattern of "action and backsliding" whereby the effect of treatment is greater in the week following receipt of an HER but tends to decay in the subsequent weeks until the next report is received. However, such a pattern is short-lived and the effect of the HER in the weeks between reports tends to stabilize over time. As such, the estimated treatment effect in the first few months is less than that observed in subsequent months when the household has received continued HERs.

4 Conclusions

We conduct a large scale field experiment in collaboration with the local electricity utility in Quito, Ecuador to induce energy conservation by residential users through information interventions that target both intrinsic and extrinsic incentives. Our layering of extrinsic incentives on top of intrinsic motives enable us to explore the complementarity of the two types of policy instruments. To our knowledge, this is the first work to investigate whether highlighting potential extrinsic benefits impacts the effect of social comparisons in and of themselves.

Results indicate that the social comparison message reduced electricity use of households above the referential neighbor by nearly 1%. However, adding extrinsic financial incentives to reduce consumption does not lead to increased conservation. Rather our data suggest that such incentives may backfire and crowd-out conservation efforts. In this regard, our paper speaks to the emerging literature warning that there may be detrimental impacts that pecuniary incentives can inflict when implemented along with non-pecuniary strategies. In our case, if households consider reducing energy consumption as a pro-social act that serves to reduce pollution and the resulting climate risks, highlighting extrinsic incentives may crowd out the effect of the social comparison by changing the frame from social to monetary or by diluting the extent to which the voluntary contribution signals pro-sociality to oneself.

Our findings also suggest that the primary channel through which messages affect use is the desire to avoid moral costs or that changes beyond those realized through social comparisons may be too costly to drive further adjustments. As additional evidence on the impacts of normative appeals is collected and analyzed, future research should set forth to disentangle these channels as a way to understand how and why normative based appeals work.

Appendix 1: Treatment Letters and Translations

Intrinsic Incentive
Sample letter for social comparison (Spanish)

SUMINISTRO: XXXXXX-X

Plan/Geocódigo: XX XX-XX-X-XX

EMPRESA ELÉCTRICA QUITO
Siempre junto a ti

INFORMACIÓN IMPORTANTE
Ahorre Electricidad y Ahorre Dinero

Estimado Cliente:
La siguiente información de su consumo mensual de electricidad durante el año pasado puede ser de su interés.

Su consumo promedio mensual fue aproximadamente:	**XXX kWh**
Un hogar similar al suyo consume en promedio:	**110 kWh**

Esto significa que, durante el año pasado usted consumió aproximadamente X,XX % más que otros hogares similares. Le exhortamos a que haga un uso eficiente de la energía para ahorrar dinero.
Por favor lea con atención los siguientes consejos sobre ahorro de energía eléctrica para que empiece a ahorrar dinero ya! Comparta esta información con los demás miembros del hogar.

- No deje la puerta del refrigerador abierta por mucho tiempo y asegúrese que la puerta cierre herméticamente.

- No deje el televisor encendido si nadie lo mira.
- No olvide apagar las luces al salir de una habitación.

!AHORRE ELECTRICIDAD, AHORRE DINERO!

Intrinsic Incentive

Sample letter for social comparison (Translation)

Meter ID: XXXXXX-X

Geocode: XX XX-XX-X-XX

EMPRESA ELÉCTRICA QUITO
Siempre junto a ti

IMPORTANT INFORMATION
Save Electricity and Save Money

Dear Customer:
We thought that you might be interested in the following information regarding your monthly electricity use over the past year.

Your average monthly consumption was:	**XXX kWh**
The average household like you consumes:	**110 kWh**

Over the past year, this means that you have consumed approximately **X,XX% more** electricity per month than others like you. We encourage you to use energy wisely to save money. Please read carefully the following savings tips so you can learn how to save right away. Share this information with all the other members of the household.

- Don't leave the refrigerator door open for too long and make sure it closes tightly.
- Turn off the television if nobody is watching it.
- Don't forget to turn off the lights when leaving a room.

!SAVE ELECTRICITY, SAVE MONEY!

Intrinsic and Extrinsic Incentive

Sample letter for social comparison and price salience combined (Translation)

Meter ID: XXXXXXX

Geocode: XX XX-XX-X-XXXX

EMPRESA ELÉCTRICA QUITO
Siempre junto a ti

IMPORTANT INFORMATION
Save Electricity and Save Money

Dear Customer: The electric tariff established by CONELEC is progressive. What this means for you is that there is a large increase in your monthly bill should you consume more than 110 kWh.
We thought that you might be interested in the following information regarding your monthly electricity use over the past year.

Your average monthly consumption was:	**XXX kWh**
The average household like you consumes:	**110 kWh**

Over the past year, this means that you have paid around **US$ XX** a month for the electricity you use (**US$ XXX** per year). If you were to reduce your electricity use by **X kWh** per month (around **X,XX**% of your current consumption), you would reduce your monthly energy bill

by nearly **XX,XX%** and would **save approximately US$ XX per year**. We encourage you to use energy wisely to save money.
Please read carefully the following savings tips so you can learn how to save right away. Share this information with all the other members of the household.

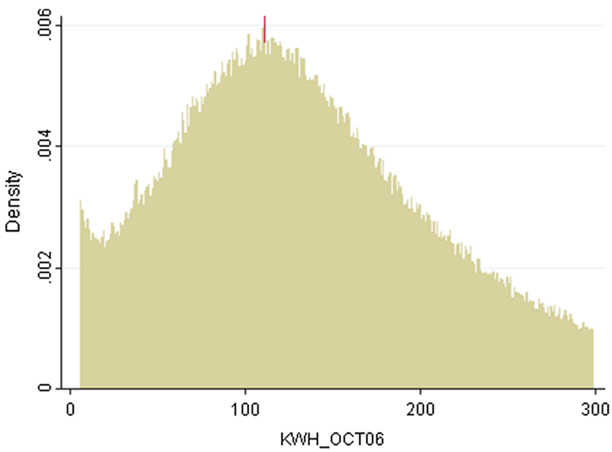
- Don't leave the refrigerator door open for too long and make sure it closes tightly.
- Turn off the television if nobody is watching it.
- Don't forget to turn off the lights when leaving a room.

!SAVE ELECTRICITY, SAVE MONEY!

Appendix 2: Sample Monthly Electric Bill


EMPRESA ELÉCTRICA QUITO S.A. E.E.Q. Factura No. 001-007-003108291
No. de Control: 149805609-83
Valor a pagar: 23.24
Fecha de emisión 18/12/2012
Fecha de vencimiento 04/01/2013
INFORMACION DEL CONSUMIDOR:
SUMINISTRO:
CODIGO ÚNICO ELÉCTRICO NACIONAL:
Cédula / R.U.C.:
Dirección servicio:
Dirección notificación: Domicilio
Plan/Geocódigo:
Parroquia - Cantón: CONOCOTO DISTRITO METROPOLITANO QUITO
Tarifa: Residencial (Baja Tension) 18/12/2012
SUMINISTRO DEL SERVICIO ELECTRICO:
Medidor: 607818-SAX-AB Factor de multiplicación: 1.00 Constante: 1.00
Recargo Pérdidas en Transformación: 0 %
Desde: 15/11/2012 Hasta: 14/12/2012 Días: 29 Tipo consumo: Leido
VALOR FACTURABLE: 14.77
COMERCIALIZACION 1.41
SUBSIDIO SOLIDARIO 1.62
SERV.ALUM.PUB 1.46
I.V.A.(0%) 0.00
TOTAL SERVICIO ELECTRICO (1): 19.26
Su ahorro por la Tarifa de la Dignidad es de 0.00
La Energía ya es de todos!
VALORES PENDIENTES DE PAGO POR SERVICIO ELECTRICO:
CONCEPTO VALOR
TOTAL VALORES PENDIENTES:
SIN EL SELLO DE CANCELADO, NO TIENE VALOR
ORIGINAL - USUARIO
OTROS VALORES A PAGAR:
CONCEPTO SUSTENTO LEGAL VALOR
IMPUESTO BOMBEROS Ley de Defensa Contra Incendios 1.46
TASA RECOLECCION BAS Ordenanza Municipal 2.52
VALORES PENDIENTES DE PAGO POR SERVICIO ELECTRICO:
TOTAL OTROS VALORES A PAGAR (2): 3.98
TOTAL A PAGAR
Valor servicio eléctrico (1): 19.26
Otros valores a pagar (2): 3.98
TOTAL (1) + (2): 23.24
(*) BASE PARA RETENCION 1%: 0.00
Pagar hasta: 04/01/2013
**** FACTURA PAGADA ****
SIN EL SELLO DE CANCELADO, NO TIENE VALOR
ORIGINAL - USUARIO

Appendix 3: 110 Mode in Consumption Prior to Creation of Notch



Appendix 4: Monthly Consumption January 2013-June 2014

See Table 4.

Table 4 Summary statistics: monthly consumption (kWh)

Month	All residential consumers		Consumers in sample	
	Mean	SD	Mean	SD
Jan-13	153.02	129.90	117.72	39.02
Feb-13	142.20	119.70	110.08	34.31
Mar-13	136.80	116.90	105.25	30.59
Apr-13	144.10	122.90	111.30	30.10
May-13	151.10	127.60	116.75	30.17
Jun-13	147.90	125.40	113.94	28.88
Jul-13	138.90	189.10	106.45	26.88
Aug-13	149.20	125.00	115.22	30.36
Sep-13	144.80	123.60	111.13	30.44
Oct-13	144.90	122.00	111.99	32.10
Nov-13	147.40	124.30	113.86	34.98
Dec-13	148.30	127.20	114.06	37.89
Jan-14	151.60	126.68	118.69	44.79
Feb-14	140.43	116.97	110.85	41.71
Mar-14	139.58	117.97	109.81	45.00
Apr-14	142.16	120.70	111.86	46.23
May-14	150.01	124.68	118.70	47.95
Jun-14	147.08	125.08	115.96	49.63

All residential consumers in the Quito Metropolitan Area. Consumers in the sample had average monthly consumption between 100 and 125 kWh in 2013

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