Not all Nudges are Created Equal: Comparing Social and Pure Informational Nudges

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Abstract

The effects of nudges as interventions to induce prosocial behavior has been broadly studied in the literature. However, little is known about how different groups are influenced by pure informational nudges versus social nudges. We use a large-scale field experiment to determine whether these types of nudges work for different groups. Our pure informational nudge makes salient a price notch and our social nudge consists of a social comparison. The results indicate that the pure informational nudge affects only those for whom the information is relevant, thus improving both individual and social welfare. In contrast, the social nudge has a homogeneous effect on all groups considered. This is evidence that the social nudge may increase a moral or emotional cost, and therefore its effect on social welfare is indeterminate. These findings offer insights for the design of interventions that use nudges to induce behavioral changes.

Keywords: Social nudge, informational nudge, field experiment, externality.

JEL classification: C93, D62, D19, D91.

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1 Introduction

The potential of “nudges” to induce behavioral changes is well established in the literature. These interventions do not change prices or choice sets and include strategies such as framing, social comparisons, price saliency, default rules, and reminders. Broadly, informational nudges can be classified as pure informational or social. Pure informational nudges do not change incentives, but only provide information that could reduce the gap between decision utility (observed choices) and experienced utility (post-choice satisfaction). In other words, pure informational nudges increase welfare by moving decision utility closer to experienced utility. Price saliency is an example of a pure informational nudge. For instance, Chetty et al. [2009] use an experimental design to show that tax-inclusive price tags reduce demand significantly. In contrast, social nudges may affect experienced utility by producing moral or emotional costs [Levitt and List, 2007], and hence could reduce the welfare of individuals. For example, in the context of charitable giving, DellaVigna et al. [2012] study how social pressure reduces the utility of donors in door-to-door fund raising campaigns.

Despite the significant attention given to nudges both in theoretical and empirical studies, little is known about how different groups are influenced by pure informational and social nudges. Hence, our main contribution is to provide an apples-to-apples comparison of a pure informational nudge and a social nudge to analyze heterogenous effects across treatments. That is, we want to determine whether pure informational nudges and social nudges work for different groups.

A few studies have explored heterogenous effects empirically across informational nudges. For instance, Hahn et al. [2016] use a field experiment in water management to study how two seemingly similar informational nudges affect the margins of choice (long versus short-term), but do not evaluate who is affected by each nudge. In the education literature, Fischer and Wagner [2018] estimate the effects of relative performance feedback and its change and find that the latter was significant only for students that went down in the ranking. However, these studies do not compare pure informational versus social nudges.

Other studies compare economic incentives and nudges. For example, Reiss and White [2008] use longitudinal data from the 2000-2001 California electricity crisis to study responses to a large and unanticipated price shock, and a voluntary conservation campaign, but the paper does not offer an elaborate discussion on their relative efficacy. On the other hand, Ito et al. [2018] uses a self-selected sample of around 700 participants that received a participation reward to explore the role of moral suasion and economic incentives on electricity consumption in Japan and finds a bigger treatment effect for the economic incentive than for the moral suasion. More recently, Holladay et al. [2019] study the effects of subsidies and social comparisons in the participation of an in-home energy audit program and find that both increase audits and that neither impact purchases of energy efficient durables. Importantly, these studies do not focus on heterogenous effects across incentives.

To our knowledge, this is the first large field experiment that jointly studies pure informational and social nudges in an effort to determine heterogenous effects across treatments. We do this in the context of energy consumption. We partnered with the Quito Electric Company (Empresa Eléctrica Quito-EEQ) to implement a large scale randomized controlled trial. In our single-period field experiment, letters containing the nudge information were attached to the electricity bills of randomly selected households in March 2014.

Our social nudge is a social comparison in which households are informed of their historical consumption and the average consumption of households like them, while the pure informational nudge makes salient a large change in the total electricity bill for an additional kWh of monthly consumption (i.e. notch). This notch implies an increment of around 40% in the total bill; however, it does not appear to induce a consumption reduction because we find no evidence of discontinuity in the distribution before the notch or bunching around it in historical consumption data. In a companion paper we use information of a third treatment group, collected in the same field experiment, that combines the social norm and the price salience treatments (see, Pellerano et al. [2017]). We do not analyze the results of that treatment in this paper.

Our experiment has several advantages to study pure informational versus social nudges. First, historical consumption and price regulations allow us to use the same reference point in both treatments. The average consumption used for the social nudge treatment is approximately 110 kWh for the households in our sample, which is where the jump in the electricity tariff is located. Second, the consumption of electricity in Quito is very stable throughout the year. This is likely due to the moderate climate that shows small variability in temperature across the year. This implies that we can use historical consumption to design our social nudge and that seasonal effects are not important in our estimations. Finally, it is unusual to find utilities that have large changes in tariffs for small changes in consumption, this makes the use of price saliency uncommon. However, in Quito the largest price notch is significant, and we use it to design our pure informational treatment.

The results for households with consumption above the reference point show that the two nudges work for different types of consumers. They indicate that social nudge causes a reduction of consumption of around 1% regardless of the pre-treatment consumption level or variance. In contrast, the effect of the pure informational nudge is significant and similar to the effect of the social nudge, but only for households in the lower part of the distribution, and for those that face low optimization frictions (approximated by the pre-treatment within-household coefficient of variation of consumption). In other words, the effect is significant for households for whom is it relatively easy to take advantage of the price notch since they only need a relatively small reduction in consumption and face low optimization frictions.

Hence, there is something fundamentally different between the two nudges. We find evidence that the pure informational nudge affects only those for whom the information is relevant. Thus, it likely improves both individual and social welfare by reducing the gap between choice and experience utility. In contrast, the social nudge affects all types of consumers. The latter may negatively affect individual welfare by increasing the moral cost of consumption but reduces the externality associated with it, thus its global effect on welfare is unknown.

We also find that none of the treatments have a significant increase in consumption for households historically consuming below the reference point. Hence, we find no evidence of a "boomerang" effect created by the intervention. Our results also show that, for households with pre-treatment consumption above the notch, the treatments increase the probability of crossing the notch. Finally, and consistent with previous literature, we find that the effect of our interventions diminishes over time.

We believe that these results contribute to the understanding of the capacity of nudges to promote prosocial behavior. They imply that pure informational nudges should be targeted to the relevant groups: those more likely to find the information useful. On the other hand, social nudges have the potential to affect most groups. This suggests policy makers should weigh both individual and social effects when appealing to the second type of nudges.

2 Institutional Background

The Quito Electric Company serves approximately 750,000 residential customers, 65% of which are located in the Metropolitan District of Quito; the rest belong to nearby *cantones* (political classification similar to counties in the U.S). Table 1 shows summary statistics for the Metropolitan District of Quito corresponding to 2013. Consumption is relatively low and steady across months, with the average ranging between 137 and 153 kWh, and the median between 123 and 130 kWh.

This is likely due to the moderate climate that shows small variability in temperature throughout the year.[1] The absence of extremely hot or cold temperatures implies that households generally do not use air conditioners or heaters, and that the main electricity usage comes from refrigerators, televisions, and lighting (Table 2).

Table 1: Summary Statistics: Monthly Electricity Consumption 2013 (kWh)

Month	Mean	Standard Deviation	Median
January	153.0	129.9	130
February	142.2	119.7	122
March	136.8	116.9	117
April	144.1	122.9	123
May	151.1	127.6	130
June	147.9	125.4	127
July	138.9	189.1	118
August	149.2	125.0	128
September	144.8	123.6	124
October	144.9	122.0	124
November	147.4	124.3	126
December	148.3	127.2	126

Source: Author calculations and EEQ.
Statistics correspond to the Quito Metropolitan District.

Electricity meters are read approximately monthly according to a schedule established at the beginning of the year, and bills are delivered by special courier around one week after the readings.

2.1 Electricity Tariff in Quito

The electricity tariff in Quito follows an "increasing-block" tariff (IBT) pricing structure which is nowadays the standard price policy of local utilities both in developed

[1] The average monthly temperature in Quito in 2011 ranged from 57 °F and 60 °F [Inamhi, 2013].

Table 2: Monthly Electricity Use for EEQ Households

End Use	kWh per month	Percentage
Refrigerator	39.8	38.0
Appliances	12.8	12.2
Television	12.7	12.1
Lighting	9.4	9.0
Washing Machine	8.0	7.6
Water Heater	8.0	7.6
Iron	6.6	6.3
Cooking	4.0	3.8
Music Electronics	2.8	2.7
Heating	0.7	0.7

Source: ENERINTER Asesoría Energética Internacional, 2012.
Data for EEQ households with monthly average usage between 99 and 110 kWh

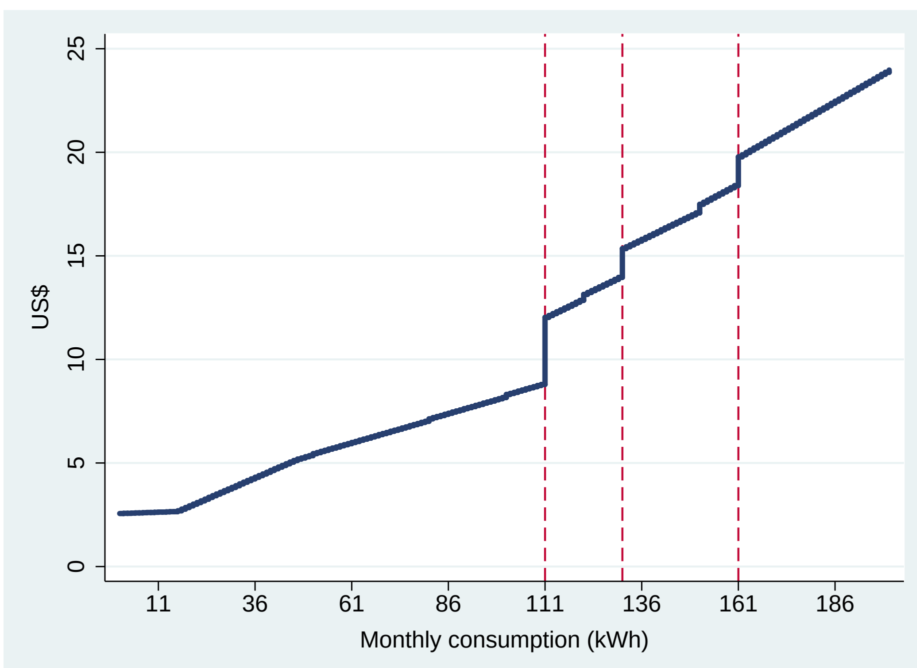

Figure 1: Sample Tariff Function for EEQ Residential Customers. December, 2013

and developing countries. An IBT pricing schedule exhibits an increasing marginal cost per kWh that increases with the monthly electricity consumption level; it is a step function where height is defined by the marginal price and length by the range of consumption that the marginal price applies to. Absent of subsidies and other charges, this price schedule would resemble a typical schedule faced by households in the United States.

However, the residential electricity tariff in Quito includes additional charges and subsidies that produce considerable changes in the cost of electricity at certain levels of consumption. For instance, households consuming at or below 110 kWh per month pay approximately $8.5 per month, and those consuming 111 kWh pay around $12 per month. In other words, increasing consumption by less than 1% implies a change in their monthly electricity bill of approximately 40%.[2] The potential savings are approximately equivalent to 0.5% of the median monthly household income in Ecuador. This notch is due to reduced marginal price, fixed fee and waste disposal fee that are part of the subsidy called "Tarifa de la Dignidad" (Dignity Tariff).[3] Figure 1 graphs the total bill as a function of monthly consumption level. As can be seen from the graph, the largest discontinuity in total expenditures is precisely at 111 kWh. Notice also from Figure 1 that there are two additional discontinuities in the total bill: at 131 and 161 kWh, although these are less prominent that the one at 111 kWh.

2.2 Pre-treatment Distribution of Consumption

The large changes in the cost of electricity do not appear to induce a consumption reduction because we find no evidence of discontinuity of the distribution before the notches, or bunching around them, in historical consumption data. Figure 2 plots the distribution of consumption corresponding to December 2013. Notice that the plotted density appears to be smooth across the 111 kWh notch. Also, following the

[2]The described values correspond to December 2013. The value of the subsidies change each month due to the varying amount of the cross subsidy, which is 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.

[3]The tariff also includes mandatory contributions for public lighting and Fire Department equal to 9.5% of total electricity expenditure before subsidies, and to a fixed fee of $1.59, respectively. Finally, there is a waste disposal fee composed of a flat fee and a charge proportional to the electricity consumption level. This tariff structure corresponds to the time period when the project was developed, some changes have been applied to the tariff since then, but they are not relevant for this paper.

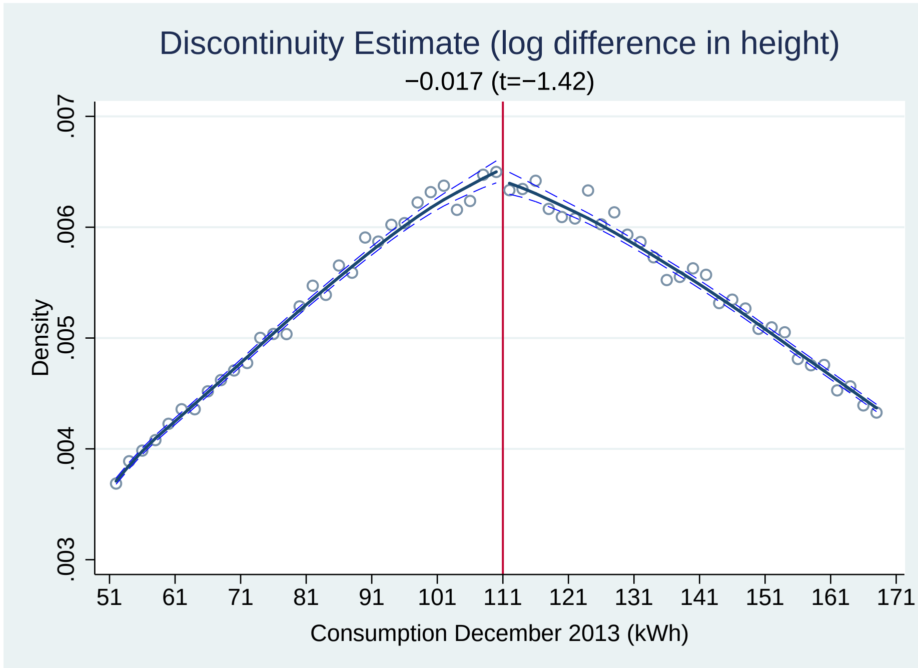

Figure 2: Discontinuity in the Density at the Notch

procedure proposed by McCrary [2008], we estimate the discontinuity in the density at the 111 kWh threshold, and find that it is small and statistically indistinguishable from zero. Similar results were obtained for the other months and the other two notches.

The lack of evidence of discontinuities in the density before the notches might be explained by the imperfect control that households have on the consumption of electricity (frictions), which makes it difficult to adjust consumption just below a given level. For example, households usually do not have real time information on their consumption. It is also very likely that they do not have complete knowledge on the energy use of different appliances. It could also be explained by an inelastic response to the price schedule. However, if consumers were totally aware of how the tariff works, and willing to reduce consumption in an effort to take advantage of the subsidies, it would be reasonable to expect bunching in the distribution around the notches. We explore this option by using the method proposed in Chetty et al. [2011] to estimate if there is bunching around the most important notch. Figure 3 plots frequencies along with the estimated density corresponding to December 2013. There is no graphical evidence of bunching around the notch.

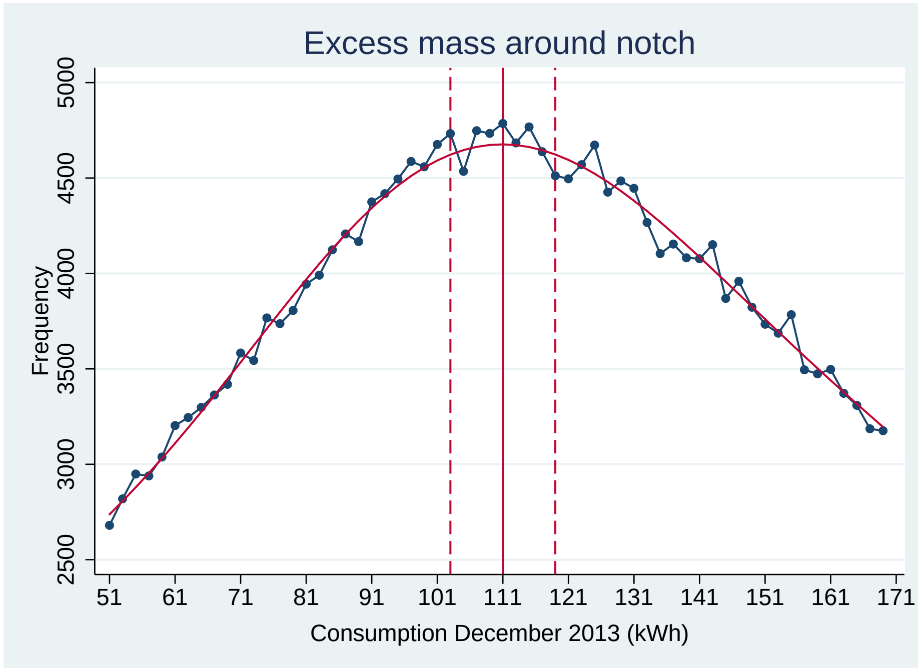

Figure 3: Bunching Around the Notch

The fact that the modal point of the distribution is close to the 111th notch might suggest that the non-linear price scheme moved the distribution from a higher level of consumption, implying that individuals are aware of the subsidy. This does not seem to be the case since the distribution of consumption corresponding to December 2006 (six months before the creation of the subsidy) is very similar to the one in 2013 (Figure 4).[4]

3 Research Design

Our field experiment focuses on households with historical consumption around the 111th notch in the metropolitan area of Quito. In particular, it targets the approximately 48,000 residential customers with monthly average consumption between 100 and 125 kWh in 2013. We have selected this group because they are more likely to respond to information regarding the 111 kWh notch.

This single-period experiment was designed within the conceptual framework

[4]The distribution of consumption corresponding to other months before the creation of the subsidy is very similar to the one in Figure 4.

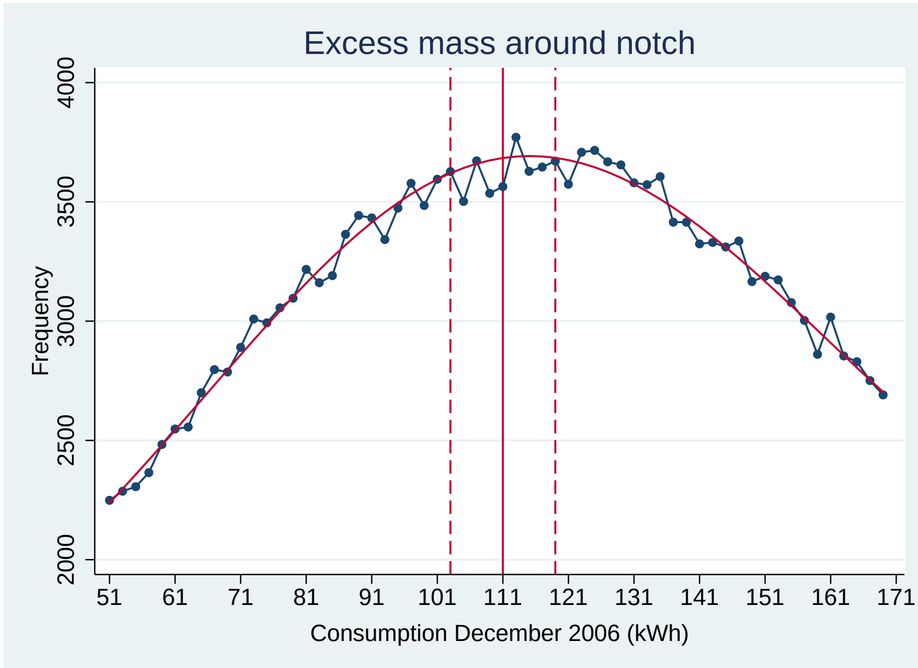

Figure 4: Consumption Distribution Prior to Notch's Creation

introduced above, where randomly selected households receive, attached to their monthly electricity bill in March 2014, additional information regarding two different treatments: (1) pure informational nudge, and (2) social social nudge.

- **Pure informational nudge:** The first treatment group receives a flyer that informs the customer of their average consumption in 2013, the size of the price notch and the effect of the notch on their monthly bill. Specifically, the customers receive information on how much they would save (pay additionally) if they reduce (increase) their monthly consumption just below (above) the 111 kWh notch. For example, a household with average consumption of 115 kWh/month is told how much approximately the monthly bill falls if consumption is reduced to 110 kWh. In addition, the flyer suggests energy saving tips to reduce consumption.

- **Social nudge:** A second treatment group receives an information intervention that makes a social comparison between the household and other households around 110 kWh. For example, a household with average consumption of 115 kWh is informed that "an average household like you" consumes approximately 110 kWh and that the household averages 115 kWh. Since our data show that the historical distribution of consumption has its modal value close to the most important notch, we exploit this fact to use the 110 kWh level as a reference point in this treatment. We use this feature to safely compare the effect of the two information interventions as they target the same population and use the same reference point. As with the first treatment, the flyer in the second treatment offers energy saving tips. Importantly, the flyer for the second treatment group *makes no mention of the price notch*.

A third group receives no informational flyer and serves as the control group.[5] The households in our sample were equally split among these groups as can be seen in Table 3. We randomize the treatments within the 74 sectors and 24 urban parishes in which EEQ divides the metropolitan area. We do this to guarantee that systematic differences across geographic areas do not drive the results.

Naturally, for the two treatments it is likely that some proportion of consumers do not read the information or just ignore it. This means that, for those who actually read the messages, the treatment effects are bigger than those presented in the next section.

Appendix A1 shows sample letters of the two treatments in Spanish and their translation to English. Notice that the flyers in our experiment are by design very simple. They only include the information described before and the logo of the utility. We did not include any elaborated design or information suggesting that energy conservation is pro-social such as smiley or frowny emoticons. We do this to isolate the effect of the information from other factors.

4 Conceptual Framework

4.1 Pure Informational Nudges

Pure informational nudges induce behavioral changes without changing incentives. Their effectiveness relies on the reduction of the gap between decision utility, that comes from observed choice, and experience utility, or post-decision satisfaction. That is, pure informational nudges have the potential to increase welfare by reducing the likelihood of unpleasant surprises.

[5] As mentioned before, in a companion paper we study a third treatment group that is not used in this paper.

Price salience is an example of a pure informational nudge that has been studied as an important determinant of economic decisions [Finkelstein, 2009, DellaVigna and Pollet, 2009, Chetty et al., 2009]. If prices are not salient, consumers may not be able to fully optimize. Moreover, there may be a cognitive cost of understanding complex pricing schedules. Therefore, information about how the electricity tariff works, given in a simple way, is likely to be welfare improving because consumers might not be aware of how the tariff works or might have incomplete knowledge on how much can be saved if they reduce consumption up to a certain level.[6]

In the context of consumers in Quito, we have good reasons to think that the electricity tariff is not salient. First, the electricity bill includes the monthly consumption, subsidies (if any), other charges, and the total due. However, there is no specific information regarding how the non-linear tariff works. In particular, there is no information on how the price changes at certain levels, due to subsidies (see Figure 5).[7] Furthermore, as discussed in the previous section, we find no evidence of discontinuity in the distribution of consumers before the notches or bunching around them that may suggest that the notches induce conservation of electricity. Then, the use of price salience is an ideal way in this context to test for the effects of pure informational nudges on prosocial behavior.

4.2 Social Nudges

Unlike pure informational nudges, social nudges may change incentives through moral or emotional costs that potentially reduce individual welfare. Recent literature has found evidence on the important impact that social nudges can have on economic behavior. Social comparisons have been particularly used in a variety of contexts such as student performance [Azmat and Iriberri, 2010]; productivity [Cohn et al., 2014]; retirement savings [Beshears et al., 2015]; tax evasion [Bott et al., 2020]; and environmental conservation [Allcott, 2011, Ito et al., 2018].

In the context of energy conservation, households may respond to social comparisons that affect their moral payoffs [Levitt and List, 2007]. If consumers bear a moral

[6]The impact of the provision of simplified information has been explored in a variety of domains such as retirement plan decisions [Duflo and Saez, 2003]; labor supply response to the income tax rates Chetty and Saez [2013]; government transfer programs take-up rates [Bhargava and Manoli, 2013].

[7]Detailed information about the electricity tariff relevant for each month is available in the website of EEQ (www.eeq.gov).


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
Pagar hasta: 04/01/2013
**** FACTURA PAGADA ****
SIN EL SELLO DE CANCELADO, NO TIENE VALOR
ORIGINAL - USUARIO

Figure 5: EEQ's Electricity Bill

cost from energy consumption (derived from environmental concerns, for instance), and if we assume that this cost depends on their beliefs about the "social norm", then social comparisons could change the moral cost of consumption, and hence prosocial behavior.

4.3 Predictions

We assume that previous to our interventions consumers perceive the budget set to be linear. The continuity of the density function and lack of bunching around the reference point support this assumption. It is also supported by Ito [2014] who finds that consumers respond to average rather than marginal electricity prices. Furthermore, we assume that consumers perceive a tariff with marginal price equal to the average price at 111 kWh. Notice that in our sample the distribution of pre-treatment consumption is centered around this point.

Our interventions change the perceptions of the budget set differently. The price salience treatment reveals that the tariff is notched rather than linear. On the other hand, we assume that the social comparison adds a linear moral cost for consuming above the norm.

We separately analyze households who historically consumed above and below 110 kWh. Figure A1 in the Appendix shows the predictions for the price salience treatment for households above the 110 kWh point. For a household that was consuming 110 kWh, there is no reduction in consumption since it is optimal not to move. It can be shown that there is a level of consumption F such that a household is indifferent between consuming at that point or at 110 kWh, because its indifference curve intersects the perceived and after treatment budget sets at F and 110 kWh respectively. For pre-treatment consumption between 110 kWh and F, households chose a corner solution at 110 kWh. They do so because the increase in utility from consumption of other goods and services due to the savings dominates the utility loss of reduced electricity consumption. Finally, for pre-treatment consumption higher than F there is no reduction in consumption. For these households it is not optimal to reduce consumption because it would have to reach 110 kWh for them to take advantage of the subsidy. This reduction brings about a decrease in utility that is bigger than the utility gain provided by the savings.

Therefore, the highly nonlinear incentive featured by the price salience treatment should produce heterogeneous effects. For households relatively close to the norm, it produces a reduction of consumption. In contrast, for those relatively far from the norm, there is no effect.

Figure A2 in the Appendix shows the prediction for the social norm treatment for households who historically consumed above 110 kWh. The information provided adds a moral cost that is reflected in the steeper budget set. Households take into account this added cost and have an incentive to reduce consumption as long as their previous consumption was higher than the norm. Hence, for this treatment we predict a reduction in consumption for households close or far from the norm.

Since consumers face optimization frictions, these have to be considered in our predictions. We argue that households that face stronger frictions are less able to optimize and therefore show smaller treatment effects. Also, frictions are more relevant for the price salience treatment than for the social norm treatment since for the former a benefit is reached only if consumption goes below 110 kWh, whereas for the latter any reduction brings about extra utility.

For households who historically consumed between 100-109 kWh, the treatments could increase or decrease consumption. Households receiving the price salience treatment could react by reducing consumption to reduce the possibility of crossing the

111th threshold, which would increase their payments by several dollars. However, their consumption could increase if households believe they could increase consumption without crossing the threshold. In the case of the social comparison treatment, households consuming below the reference, could adjust its beliefs about the optimal level of consumption and also increase consumption, or they could try to reduce consumption to avoid the likelihood of becoming a higher-than-average consumer.

Table 3: Pre-treatment: Household Yearly Average in 2013 Monthly Consumption (kWh)

Group	Count	Average	Median	Standard Deviation
Panel A. All sample				
Control	15,875	112.35	112.33	7.22
Social Comparison	15,854	112.30	112.17	7.21
Price Notch Salience	15,860	112.35	112.25	7.22
Panel B. Above the notch				
Control	9,425	117.42	117.42	4.34
Social Comparison	9,359	117.37	117.33	4.37
Price Notch Salience	9,406	117.42	117.42	4.35
Panel C. Below the notch				
Control	6,450	104.95	104.92	2.92
Social Comparison	6,495	104.98	105.00	2.92
Price Notch Salience	6,454	104.96	105.00	2.92

Notes: This table reports summary statistics of the pretreatment variable – average 2013 monthly consumption – for each household in the treatment groups. The notch that defines Panels B and C is 110 kWh/month as explained in the text.

5 Results

As a first step we show that the three groups we have considered are balanced with respect to average consumption corresponding to 2013. This holds for the complete sample of households and for the samples split above and below the 111 kWh notch. The three panels of Table 3 show that the average, median and standard deviation of consumption are very similar across treatments. Also, Table 4 shows estimates of the

Table 4: Pre-treatment: Test of Differences in Household Average 2013 Monthly Consumption Across Groups

	Difference	Difference (%)	Standard Error	p-value
Panel A. All sample				
Social Comparison vs. Control	-0.057	-0.05%	0.081	0.49
Price Notch Salience vs. Control	-0.007	-0.01%	0.081	0.94
Price Notch Salience vs. Social Comparison	0.050	0.04%	0.081	0.54
Panel B. Above the notch				
Social Comparison vs. Control	-0.048	-0.04%	0.064	0.45
Price Notch Salience vs. Control	-0.007	-0.01%	0.063	0.91
Price Notch Salience vs. Social Comparison	0.041	0.04%	0.064	0.52
Panel C. Below the notch				
Social Comparison vs. Control	0.035	0.03%	0.051	0.50
Price Notch Salience vs. Control	0.013	0.01%	0.051	0.79
Price Notch Salience vs. Social Comparison	-0.021	-0.02%	0.051	0.68

Notes: This table 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. Standard errors are robust. The notch that defines Panels B and C is 110 kWh/month as explained in the text.

differences in average consumption across groups. For all the pairwise comparisons differences are less than 0.01% and none of them are significant at standard levels.

In our estimations the dependent variable is a "month" of consumption, which is the average daily consumption during the meter-read window multiplied by 365/12. We first consider the effects for the three months after the intervention (i.e. April-June, 2014). Following the conceptual framework described above, we separately analyze households with historical average consumption above and below the notch. In all the specifications presented below, robust standard errors are clustered at the household level.

5.1 Treatment Effects for Households Historically above the Notch

Table 5 shows the estimated average treatment effects corresponding to households who historically consumed above the notch. In the first specification we use an OLS regression that considers a cross sectional estimation that includes only post-

Table 5: Estimates of Average Treatment Effects for Households Above the Notch. First Quarter After the Intervention

	(1)	(2)	(3)	(4)
Social Comparison (SC)	-1.362**	-1.259***	-1.250**	-1.245**
	(0.599)	(0.461)	(0.527)	(0.527)
Price Notch Salience (PNS)	-0.378	-0.454	-0.369	-0.359
	(0.612)	(0.469)	(0.539)	(0.540)
PNS - SC	0.984	0.805*	0.881	0.886*
	(0.608)	(0.472)	(0.537)	(0.537)
Constant	122.039***	-	-	-
	(0.441)	-	-	-
Pre-treatment Consumption	No	Yes	No	No
Post-treatment Indicator	No	No	Yes	No
Year-by-month Fixed Effects	Yes	Yes	No	Yes
Household Fixed Effects	No	No	No	Yes
N	82,760	82,760	496,640	496,640

Notes: 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 is all households who had pre-treatment average annual consumption above 110 kWh. Specifications (1) and (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. Pre-treatment consumption is the monthly consumption for the periods April-June, 2013 and January-February, 2014, see text for details. Robust standard errors clustered at the household level in parentheses;* $p<0.1$; ** $p<0.05$; *** $p<0.01$.

intervention observations with year-by-month fixed effects. The coefficients on Table 5 are the differences in conditional means of each treatment group with respect to the control group. Naturally, due to the independence of treatment assignment to potential outcomes, these differences identify average treatment effects.

We find that the social comparison treatment reduces consumption by approximately 1.36 kWh/month (around 1%), and it is significant at the 5% level. On the other hand, the price notch salience treatment estimate is approximately one third of that of the social comparison, and it is not statistically significant at standard levels.

To increase the precision of our estimations we add pre-intervention consumption to the basic specification. Specifically, we include monthly consumption for the same quarter in the year previous to the experiment (i.e. April-June, 2013), and consumption corresponding to the two months before the intervention (i.e. January-February, 2014). These latter variables are used to capture any changes in household consumption patterns after 2013 but before the intervention. The coefficients for this specification are very similar to the basic one, and are presented in the second column of Table 5.

We take advantage of the panel nature of our data and use information on consumption of electricity ranging from January, 2013 to June, 2014 in our last two specifications. The specification in column three is a standard difference-in-difference estimation in which we add a post-treatment indicator and its interactions with the treatment indicators. The last specification uses a panel data structure with both year-by-month and household fixed effects. The estimates for these specifications are very similar to the previous ones, which is evidence of the robustness of the results. Notice that because of the independence produced by random assignment, all estimators are unbiased and consistent and identify the treatment effects. [8]

To complement the previous results, the third row of Table 5, and of the tables that follow, present the difference between the two treatment effects and its standard errors. We do this by recoding the treatment indicators to have the social comparison instead of the control group as the excluded category. Notice that the difference between the two treatments is significant at the 10% in two of the four specifications.

The effect we find for the social comparison treatment is around half the size of the more complex OPOWER Home Energy Reports utilized in the U.S., but it still suggests that low-cost information interventions can induce energy conservation.

5.1.1 Heterogeneous Effects

The non-significant effect we find for the price notch salience treatment is somewhat surprising. This could be due to the frictions mentioned before, which prevent households from optimizing consumption, or because customers did not actually read the messages. Even though we believe these two explanations are reasonable, the fact that we find significant effects for the first treatment implies that at least a small proportion of households read the flyers, and that some were able to successfully reduce consumption, despite the frictions. Another possibility for the lack of response to the price notch treatment is the relatively small impact that non-linear incentives have

[8] The constant has no interpretation in the specifications in columns 2-4, and therefore it is not reported.

Table 6: Estimates of Average Treatment Effects for Households Above the Notch. First Quarter After the Intervention

	(1)	(2)	(3)	(4)
Panel A. 111-115 kWh				
Social Comparison (SC)	-1.555	-1.236*	-1.430*	-1.396
	(0.970)	(0.744)	(0.857)	(0.857)
Price Notch Salience (PNS)	-0.935	-1.449*	-1.010	-1.016
	(0.970)	(0.776)	(0.866)	(0.867)
PNS - SC	0.620	-0.213	0.420	0.380
	(0.955)	(0.771)	(0.853)	(0.853)
Constant	117.884***	-	-	-
	(0.715)	-	-	-
N	30,749	30,749	184,502	184,502
Panel B. 116-125 kWh				
Social Comparison (SC)	-1.175	-1.278**	-1.155*	-1.166*
	(0.759)	(0.590)	(0.668)	(0.668)
Price Notch Salience (PNS)	-0.076	0.156	0.008	0.027
	(0.783)	(0.588)	(0.668)	(0.668)
PNS - SC	1.099	1.434**	1.163*	1.193*
	(0.782)	(0.598)	(0.690)	(0.690)
Constant	124.479***	-	-	-
	(0.557)	-	-	-
N	52,011	52,011	321,138	321,138
Pre-treatment Consumption	No	Yes	No	No
Post-treatment Indicator	No	No	Yes	No
Year-by-month Fixed Effects	Yes	Yes	No	Yes
Household Fixed effects	No	No	No	Yes

Notes: 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 is all households who had pre-treatment average annual consumption above 110 kWh. Specifications (1) and (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. Pre-treatment consumption is the monthly consumption for the periods April-June, 2013 and January-February, 2014, see text for details. Robust standard errors clustered at the household level in parentheses;* p<0.1; ** p<0.05; *** p<0.01.

on behavior in the energy sector (Reiss and White [2005], Borenstein [2009, 2012], and Wolak [2011], Ito [2014]). Alternatively, the small size of the subsidy relative to household income (around 0.5% of the median monthly household income) could explain the absence of a significant effect.

Our findings could also be explained by heterogeneous effects as explained in the conceptual framework. In particular, those households whose consumption falls relatively far from the notch might be less likely to alter behavior than those with consumption close to it. This is because it is more difficult for the former group to reduce consumption to take advantage of the subsidy. To explore this option, we divide the sample into households who were historically just above the notch (averaging 111-115 kWh/month), and households that were well above the notch (averaging 116-125 kWh/month). Results are presented in Table 6, which has the same specifications considered in Table 5. For the latter group, the price notch treatment had no statistically significant effect on consumption. On the other hand, we find suggestive evidence that this treatment induced conservation for households who were just above the notch. Unfortunately, our estimates are imprecise and only the one in the second specification is significant at the 10% level and has a size similar to the estimate corresponding to the social comparison treatment. These findings imply that a considerable effect of the price salience treatment for households who historically consumed just above the notch cannot be ruled out.

In contrast, Table 6 shows that the effect of the social comparison treatment is similar for households who historically were several kilowatt hours above the notch and for those who were just above it. This suggests that the effect of the social comparison is significant across the consumption distribution, whereas the effect of the price notch information exists only for those who were just above the notch. The third row of Table 6 also shows the differences between the two treatment effects. For households just above the notch, no specification brings about a significant difference. On the other hand, for those way above the notch the difference is significant at least at the 10% level in three specifications. These findings are consistent with our conceptual framework.

The treatment effects could also be heterogeneous in terms of optimization frictions. We approximate these frictions with the pre-treatment consumption variation. To explore this alternative, we calculate the within-household coefficient of variation for the consumption corresponding to the 12 months before treatment. Then, we

Table 7: Estimates of Average Treatment Effects for Households Above the Notch. High and Low Historical Consumption Variance. First Quarter After the Intervention

	(1)	(2)	(3)	(4)
Panel A. High Variance				
Social Comparison (SC)	-1.282	-1.204	-1.124	-1.127
	(1.116)	(0.831)	(0.970)	(0.970)
Price Notch salience (PNS)	0.121	-0.074	0.163	0.180
	(1.137)	(0.839)	(0.992)	(0.992)
PNS - SC	1.403	1.129	1.287	1.307
	(1.134)	(0.852)	(0.991)	(0.990)
Constant	123.263***	-	-	-
	(0.821)	-	-	-
N	41,409	41,409	248,582	248,582
Panel B. Low Variance				
Social Comparison (SC)	-1.405***	-1.255***	-1.335***	-1.335***
	(0.431)	(0.391)	(0.404)	(0.404)
Price Notch Salience (PNS)	-0.837*	-0.820**	-0.858**	-0.873**
	(0.443)	(0.407)	(0.416)	(0.417)
PNS - SC	0.567	0.434	0.477	0.462
	(0.446)	(0.409)	(0.419)	(0.420)
Constant	120.776***	-	-	-
	(0.303)	-	-	-
N	41,325	41,325	247,325	247,325
Pre-treatment Consumption	No	Yes	No	No
Post-treatment Indicator	No	No	Yes	No
Year-by-month Fixed Effects	Yes	Yes	No	Yes
Houshold Fixed effects	No	No	No	Yes

Notes: 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 is all households who had pre-treatment average annual consumption above 110 kWh. Panel A includes households with high pre-treatment coefficient of variation, and Panel B includes households with low pre-treatment coefficient of variation, see text for details. Specifications (1) and (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. Pre-treatment consumption is the monthly consumption for the periods April-June, 2013 and January-February, 2014, see text for details. Robust standard errors clustered at the household level in parentheses;* $p<0.1$; ** $p<0.05$; *** $p<0.01$.

split our households in above (high-variance) and below (low-variance) the median coefficient of variation.

The estimates for these samples are shown in Table 7, which includes the same specifications as the previous tables. A relatively high pre-treatment consumption variance likely implies a relatively high post-treatment variance, which will imply relatively larger standard errors for the estimated treatment effects. Therefore, it is not a surprise that the standard errors of the coefficients corresponding to the high-variance group are considerably larger than those corresponding to the low variance group. In fact, none of the coefficients corresponding to the high variance sample is significant at standard levels, while for the low variance sample all the coefficients are significant at least at the 10%.

Table 8: Estimates of Average Treatment Effects for Households Below the Notch. First Quarter After the Intervention

	(1)	(2)	(3)	(4)
Social Comparison (SC)	0.371	-0.624	0.043	0.041
	(0.711)	(0.565)	(0.632)	(0.632)
Price Notch Salience (PNS)	0.372	-0.201	0.153	0.149
	(0.725)	(0.555)	(0.641)	(0.641)
PNS - SC	0.001	0.422	0.110	0.108
	(0.720)	(0.557)	(0.635)	(0.635)
Constant	110.292***	-	-	-
	(0.524)	-	-	-
Pre-treatment Consumption	No	Yes	No	No
Post-treatment Indicator	No	No	Yes	No
Year-by-month Fixed Effects	Yes	Yes	No	Yes
Houshold Fixed effects	No	No	No	Yes
N	56,728	56,728	340,383	340,383

Notes: 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 is all households who had pre-treatment average annual consumption below 110 kWh. Specifications (1) and (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. Pre-treatment consumption is the monthly consumption for the periods April-June, 2013 and January-February, 2014, see text for details. Robust standard errors clustered at the household level in parentheses;* $p<0.1$; ** $p<0.05$; *** $p<0.01$.

Notice that the point estimates for the social comparison treatment are similar for the two samples, and range from -1.124 to -1.405. However, the point estimates for the price salience treatment are considerably different in the two samples. In the high-variance group the point estimates for this treatment range from -0.048 to 0.18, whereas for the low-variance group they range from -0.873 to -0.837 and are significant at the 5% or 10% levels.

These results are also consistent with the conceptual framework. They indicate that households in the social comparison group reduce consumption by around 1% regardless of where their pre-treatment consumption variance was before treatment. In fact, the point estimates for this group are remarkably similar in all the specifications we have considered. This suggests that the social comparison offers a homogeneous incentive to reduce consumption. This evidence is not in line with Andor et al. [2020] who find that the effect of social norms on electricity consumption increases with pre-treatment consumption. Notice however, that our sample considers only households with pre-treatment consumption around the price notch (between 100 and 125 kWh per month) and therefore offers less heterogeneity in baseline consumption.

In contrast, the effects estimated for the price salience treatment might be evidence of heterogeneous incentives. One alternative to explain these incentives is the presence of different optimization frictions. In particular, if –on average– households that experience relatively high consumption variance across time face stronger frictions, or have less control over electricity consumption, than those with relatively low consumption variance, then it would be more difficult for the former group to re-optimize consumption as a response to the price salience information. Hence, households in the price salience treatment, who face strong optimization frictions, are unlikely to try to reduce consumption to take advantage of the subsidy, knowing that it is likely that they will not be successful.

5.2 Treatment Effects for Households Historically below the Notch

As mentioned in the previous section, for households who historically consumed below the notch, the treatments could potentially increase or decrease consumption. In our estimations we find that none of the treatments have a significant effect for this group. Table 8, which considers the same specifications in the previous tables, shows that all the estimates across treatments and specifications are not significant at standard levels. Hence, for this group of consumers, we find no evidence that our interventions induced conservation nor that they produced a non-desirable "boomerang" effect that increases consumption.

Table 9: Estimates of the Effect of Treatment on the Probability of Crossing the 110 kWh Notch. First Quarter After the Intervention

	Above 110 – treatment moves below (1)	Below 110 – treatment moves above (2)
Social Comparison (SC)	0.020***	-0.003
	(0.005)	(0.007)
Price Notch Salience (PNS)	0.011**	-0.009
	(0.005)	(0.007)
PNS - SC	-0.009*	-0.006
	(0.005)	(0.007)
Constant	0.391***	0.221***
	(0.004)	(0.003)
N	498,132	341,532

Notes: The sample in column (1) includes households with historical consumption above the notch; the sample in column (2) includes households with historical consumption below the notch. The dependent variable is binary. In column (1) it is equal to one if the post-treatment monthly consumption is less or equal to 110 kWh; in column (2) it is equal to one if the post-treatment monthly consumption is greater than 110 kWh. The two specifications are linear probability models estimated using a panel setting with both household and month-by-year fixed effects. The data used ranges from January 2013 to June 2014. The first post-treatment month is April 2014. Robust standard errors clustered at the household level in parentheses;* $p<0.1$; ** $p<0.05$; *** $p<0.01$.

5.3 Probability of Crossing the Notch

We also explore the effects of our interventions on the probability of crossing the 110 kWh reference point. The results are presented in Table 9. We use linear probability models estimated using a panel setting with both household and month-by-year fixed effects. For the households with historical consumption above the notch, our estimates represent the effect of the treatments on the probability of reducing consumption below the reference point. Results are presented in column 1 and indicate that the effect of the social norm treatment is 2% and it is significant at the 1% level. In other words, this intervention induced a small proportion of households to go from being a "high-use" consumer to a "low-use" consumer.

On the other hand, the effect of the price salience information is around 1% and it is significant at the 5% level. This estimate is useful to measure the ability of households to successfully reduce consumption and take advantage of the subsidy as a response to our intervention. The difference between the two effects is significant at the 10% level. The smaller size of the price salience estimate in relation to the social norm is consistent with the previous results on the effect of our treatments on consumption.

Table 9 also shows in column 2 the coefficients corresponding to households with historical consumption below the notch. They represent the effect of the treatments on the probability of increasing consumption above the reference point. Notice that the estimates for the two treatments are negative, which ratifies our previous findings of the absence of the "boomerang" effect. These findings could be interpreted as a response of consumers who lower consumption to reduce the likelihood of crossing the threshold, which will imply losing the subsidy and considerably increase the cost of electricity. However, the estimates are not statistically significant at standard levels.

Table 10: Estimates of Average Treatment Effects by Quarter for Households Above the Notch

	April-June	July-September	October-December
Social Comparison	-1.244**	-0.873	-0.403
	(0.527)	(0.599)	(0.690)
Price Notch Salience	-0.358	-0.276	-0.323
	(0.540)	(0.609)	(0.694)
N	658,922	658,922	658,922

Notes: The dependent variable is a "month" of consumption, which is the average daily consumption during the meter-read window multiplied by 365/12. The estimations are from panel data specifications with year-by-month and household fixed effects. Data ranges from January 2013 to December 2014. Robust standard errors clustered at the household level in parentheses;* p<0.1; ** p<0.05; *** p<0.01.

5.4 Impermanence of Effects

The empirical evidence suggests that non-pecuniary incentives only hold in the short term (see for instance, Gneezy and List [2006], Landry et al. [2010], Ferraro and Price [2013], and Ito et al. [2018]). As pointed out by Gneezy and List [2006], this could be explained if these incentives have the greatest impact shortly after the intervention, when they activate moral sentiments. However, they disappear over time as the decision maker forgets about the intervention.

We test for this in our experiment by estimating separate treatment effects for the three quarters after the intervention for the sample of households with historical consumption above the notch. We do this by interacting indicators for each quarter with indicators for our treatments in a panel data framework with both household and month-by-year fixed effects. Results are shown in Table 10. Our findings are consistent with previous literature in that the treatment effects are diminishing over time. The coefficients corresponding to the second and third quarters after the interventions are in general smaller in absolute terms than those corresponding to the first. In the case of the social comparison intervention, the estimates corresponding to the second and third quarters are no longer significant at standard levels.

6 Conclusions

This paper uses a large-scale field experiment to analyze the role of pure informational and social nudges as policy instruments to induce prosocial behavior. We use a unique feature of the electricity tariff in Quito, Ecuador to make salient a sizable price notch (pure informational nudge) that apparently had not historically induced consumption reduction. We also study the effect of a social norm message (social nudge) in which we use the same reference point as in the first treatment. Specifically, we compare these interventions and estimate whether they work for different groups.

We find that for households historically consuming above the reference point, the social comparison treatment reduces consumption by around 1% regardless of where their pre-treatment consumption and consumption variance were before treatment. In fact, the point estimates for this treatment are remarkably similar in all the specifications we considered. This suggests that the social comparison offers a homogeneous incentive to reduce consumption.

In contrast, results indicate that the effect of the price salience treatment is heterogeneous. It is significant for households who were just above the notch, but not for those who were way above it. This is consistent with our conceptual framework and implies that it is more difficult for high-use households to reduce consumption below the notch to take advantage of the subsidy.

We also find evidence that the price salience information has a significant effect for households with relatively low pre-treatment consumption variance, but not for households with relatively high pre-treatment consumption variance. If pre-consumption variance is a proxy for optimization frictions, then these findings are consistent with heterogeneous incentives in terms of the ability of households to re-optimize consumption as a response to our price salience intervention.

Results also show that none of the treatments have a significant effect for households historically consuming below the notch. Hence, we find no evidence of a non-desirable "boomerang" effect that increases consumption. Additionally, for households with pre-treatment average consumption above the notch, we find that our treatments increase the probability of crossing the notch for a small proportion of consumers. For households with pre-treatment average consumption below the notch, we find that our interventions reduce the probability of crossing the notch. However, these estimations are not statistically significant. Also, and consistent with previous literature, we find that the effect of our information interventions diminishes over time.

These results have important policy implications. They provide additional evidence of the role of nudges to promote prosocial behavior. In particular, our findings indicate that pure informational nudges might be effective in reducing consumption if targeted to the correct segments of the population. In other words, this type of intervention has an effect only on those for whom the information is relevant, and therefore can reduce the gap between choice and experience utility, which in turn increase individual welfare. Assuming that the reduction of consumption reduces its externality, then carefully designed pure informational nudges can be welfare improving both at the individual and aggregate levels in the context of conservation.

In contrast, the homogeneous effect of the social nudge treatment suggests that it affects all types of consumers, even if the information is not relevant for them because they are far away from the reference point or because they face high optimization frictions. Hence, the social nudge intervention may negatively affect individual welfare by increasing moral or emotional costs. Policy makers should consider the potentially negative effects of social nudges when designing interventions aimed to promote prosocial behavior.

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Declarations of interest

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Availability of data and material

This research was implemented using confidential data provided by Empresa Eléctrica Quito-EEQ. Independent researchers can obtain the data by writing a formal request directed to the CEO of the SRI.

Code availability

Replication Stata Do-files are fully available for researchers.

References

Hunt Allcott. Rethinking real-time electricity pricing. *Resource and Energy Economics*, 33(4):820 – 842, 2011. ISSN 0928-7655. doi: http://dx.doi.org/10.1016/j.reseneeco.2011.06.003. URL http://www.sciencedirect.com/science/article/pii/S092876551100042X.

Mark A. Andor, Andreas Gerster, Jörg Peters, and Christoph M. Schmidt. Social norms and energy conservation beyond the us. *Journal of Environmental Economics and Management*, page 102351, 2020.

Susan Athey and Guido W Imbens. Identification and inference in nonlinear difference-in-differences models. *Econometrica*, 74(2):431–497, 2006.

Ghazala Azmat and Nagore Iriberri. The importance of relative performance feedback information: Evidence from a natural experiment using high school students. *Journal of Public Economics*, 94(7-8):435–452, 2010.

John Beshears, James J Choi, David Laibson, Brigitte C Madrian, and Katherine L Milkman. The effect of providing peer information on retirement savings decisions. *The Journal of finance*, 70(3):1161–1201, 2015.

Saurabh Bhargava and Dayanand Manoli. Why are benefits left on the table? assessing the role of information, complexity, and stigma on take-up with an irs field experiment. 2013. Carnegie Mellon University Working Paper, Last accessed: February 24, 2015 at https://sites.google.com/site/sbhargav/Bhargava_IRS%20Experiment.pdf?attredirects=0.

Severin Borenstein. To what electricity price do consumers respond? residential demand elasticity under increasing-block pricing. 2009. University of California, Berkeley Working Paper, Last accessed: January 23, 2015 at http://faculty.haas.berkeley.edu/borenste/download/NBER_SI_2009.pdf.

Severin Borenstein. The redistributional impact of nonlinear electricity pricing. *American Economic Journal: Economic Policy*, 4(3):56–90, 2012.

Kristina M Bott, Alexander W Cappelen, Erik Ø Sørensen, and Bertil Tungodden. You've got mail: A randomized field experiment on tax evasion. *Management Science*, 66(7):2801–2819, 2020.

Raj Chetty and Emmanuel Saez. Teaching the tax code: Earnings responses to an experiment with eitc recipients. *American Economic Journal: Applied Economics*, 5(1):1–31, 2013.

Raj Chetty, Adam Looney, and Kory Kroft. Salience and taxation: Theory and evidence. *American Economic Review*, 99(4):1145–77, 2009. doi: 10.1257/aer.99.4.1145.

Raj Chetty, John N. Friedman, Tore Olsen, and Luigi Pistaferri. Adjustment costs, firm responses, and micro vs. macro labor supply elasticities: Evidence from danish tax records. *Quarterly Journal of Economics*, 126(2):749–804, 2011.

Alain Cohn, Ernst Fehr, Benedikt Herrmann, and Frédéric Schneider. Social comparison and effort provision: Evidence from a field experiment. *Journal of the European Economic Association*, 12(4):877–898, 2014.

Dora L. Costa and Matthew E. Kahn. Energy conservation "nudges" and environmentalist ideology: Evidence from a randomized residential electricity field experiment. *Journal of the European Economic Association*, 11(3):680–702, 2013.

Stefano DellaVigna and Joshua M. Pollet. Investor inattention and friday earnings announcements. *The Journal of Finance*, 64(2):709–749, 2009.

Stefano DellaVigna, John A List, and Ulrike Malmendier. Testing for altruism and social pressure in charitable giving. *The Quarterly Journal of Economics*, 127(1): 1–56, 2012.

Esther Duflo and Emmanuel Saez. The Role of Information and Social Interactions in Retirement Plan Decisions: Evidence from a Randomized Experiment. *Quarterly Journal of Economics*, 118(3):815–842, August 2003. URL http://ideas.repec.org/a/tpr/qjecon/v118y2003i3p815-842.html.

Paul J. Ferraro and Michael K. Price. Using nonpecuniary strategies to influence behavior: Evidence from a large-scale field experiment. *Review of Economics and Statistics*, 95(1):64–73, 2013.

Amy Finkelstein. E-ztax: Tax salience and tax rates. *Quarterly Journal of Economics*, 124(3):969–1010, 2009.

Mira Fischer and Valentin Wagner. Effects of timing and reference frame of feedback: Evidence from a field experiment. 2018.

Uri Gneezy and John A. List. Putting behavioral economics to work: Testing for gift exchange in labor markets using field experiments. *Econometrica*, 74(5):1365–1384, 2006.

Robert Hahn, Robert D Metcalfe, David Novgorodsky, and Michael K Price. The behavioralist as policy designer: The need to test multiple treatments to meet multiple targets. Working Paper 22886, National Bureau of Economic Research, December 2016. URL http://www.nber.org/papers/w22886.

Scott Holladay, Jacob LaRiviere, David Novgorodsky, and Michael Price. Prices versus nudges: What matters for search versus purchase of energy investments? *Journal of Public Economics*, 172:151–173, 2019.

Inamhi. Anuario metereológico 2011. Instituto Nacional de Metereología e Hidrología, Quito, Ecuador, Last accessed: February 24, 2015 at http://www.serviciometeorologico.gob.ec/wp-content/uploads/anuarios/meteorologicos/Am%202011.pdf, 2013.

Koichiro Ito. Do consumers respond to marginal or average price? evidence from nonlinear electricity pricing. *American Economic Review*, 104(2):537–63, 2014. doi: 10.1257/aer.104.2.537.

Koichiro Ito, Takanori Ida, and Makoto Tanaka. Moral suasion and economic incentives: Field experimental evidence from energy demand. *American Economic Journal: Economic Policy*, 10(1):240–67, 2018.

Keith Kranker. CIC: Stata module to implement the Athey and Imbens (2006) Changes-in-Changes model. Statistical Software Components, Boston College Department of Economics, June 2019. URL https://ideas.repec.org/c/boc/bocode/s458656.html.

Craig E. Landry, Andreas Lange, John A. List, Michael K. Price, and Nicholas G. Rupp. Is a Donor in Hand Better than Two in the Bush? Evidence from a Natural Field Experiment. *American Economic Review*, 100(3):958–83, June 2010. URL http://ideas.repec.org/a/aea/aecrev/v100y2010i3p958-83.html.

Steven D. Levitt and John A. List. What do laboratory experiments measuring social preferences reveal about the real world? *The Journal of Economic Perspectives*, pages 153–174, 2007.

Justin McCrary. Manipulation of the running variable in the regression discontinuity design: A density test. *Journal of Econometrics*, 142(2):698–714, 2008.

Jessica M. Nolan, P. Wesley Schultz, Robert B. Cialdini, Noah J. Goldstein, and Vladas Griskevicius. Normative social influence is underdetected. *Personality and Social Psychology Bulletin*, 34(7):913–923, 2008.

José A. Pellerano, Michael K. Price, Steven L. Puller, and Gonzalo E. Sánchez. Do extrinsic incentives undermine social norms? evidence from a field experiment in energy conservation. *Environmental and Resource Economics*, 67(3):413–428, 2017.

Peter C. Reiss and Matthew W. White. Household electricity demand, revisited. *Review of Economic Studies*, 72(3):853–883, 2005.

Peter C. Reiss and Matthew W. White. What changes energy consumption? prices and public pressures. *RAND Journal of Economics*, 39(3):636–663, 2008.

P. Wesley Schultz, Jessica M. Nolan, Robert B. Cialdini, Noah J. Goldstein, and Vladas Griskevicius. The constructive, destructive, and reconstructive power of social norms. *Psychological Science*, 18(5):429–434, 2007.

Blake Shaffer. Misunderstanding nonlinear prices: Evidence from a natural experiment on residential electricity demand. *American Economic Journal: Economic Policy*, 12(3):433–61, 2020.

Frank A. Wolak. Do residential customers respond to hourly prices? evidence from a dynamic pricing experiment. *American Economic Review*, 101(3):83–87, 2011. doi: 10.1257/aer.101.3.83.

Appendix

A1. Treatment Letters and Translations

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!

Sample letter for social comparison (Spanish)

Meter ID: XXXXXX-X

Geocode: XX XX-XX-X-XX

EMPRESA ELÉCTRICA QUITO
Siempre junto a ti

IMPORTANT INFORMATION

<u>Save Electricity and Save Money</u>

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!

Sample letter for social comparison (Translation)

SUMINISTRO: XXXXXXX

Plan/Geocódigo: XX XX-XX-X-XXXX

EMPRESA ELÉCTRICA QUITO
Siempre junto a ti

INFORMACIÓN IMPORTANTE

Ahorre Electricidad y Ahorre Dinero

Estimado Cliente:

La tarifa eléctrica establecida por el CONELEC funciona de manera progresiva. Esto implica que si usted consume más de 110 kWh al mes, hay un incremento importante de costo en su factura.

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

Esto significa que, durante el año pasado usted pagó en promedio alrededor de **US$ XX** por consumo de electricidad cada mes (**US$ XXX** al año). Si usted reduce su consumo mensual de electricidad en **X kWh** (alrededor de **X,XX %** de su consumo promedio), su pago mensual se reduciría cerca de **XX,XX %**, por lo cual **usted ahorraría US$ XX al año.** Le exhortamos a que hago un uso eficiente de 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!

Sample letter for price notch salience (Spanish)

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

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.

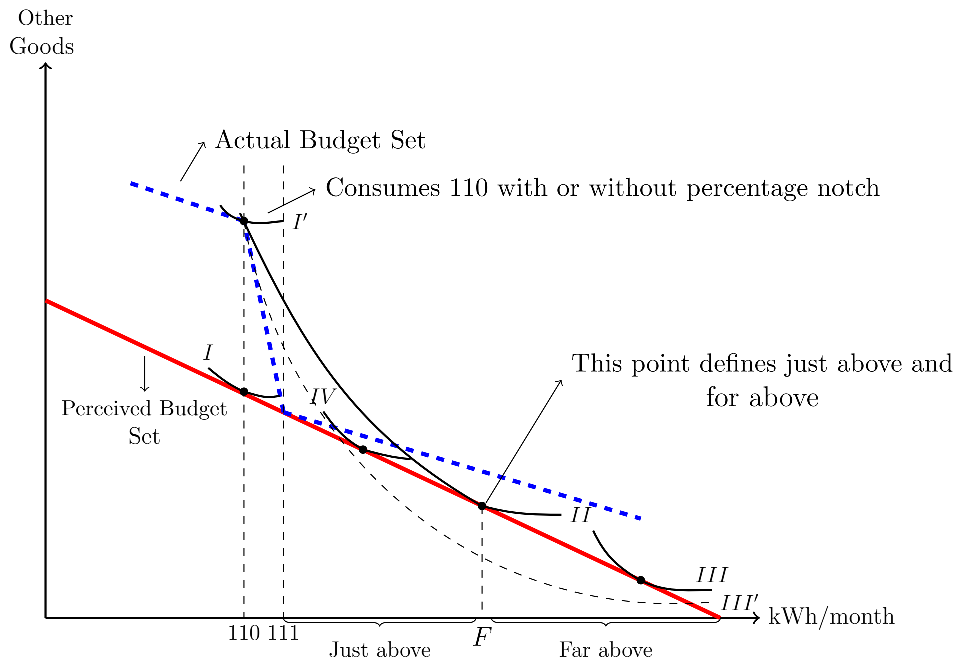
Please read carefully the following savings tips so you can learn how to save right away. Share this information with all the other members of the household.

- 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.

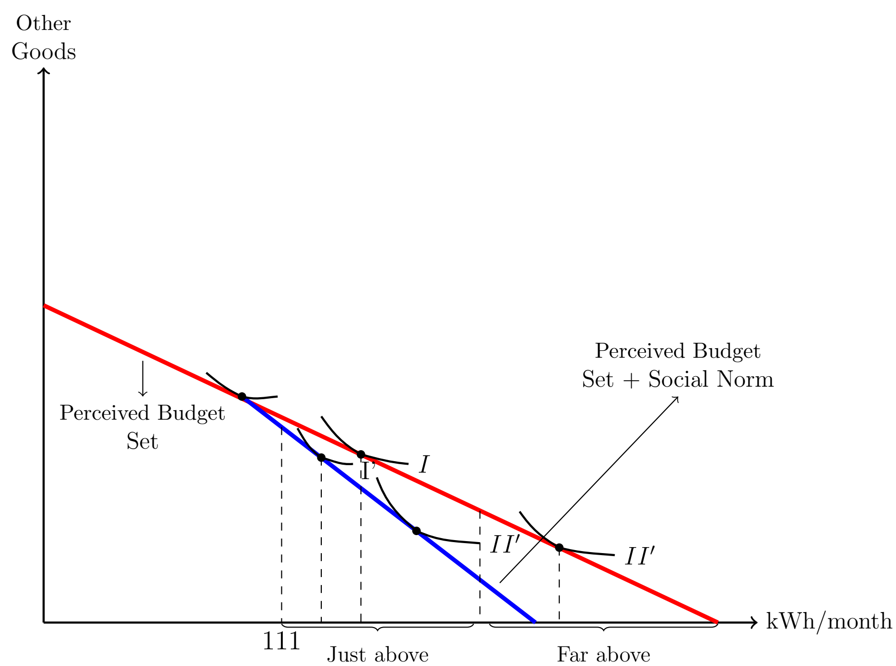
¡SAVE ELECTRICITY, SAVE MONEY!

Sample letter for price notch salience (Translation)

A2. Conceptual Framework



Price Salience – Optimization with Actual and Perceived Budget Set (Households historically above 110)



Social Norm – Optimization with Actual and Perceived Budget Set (Households historically above 110)