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Price Transparency in Residential Electricity: Experiments for Regulatory Policy

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Abstract: Two laboratory studies investigated the effect of price transparency on consumers' decision-making in the residential electricity market. The first tested whether consumers have difficulties when confronted with unit prices expressed as discounts from standard rates, which vary between suppliers. Results showed that consumers were much more likely to choose packages with low unit prices when unit prices were presented explicitly rather than as discounts. When discounts were described as percentages, consumers' decisions were also less accurate. The second study pre-tested the likely impact of a potential mandatory "estimated annual bill" (EAB) on marketing material, calculated for a customer with average usage. Results demonstrated that consumers were more likely to judge value according to unit prices when an EAB appeared on advertisements. Moreover, when unit prices were communicated via an EAB rather than a discount, consumers chose lower unit price offerings and were more precise in their decision-making. The findings suggest that the EAB is likely to be beneficial for consumers' decision-making.

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1. Introduction

Market economies rely on competition to incentivise firms to lower prices and to improve quality, but an underlying assumption of a competitive market is that consumers are able to choose the product from among those available that best suits them. For this reason and for reasons of fairness, price transparency is an important principle of consumer protection policy. Whether prices in any given market are, in fact, transparent is an empirical matter. Even if no component of the price is hidden, empirical evidence shows that marketing practices that simply split the full price into two or more components can affect consumers' abilities to make good decisions (Grubb, 2015; Greenleaf et al., 2016).

The present paper describes an experimental investigation of a specific pricing practice in Ireland's residential energy market, which raises concerns about price transparency. Suppliers aim to entice consumers to switch by framing unit prices as discounts from standard prices, which are expressed as percentages or annual cash savings.¹ However, while discounts may generally be attractive and may prompt switching and other forms of consumer activity, from the consumer's perspective there is a potential difficulty with this price framing. The discounts are offered relative to the standard unit rate (SUR) for the specific company concerned. Because SURs vary across companies, the size of any discount is not a reliable guide to the underlying unit price, which is what ultimately affects bills.

The paper describes two experimental studies. The first study investigated whether framing prices in this way causes consumers problems. The second study tested the effectiveness of a potential regulation designed to make it easier for consumers to compare products. This use of laboratory experiments to pre-test potential regulations, conducted in close co-operation with the relevant regulator, the Commission for Energy Regulation (CER), represents an innovative application of behavioural economics to policy in Ireland.

The results of the first study suggest that consumers are much less likely to choose the package with the lowest unit price when prices are framed as discounts from SURs, compared to when prices are expressed as a simple per unit rate (PUR). The potential

¹ Regulation stipulate that the advertised cash savings must be applicable to a customer with average usage levels, with the annual average usage set by regulatory standard to ensure comparability across offerings. During the period of study, it stood at 5,300 kWh.

regulatory remedy tested in the second study consisted of mandated presentation of the price as the Estimated Annual Bill (EAB) calculated for average usage. The results suggest that mandated presentation of the EAB is likely to have a beneficial effect on decisions, assisting consumers to locate packages with lower unit prices and, moreover, improving the consistency of consumers' decisions. The experiments employed only electricity packages, but the decision-making mechanisms behind our results are likely also to apply to choices of residential gas packages, and perhaps to other markets in which prices are expressed as discounts from variable standard prices.

2. Previous Research

Before describing the experimental designs, this section presents a brief overview of relevant international literature. This is separated into two parts. First, we discuss evidence that consumers fail to choose optimally in the market for residential energy. Second, we consider the potential decision-making mechanisms involved.

2.1 Mistakes in the Market

The deregulation of domestic energy markets was intended to increase choice and to lower prices for electricity and gas customers through the mechanism of competition. While to some extent these aims have been achieved (Joskow, 2008), international evidence from multiple markets points to price dispersion, low switching rates and substantial numbers of consumers who struggle to locate the best value offerings within the market (Giulietti, Waddams Price and Waterson, 2005; Brennan, 2007; Wilson and Waddams Price, 2010).

At one level this is arguably surprising, because residential energy is essentially a homogeneous good. The quality of supply, in terms of network access, maintenance and metering, is determined by a centralised system and is hence common to all suppliers. In the absence of complex time-of-day tariffs or multiple varieties of "green" energy packages, differences between the offerings of different suppliers primarily surround aspects of billing and customer service. Consequently, it is a reasonable presumption that for a large proportion of consumers, price is the dominant attribute. In most markets, including Ireland, prices

excluding taxes generally consists of two components: an annual standing charge and a per unit rate.

Despite the seeming simplicity of this price structure, many appear unable to switch to the cheapest package. Perhaps the most compelling demonstration of this is provided by Wilson and Waddams Price (2010), who used a combination of survey and billing data to show that the large majority of a sample of British consumers who switched electricity supplier to make savings did not select the best deal, while approximately one quarter actually managed to increase their bill. The authors concluded that “many of the choices are consistent with genuine decision error or inattention” (p.665). These findings therefore indicate errors in consumers’ decision-making, but offer less insight into the mechanisms behind such errors.

2.2 *Decision-Making Mechanisms*

Even where suppliers describe prices simply as a standing charge and a PUR, the prices of residential energy packages have two components that must be combined in order to make price comparisons, with different weightings depending on usage. Framing the price as a discount from variable SURs introduces a third element of complexity to price comparisons, such that consumers need to know the SUR for each supplier, combine it with information on the size of the discount, and also take into account any differences in standing charge. This is before considering other attributes of the overall package that consumers might wish to emphasise, including brand, customer services, other offers, and so on.

Greenleaf et al. (2016) recently conducted a comprehensive review of “partitioned pricing”, focusing on the psychological processes involved when consumers are confronted by prices separated into multiple components. Most work in this area has focused on how splitting the price into a base price plus surcharge(s) can lead consumers to underestimate prices. Arguably, subtraction is likely to be a more error-prone operation. Reviewing multiple studies, Greenleaf et al. conclude that partitioned prices can lead both to misperceptions of overall prices and to changes in demand for the relevant products. Even simple separation of prices into two additive components can have substantial effects on consumers’ choices (Morwitz, Greenleaf and Johnson, 1998; Office of Fair Trading, 2010).

Greenleaf et al. (2016) propose a six-stage psychological process involved in processing partitioned prices, three of which are relevant to the present issue. First, consumers must pay attention to each price component. Second, they must combine the information accurately, whether by an arithmetic calculation or an accurate rule-of-thumb (heuristic). Third, they must combine the information with other attributes of the product. For present purposes, if consumers faced with discount price frames in the Irish residential energy market fail to take variation in SURs between suppliers into account, if they struggle to combine SURs and discounts into overall prices, or if the requirement to perform this information processing leads them to be less accurate in comparing prices with other attributes, the quality of their decision-making is likely to be reduced by the price frame.

A smaller body of research has directly addressed discounts, which attract attention and demand but may potentially have different effects depending on how they are expressed. DeVecchio, Krishnan and Smith (2007, p.160-161) review mixed evidence on whether promotions are more attractive when framed as monetary amounts rather than percentages. Studies that have assessed the accuracy with which consumers process percentage differences reveal systematic distortions (Kruger and Vargas, 2008). One possibility is that the greater difficulty of calculating or estimating the impact of percentage discounts may induce some uncertainty on behalf of the consumer, causing them to give the discount less weight in the decision. Similar effects have been recorded for the weight given to surcharges (Morwitz et al., 1998). These findings are consistent with laboratory research in judgment that shows how the ease of mental processing of a cue, or “cue fluency”, increases the weight given to the cue in judgements (Shah & Oppenheimer, 2007).

We can find no empirical study that has directly investigated how consumers cope with discounts from variable standard prices. One previous study has employed laboratory experiments to study choice of energy packages. Sitzia, Zheng and Zizzo (2015) focus on the role of inattention, the first relevant psychological mechanism invoked by Greenleaf et al. (2016). They find that choice of tariff in energy markets is more likely to be suboptimal when decision-makers have other tasks competing for their attention. This suggests that cognitive load may be an important factor and, hence, that additional complexity in the price frame may be harmful to good decision-making. Lunn et al. (2016) also employed laboratory experiments to reveal limits to the number of separate product attributes that can be taken into account simultaneously by consumers. These findings also imply that the discount price

frame is likely to affect the accuracy of consumers' decisions, because it effectively turns a single price component (unit price) into two components (SUR and discount) that must be integrated by the consumer.

3. Study 1: How Do Discounts Affect the Accuracy of Consumers' Decisions?

We addressed this research question through a laboratory study consisting of multiple decision tasks carried out by the same participants under different price frames and when confronted with different volumes of information. This technique is statistically powerful in that it generates repeated measures that allow within-subject comparisons of how decisions are affected by the price frame. We first describe the nature of the tasks and how they were ordered during the experimental session, before providing detail on methods.

3.1 Experimental Tasks

The primary aim of the first study was to investigate whether framing prices as discounts makes it harder for consumers to opt for cheaper electricity, compared to when prices are framed simply as a unit price (the per unit rate, PUR). Two types of task were employed.

The first was a binary choice task. Participants faced multiple trials in which they had to choose which of two hypothetical electricity packages they preferred. The trials contained multiple combinations of prices and suppliers. The packages were displayed on a computer screen in a similar manner to online marketing material, with large fonts, bright colours and logos. In the simplest form (Stages 1 to 3), the information available for each package consisted of just two attributes, the brand (one of the four main residential electricity brands)² and a unit price, either framed as a discount or as a PUR. It was clear to participants that these were hypothetical decisions of the form: "if company X was offering discount Y and company P was offering discount Q, which of the two would you choose?" There was no time limit for responses; participants proceeded at their own pace. The primary empirical measure was the likelihood that participants opted for the package with the lower unit price.

² Bord Gáis, Electric Ireland, Energia, SSE Airtricity.

This choice task therefore provided an empirical measure of the extent to which changing the price frame altered the attractiveness of packages with lower unit prices.

Although this task was a hypothetical subjective choice, participants were given an incentive to concentrate and to respond accurately. They were instructed at the start of the experiment that the best participant in every ten would receive a €50 shopping voucher and that their best way of winning the voucher was to respond as accurately as possible, choosing the option that they would truly prefer if faced with the two products shown in a real-life situation. On the rare occasion a participant asked how this would be determined, we explained that we had a statistical method for testing how accurately people responded according to their true preferences and reiterated that this was the best way to win the voucher. No participant queried this. Participants were rewarded according to how well their individual responses were captured by a preference function estimated by binary regression, which was primarily determined by how consistently they responded across price frames. The purpose of this incentive was to motivate participants to concentrate and to be consistent. It is logically possible that a subset of participants might have ignored our advice to respond according to their true preferences and instead tried to second-guess the method we would use to assess performance. Given our interaction with participants and the smooth unimodal shape of our descriptive data, we judge this to be very unlikely.

The second type of task was a “Surplus Identification” (S-ID) task (Lunn, Bohacek and McGowan, 2016). Rather than testing for bias in what consumers prefer, the S-ID task tested how accurately they could combine product information to judge which of two products was superior. The primary empirical measure was the size of the surplus participants required to identify the better option reliably, i.e. how much better or worse the product on the right was compared to the one on the left. Unlike a choice or stated preference task, the decision was not subjective. The extent to which one product was superior, the available surplus, was objectively defined using a “buyer’s agent” paradigm. The participant was told that their job was to choose a package for a friend or relative. They were given a description of what the buyer was looking for and multiple examples of kinds of packages the buyer liked and the trade-off between attributes involved. They then undertook trials in which their task was to select one of two products for the buyer, receiving feedback after each choice. There was no time limit for responses.

Although it is possible that participants would be more accurate choosing for themselves than trying to apply someone else's preferences, the key measure was their *relative* performance. The S-ID task tested whether the price frame made it easier or harder to integrate the available product information into decisions. Again, a tournament-style incentive was employed. To judge which participants won a €50 voucher, performance was judged by the objective accuracy of responses.

Different consumers may have different knowledge of suppliers' SURs at different decision points. Similarly, the experiment proceeded in sequential stages, with participants being given additional information at each stage. There were five stages. We reasoned that when consumers respond to adverts, salespeople and other means of communicating offers, they often do so without specific knowledge of SURs and standing charges for individual suppliers.³ In the first stage, therefore, participants had to rely on background knowledge of suppliers. In the second stage, we supplied the actual SURs for the four companies (which ranged from 18.31c/kWh to 19.08c/kWh at the time the experiment was undertaken). In the third stage, SUR information presented alongside the discount on every trial. Thus, the first three stages were designed to mimic real-world situations where: (1) consumers had not looked up suppliers' standard rates; (2) where they had looked them up but needed to rely on memory when comparing offers; and (3) where they had looked them up and written them down to help when comparing offers. For these first three stages, information consisted of only a brand and a unit price. For the fourth stage, we increased the complexity by adding two more pieces of information for each package, namely the standing charge (for the company in summer 2015) and billing method (paper or paperless). The fifth and final stage was the S-ID task.

3.2 *Method*

Thirty-six consumers took part in the first study. They were selected from a list of individuals who signed up online in response to adverts asking for volunteers to participate in experiments in consumer choice. Each was paid a fee of €25 for participation. The sample was selected to be representative of consumers aged 18-70 years by gender, age and working

³ Indeed, when members of the research team set out to find the SUR for each of the four main suppliers in the Irish market this proved to be surprisingly difficult. In most cases a few minutes of searching on the company website was sufficient to obtain the supplier's SUR, but in one case a phone call had to be made following half an hour of fruitless searching.

status. Participants undertook the experiment individually. The session lasted approximately one hour in total, with a refreshment break between Stage 4 and Stage 5.

Before the session began participants were informed of the incentive and signed a consent form. For half the participants discounts were expressed throughout the experiment as a percentage, for the other half as a annual Euro saving. We explained clearly that discounts were offered relative to the standard price for the specific company. Example displays for the choice tasks at different stages are provided in Figures A1 to A3 in Appendix A. Participants indicated choices by pressing one of two buttons on a response box.

In the first stage, participants undertook two experimental runs of 24 trials, one for each price frame, with the order pseudo-randomised across participants. Trials were presented in blocks of six possible pairs from among the four suppliers. Prices were drawn randomly from a range of 0-20% discount. SURs were those that existed in the market in summer 2015. Initially, the difference in price between offerings was drawn randomly from possible differences such that failing to take account of the different SURs would result in contrasting choices between the price frames. However, a concern was that for modest price differences strong brand preferences might dominate, causing any effect to be underestimated. We therefore adapted prices across the first experimental run in each stage according to participants' previous responses. After a brand was chosen, its price was incrementally increased for subsequent trials, by the equivalent of a 5%, 3% or 1% discount, depending on how many times the same brand had previously been ignored in favour of an alternative. In this way, the experiment effectively titrated participants' brand preferences to ensure that they faced a trade-off between brand and unit price. It is important to understand that this process did not interfere with the matching of trials between price frames. For each individual decision under the discount price frame were matched to those under the PUR price frame.

In Stage 2, the discount frame was repeated (24 trials) but participants were first shown the SURs for each brand on screen and had as long as they wanted to observe them (but not write them down). For Stage 3, the discount frame was repeated again (24 trials), but SURs were presented alongside every package. In Stage 4, both price frames were retested (2 x 24 trials) with the supplier's actual standing charge added and a billing method randomly assigned to each offering.

For Stage 5, participants were told that their task was to choose an electricity package for an elderly relative. They were instructed that the buyer wanted cheap electricity and had no preferences over supplier. However, the buyer would prefer to receive a paper bill. Thus, to judge which package was superior, participants had to integrate the information about the unit price and standing charge, then trade these off against whether there was a paperless bill. If they got the answer correct, they were rewarded with a picture of a smiling older person and a friendly “ping”; if they got it wrong, they heard a “buzz” and no smiling person appeared. An example display is shown in Figure A4 of Appendix A. SUR information was shown alongside each package. They undertook two experimental runs of 60 trials, with price frames pseudo-randomised across participants. As in the choice task, discounts ranged from 0 to 20%. We assumed that the elderly relative’s usage was 4,000 kWh and that a paperless bill was considered equivalent to adding €20 to the annual bill and a paper bill equivalent to taking €20 of the annual bill. Participants were not told these figures but had to learn to make the trade-off from examples and repeated feedback. To demonstrate the trade-offs involved they were first shown eight examples under both price frames, e.g. sometimes the unit price difference was small and an offering with a lower standing charge and paper bill was better, other times the unit price difference was large and so the package with the better unit price was the right answer, and so on. The resulting range of annual bills was €700-956. The difference in equivalent annual bills (surplus) was varied across trials to determine when participants could identify it reliably. The surplus adapted to the accuracy of each participant, reducing in response to a series of correct responses and increasing in response to incorrect responses.

After completion of the experiment, four €50 shopping vouchers were paid out to the two participants who were most consistent across the choice trials and the two who were most accurate in the S-ID task.

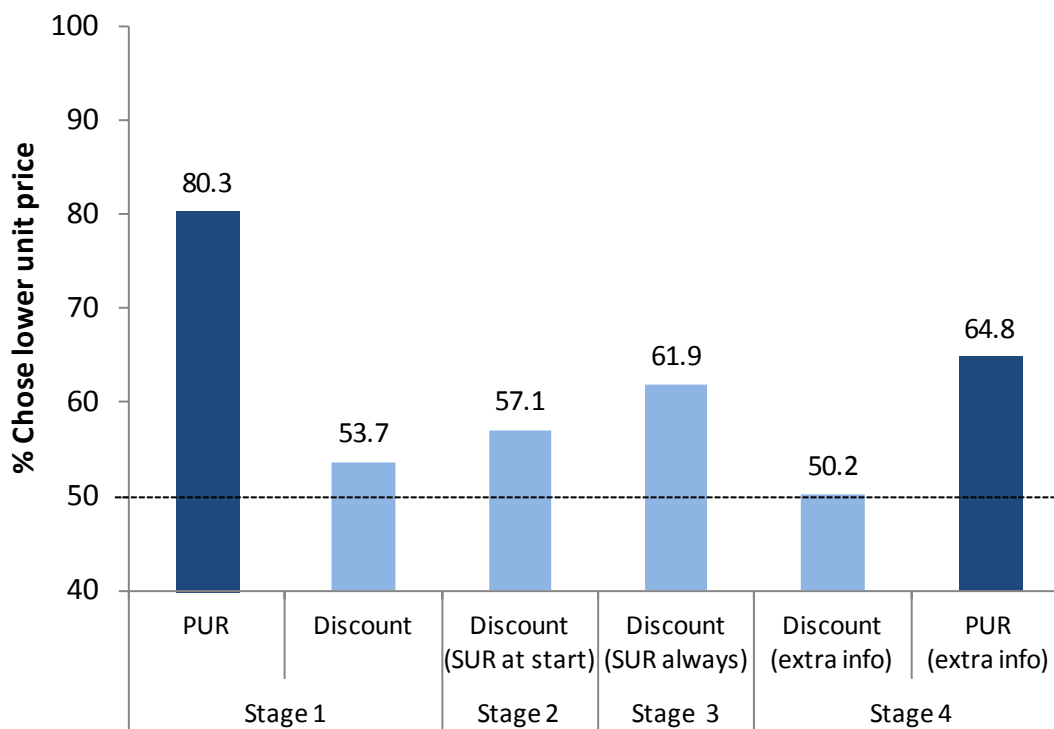
3.3 Results

Figure 1 provides descriptive results for the choice task (Stages 1 to 4). Results for the annual and percentage discounts were not significantly different and so the data are pooled. There was a large effect of price frame. In Stage 1, when the price was expressed as a PUR they opted for the lower unit price on over 80% of trials, but when the price was expressed as a

discount this plummeted to a level not statistically significantly different from chance (50%). Recall that these were exactly the same offerings, consisting of only a brand and unit price, presented with different price frames.

Showing participants the suppliers' SURs at the start of the experimental run in Stage 2 resulted in a small increase in the proportion of choices favouring the lower unit price. Providing the SUR information on each trial in Stage 3 increased the proportion to just less than 62%, still far short of the 80% under the PUR frame. In Stage 4, when information on the standing charge and billing method was included in offerings, responses in the discount frame fell away to chance while almost 65% of choices were for the lower unit price package in the PUR price frame.

Figure 1: Proportion of choices of package with lower unit price in Study 1



Analysis of individual differences reveals that the large majority, 29 of 36 participants, chose the lowest unit price more often under the PUR price frame than the discount price frame in Stage 1. Of these, 26 chose it more often under the PUR in Stage 1 than under the discount price frame for all of Stages 1 to 3. Once extra attributes were added in Stage 4, 26 of 36 chose the lowest unit price option more often under the PUR price frame.

The likelihood of choosing the lowest unit price is not a perfect metric for examining choices, because in Stages 1 to 3 it is possible that choices were influenced by participants' assumptions regarding how standing charges varied across suppliers. However, repeating the above analysis based on the likelihood of choosing the option with the lowest average annual bill (based on 5,300 kWh per year) produces an almost identical pattern to that displayed in Figure 1.

To assess the statistical significance of the findings, we fitted mixed effect logit (MEL) models, where the dependent variable was whether the participant chose the package with the lower unit price. The models in Table 1 are fitted to observations from Stages 1 to 3, where only the unit price and brand were displayed. These are random intercept models in which participants are assumed to vary normally in the likelihood of choosing the lower unit price. Fixed effects models in which this assumption of normality is relaxed produce almost identical results. The non-significant constant in Model (1) implies that choices in the baseline condition (Stage 1, Discount) were not statistically different from chance. The PUR price frame produced a strong and statistically significant increase in the probability of opting for the lower unit price package. When the SUR information was shown in Stage 2, it had a positive but non-significant effect. Once it was displayed with all packages, it had a significant effect, but a significantly and substantially smaller one than the PUR price frame. Model (2) introduces variables for whether the discount was a Euro saving or percentage and whether the participant encountered the discount or PUR price frame first. The significant constant term once this last variable was introduced reveals that chance-level performance was confined to those participants who encountered the discount price frame first, suggesting that making decisions under the PUR frame induced a degree of learning or, perhaps, distrust of the discount. The significant interaction with the stage of the experiment indicates that this effect was confined to Stage 1. Finally, the significant interaction between the PUR price frame and the Euro discount implies a somewhat larger effect in comparison to when the discount was expressed as a percentage.

Table 1: Mixed effect logit (MEL) models for Stages 1 to 3 in Study 1. The dependent variable is whether the participant chose the package with lower unit price.

	(1)	(2)
<i>Stage/frame (Ref=Stage 1/Discount)</i>		
Stage 1/PUR	1.397*** (0.116)	1.397*** (0.116)
Stage 2/Discount (SUR start)	0.151 (0.102)	0.151 (0.102)
Stage 3/Discount (SUR always)	0.376*** (0.103)	0.376*** (0.103)
Discount first		-0.618** (0.256)
Euro discount		-0.131 (0.274)
<i>Interactions</i>		
Stage 1/PUR*Discount first		0.112 (0.235)
Stage 2/Discount*Discount first		0.702*** (0.207)
Stage 3/Discount*Discount first		0.802*** (0.209)
Stage 1/PUR*Euro Discount		0.601** (0.235)
Stage 2/Discount*Euro Discount		0.128 (0.206)
Stage 3/Discount*Euro Discount		-0.042 (0.208)
Constant	0.143 (0.134)	0.534** (0.233)
<i>Random effects parameters</i>		
Var(constant)	0.465 (0.123)	0.534 (0.233)
Obs.	3,456	3,456
Participants	36	36

Standard errors in parentheses; *p<0.1, **p<0.05, ***p<0.01

Table 2 presents a similar analysis for Stage 4. These responses are modelled separately because different individuals are likely to accord different relative weights to the standing charge and billing method, relative to the unit price. Model (3) reveals that at this stage also, participants were significantly more likely to choose the lower unit price package under the PUR price frame, with responses again at chance for the discount price frame. In model (4), the interaction terms are this time non-significant, but there is a suggestion that the Euro discount may have increased the likelihood of opting for the lower unit price relative to the percentage discount ($p<0.1$). One possibility is that this reflected the fact that the discount and the standing charge were both expressed in the same units (Euros per year).

Table 2: Mixed effect logit (MEL) models for Stage 4 in Study 1. The dependent variable is whether the participant chose the package with lower unit price.

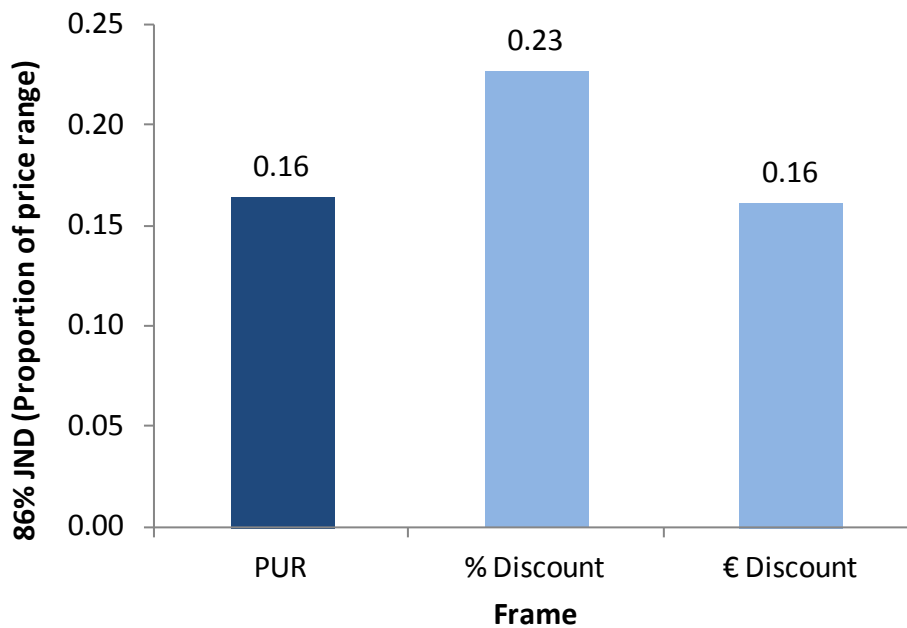
	(3)	(4)
<i>Stage/frame (Ref=Stage 4/Discount)</i>		
Stage 4/PUR	0.650*** (0.103)	0.915*** (0.178)
Discount first		0.100 (0.236)
Euro discount		0.434* (0.236)
<i>Interactions</i>		
Stage 4/PUR*Discount first		-0.273 (0.205)
Stage 4/PUR*Euro Discount		-0.262 (0.205)
Constant	0.005 (0.121)	-0.261 (0.201)
<i>Random effects parameters</i>		
Var(constant)	0.345 (0.107)	0.320 (0.101)
Obs.	1,728	1,728
Participants	36	36

Standard errors in parentheses; *p<0.1, **p<0.05, ***p<0.01

To analyse the responses to Stage 5, the S-ID task, we fitted 36 logistic regressions at the individual level to the likelihood of choosing the package presented on the right of the screen, with the size of the surplus expressed as a proportion of the €256 range of annual bills as a single covariate. This technique allows us to express the results as a “just noticeable difference” (JND), which is the size of surplus the participant required to identify the better package correctly on 86% of occasions.⁴ Figure 3 displays the median JND by price frame. Medians are presented because there was considerable variation in performance for this task between individuals, which was not normally distributed. Under the PUR price frame, participants could identify the better product 86% of the time when the difference in annual bill (available surplus) corresponded to approximately one-sixth of the price range. This performance was similar for the Euro discount, but for the percentage discount a higher surplus was required in order for participants to identify it reliably. A non-parametric test for different levels of accuracy between the two types of discount revealed a significant difference in performance (p=0.01).

⁴ This criterion is essentially arbitrary. We used 86% correct because it equates to one standard deviation of the logistic distribution fitted to the data.

Figure 3: Median “just noticeable difference” (JND) for identifying that one package was superior to another by price frame, Stage 5 of Study 1.



3.4 Discussion

Study 1 suggests that discount price frames for residential electricity cause consumers difficulty. The large majority of experimental participants opted for lower unit price packages when the unit price was expressed as the PUR compared to when the unit price was expressed as a percentage or Euro discount. This occurred despite the fact that participants were incentivised in such a way as to reward consistent decision-making. The effect remained strong when SUR information was presented alongside every offering and when information about standing charges and billing methods was added to packages. Over and above this strong influence on the weight given to the unit price, Study 1 found that the percentage discount price frame reduced the precision with which consumers could integrate the product information in order to identify better value offerings.

As with all laboratory experiments, the extent to which the results are likely to generalise to everyday consumer decisions requires careful consideration. It is possible that our findings substantially underestimate the true influence of discounts on decisions. At the beginning of the experiment, consumers were told that the discounts they were shown were taken from standard rates that differed between the suppliers. Thus, failing to understand this essential

fact was eliminated as a potential cause of bias. Moreover, our measures of the effect are for the same participants, following an explanation, across multiple trials in which they were able to familiarise themselves with the issue, making far more decisions in the process than a typical consumer. Any associated learning would reduced the measured effect size, which was nevertheless large. Lastly, each participant in the experiment only encountered one of the discount frames, whereas in the market comparisons must be made that involve both types of discount, which may add to consumers' difficulty.

It is also possible that the findings somewhat overestimate the effect. A proportion of consumers may compare electricity packages not by simply using their judgement, as participants in the present experiment did, but by sitting down to do arithmetic, perhaps with a calculator, or by using a "decision aid" such as a cost comparison site, mobile app, etc. Consumers who take this route should be unaffected by discounts. However, two aspects of this argument are important to note. First, we do not know what proportion of consumers make their decisions in this way; it may be a small minority. Second, even those who perform full arithmetic calculations must make an initial decision to invest time and effort to do so. Thus, they require an initial judgement that exploring a switch is worthwhile, perhaps in response to marketing information. Our results suggest that expressing unit prices as discounts is likely to affect this initial decision. Ultimately, however, we cannot know whether marketing that stresses the size of discounts spurs more consumers to be active than would marketing that communicated unit prices more faithfully.

Nonetheless, giving due consideration to these arguments, Study 1 implies that the practice of discounting from variable standard unit prices is likely to damage price transparency and is, therefore, of concern from a consumer protection perspective. Study 2 set out to pre-test a potential regulatory remedy.

4. Study 2: Pre-Testing a Mandatory Estimated Annual Bill

Study 2 was conducted in close collaboration with CER and was designed to pre-test an intervention under consideration by the regulator via consultation (Commission for Energy Regulation, 2016). This consisted of a mandatory "Estimated Annual Bill" (EAB) to appear on marketing material, based on the usage of an average consumer as defined by the

regulator. The logic of this mandate is to increase price transparency and hence to make comparison easier. Mandatory simplification is increasingly used internationally by regulators as a way to support consumers' decision-making (Sunstein, 2011) and standardised price descriptions have proven effective in other domains, such as the "annual percentage rate" (APR) on credit products.

Study 2 addressed two research questions that were similar to the research questions of Study 1, namely whether providing a mandatory EAB would prompt consumers to choose packages with lower unit prices and whether an EAB would improve the precision of consumers' decisions. With any mandated disclosure there is a concern about whether the information will attract attention and, if so, be understood. Therefore Study 2 additionally set out to test whether the prominence of the EAB, including its font size, would matter. Previous research shows that font-size can influence the weight consumers give to surcharges (e.g. Kim, 2006). Lastly, Study 2 tested whether a footnote explaining the meaning of the EAB would assist consumers to understand and make use of it.

4.1 Experimental Tasks

Like Study 1, Study 2 employed both a choice task and an S-ID task but also included an advertisement rating task in which participants rated the quality of deals offered in advertisements on a scale from 1 ("very poor deal") to 7 ("very good deal"). This task was the first to be performed and no assistance was offered in relation to how prices were framed. We showed four adverts (one for each supplier) under each of four sequential conditions, which varied according to the presence and prominence of the EAB information. The first four advertisements were rated with no EAB information. We then repeated the exercise with EAB information added in a smaller font next to the discount information. We then repeated the task again with the EAB information displayed with equivalent prominence to the discount information (matched for style of presentation and font). We then repeated the task a final time with an additional explanatory footnote added as well.

Study 2 proceeded in four stages. In Stage 1, participants rated the advertisements. In Stage 2, they completed a choice task. This was modified somewhat from the task in Study 1 to reflect not only the desire to test the potential impact of EAB information (rather than PUR information), but also changes that had occurred in the market during the period between the

two studies. In particular, all four main suppliers had begun to offer promotional inducements to new customers in the form of free goods, cash-back, supermarket points and so on. The presence of cash-back and other promotions raises an important issue, because the proposed intervention included discounts, cash-back and refunds in the calculation of the EAB, but not non-monetary promotional goods. To reflect this, the packages offered in the choice task varied in both the level of cash-back and whether or not a free Ireland football jersey was on offer.⁵ In Stage 2, no SUR information was given and choices were made under the discount price frame (as in Study 1) and under an EAB price frame. In Stage 3, participants were given the SURs for the four suppliers on a laminated sheet, which they kept in front of them thereafter. They then completed the choice task again. Lastly, in Stage 4, they completed an S-ID task under both price frames. Because the EAB is calculated for average usage, we employed two usage levels for the S-ID task. Half the participants had to choose for an elderly relative who had lower than average usage, while half had to choose for a family with children who had above average usage.

4.2 *Method*

Methods were as for Study 1 with the following modifications. Forty consumers aged between 18 and 70 years were recruited by a Dublin-based market research company to be representative by age, gender and working status. Each was paid €30 for participation.

The advertisements for the rating task were designed to be similar to typical billboard or magazine advertisements for electricity packages. They used photographic backdrops and presentation of numbers designed to be typical of those that appear in international marketing of residential electricity services. Examples are provided in Figure B1 of Appendix B. Four backdrops were counterbalanced across suppliers and participants. The packages advertised were the actual offerings being marketed to new customers of the four main suppliers in June 2016. Three were offering percentage discounts, while the fourth was offering a Euro discount. In keeping with contemporary practice, a footnote read: “Discount relative to [supplier’s] standard unit rate. Annual standing charge applies. Offer available from 1.7.16-31.12.16; valid for 12 months. Terms and conditions apply ([supplier web address])”. Four adverts, one for each supplier, were first presented and rated with no EAB. Advertisements

⁵ This was a promotion offered by one of the four suppliers at the time of the experiment, which coincided with the 2016 European Football Championships.

appeared one at a time and participants scored each advertisement before the next one appeared. The order of presentation was counterbalanced across participants. The adverts were then shown again with the EAB information added below the discount information. The adverts were then shown with the EAB information presented in the equivalent font to the discount information, and rated a third time. Finally, the adverts were rated a fourth time with the following text added to the start of the footnote: “The estimated annual bill is calculated using the average household’s consumption of 5,300 kWh and is inclusive of any discounts, cash-back and refunds.”

Example displays for the choice task are shown in Figure B2 of Appendix B. Unlike in Study 1, the two types of discounts could appear alongside each other, as in the market (Euro for one supplier, percentage for the other three). A level of cash-back (€0, €50 or €100), a free football shirt (yes or no) and a billing method (paper or paperless) were randomly assigned. Similarly to Study 1, on the first run (24 trials) of each stage, preferences were titrated such that after the participant chose in favour of a particular attribute (including brand) it was made marginally more expensive on subsequent trials, whereas after the participant chose against an attribute it was made marginally cheaper. Thus, the trials required trade-offs to be made between the attributes and the unit price. The choices between packages presented in the second run of each stage, i.e. under the alternative price frame, were always matched to those of the first run.

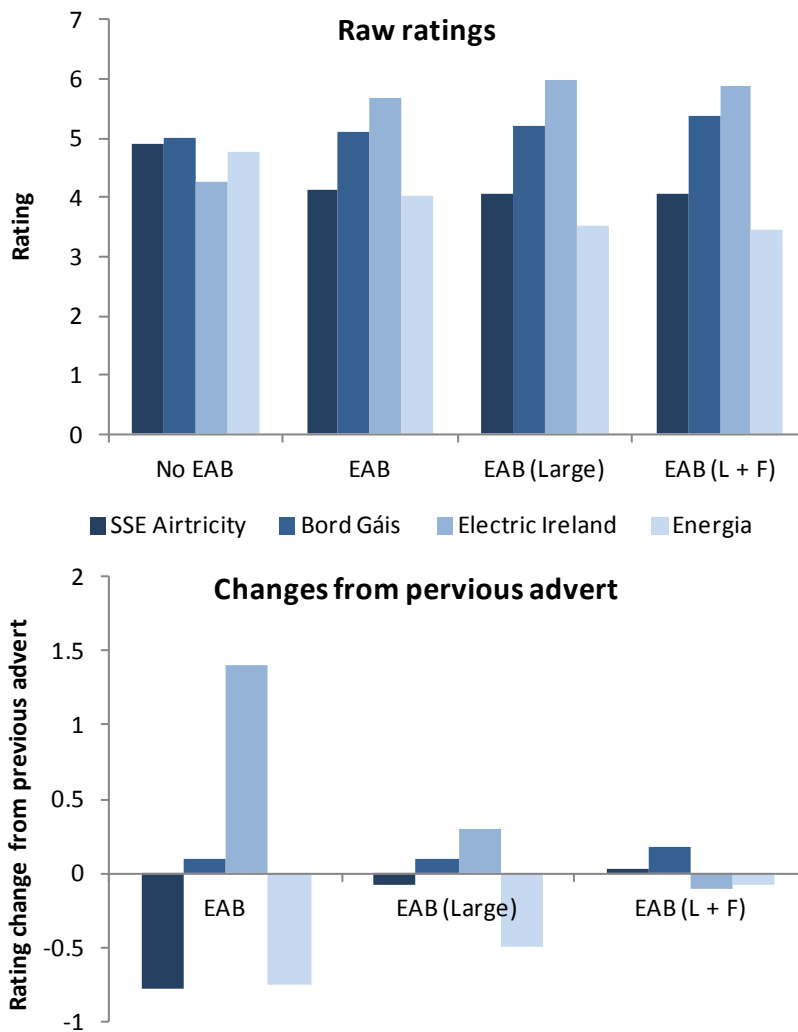
Example displays of the SI-D task in Stage 4 are presented in Figure B3 of Appendix B. Whether participants were assigned to the family (high usage, 6,800 kWh) or the elderly relative (low usage, 4,000 kWh), they were told that the buyer wanted cheap electricity, had no preference for brand, but preferred to receive a paper bill (the equivalent of ±€20 in the low usage condition; ±€30 in the high usage condition) and liked earning free supermarket points (+€6 for low usage; +€4 for high usage). Offerings also varied in levels of cash-back. Thus, on each trial participants had to integrate five pieces of information: unit price, standing charge, cash-back, billing method and whether supermarket points were included. Before the trial began, participants were shown seven example trials, under both the discount and EAB price frames, which illustrated the trade-offs between attributes, e.g. sometimes the difference in unit price was large and outweighed other positive attributes, sometimes it was smaller and the correct answer was to opt with the package with free supermarket points and a paper bill. In Study 1, the difference in equivalent annual bills (surplus) and hence difficulty

of the judgement varied continuously according to the participant's performance. In Study 2, the sizes of surplus to be presented were fixed such that each trial was either "hard", "medium" or "easy". Give or take some rounding in the prices, these were the equivalent of surpluses of 4%, 12% or 20% of the full range of annual bills (€290 [600-890] in the low usage condition, €460 [970-1,430] in the high usage condition).

4.3 Results

The SURs of the four main suppliers at the time of the experiment, in cent per kWh, were: SSE Airtricity, 18.69; Bord Gáis, 17.94; Electric Ireland, 17.17; and Energia, 18.90. Thus, the highest SUR was more than 10% above the lowest. Figure 3 presents mean ratings for advertisements in Stage 1 by brand and condition. Once the EAB information was introduced, ratings declined for the two suppliers with higher SURs, while ratings increased for the two suppliers with lower SURs, but especially the one with the lowest. When the prominence of the EAB was increased to match the discount information, in terms of presentation and font size (see Appendix this effect strengthened. Less impact was apparent from the introduction of the explanatory text in the footnote.

Figure 4: Advertisement ratings by brand in Stage 1 of Study 2



To test the statistical significance of these changes we fitted mixed effect ordinary least squares models to the raw scores, with a random effect on the intercept, such that individuals were assumed to vary normally in their propensity to give high or low ratings. Very similar results arise if the ratings are treated not as a continuous variable but as seven ordered categories, or if the assumption of normal variation between individuals is relaxed and a fixed effects model employed. Table 3 shows the results of a model where the rating was regressed on the brand and condition, plus the interaction between the two, controlling for the background picture and order of presentation (neither of which was a significant factor in ratings).

Table 3: Mixed effect model for Stage 1 in Study 1, estimated by OLS. The dependent variable is the advertisement rating.

	(1)
<i>Condition (Ref = no EAB)</i>	
EAB	-0.75*** (0.273)
EAB (Large)	-1.25*** (0.273)
EAB (Large + Footnote)	-1.325*** (0.273)
<i>Brand (Ref = Energia)</i>	
SSE Airtricity	0.125 (0.273)
Bord Gáis	0.225 (0.273)
Electric Ireland	-0.5* (0.273)
<i>Interaction EAB*Brand</i>	
EAB*SSE Airtricity	-0.025 (0.386)
EAB*Bord Gáis	0.850** (0.386)
EAB*Electric Ireland	2.150*** (0.386)
<i>Interaction EAB (Large)* Brand</i>	
EAB(L)*SSE Airtricity	0.400 (0.386)
EAB(L)*Bord Gáis	1.450*** (0.386)
EAB(L)*Electric Ireland	2.950*** (0.386)
<i>Interaction EAB (L+F)* Brand</i>	
EAB(L+F)*SSE Airtricity	0.500 (0.386)
EAB(L+F)*Bord Gáis	1.700*** (0.386)
EAB(L+F)*Electric Ireland	2.925*** (0.386)
Constant	4.71*** (0.134)
Picture Controls	YES
Order Controls	YES
<i>Random effects parameters</i>	
Var(constant)	0.197 (0.065)
Obs.	640
Participants	40

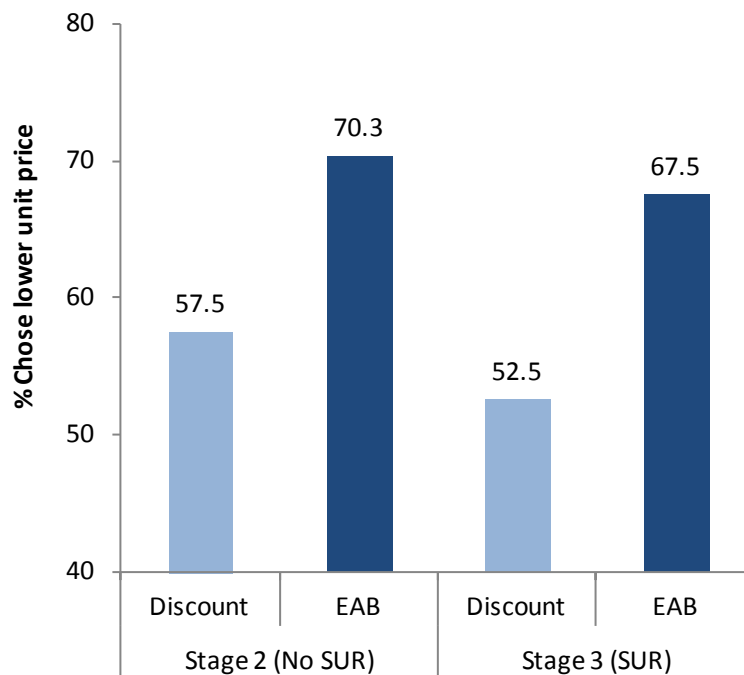
Standard errors in parentheses; *p<0.1, **p<0.05, ***p<0.01

The increasing negative coefficient as the intervention strengthened across the different conditions relates to the reference supplier only, which had the highest SUR. This confirms that the presence of the EAB information reduced the ratings for this supplier significantly.

The coefficients on the interactions between brand and condition reveal that the increase in ratings for the two suppliers with lower SURs, relative to the reference supplier, was also statistically significant. Tests for equivalence between coefficients further reveals that while the largest effects were associated with the introduction of the EAB information in the second round of ratings, the additional effect of increasing the font size was also statistically significant ($p < 0.01$), while the impact of the explanatory footnote text was non-significant. Analysis of individual differences revealed that ratings and changes to ratings were unimodally distributed across participants, implying that the results were not driven by a small subset. Across the conditions, 34 of the 40 participants increased their rating for the supplier with the lowest SUR relative to the supplier with the highest.

Stages 2 and 3 were analysed in a similar fashion to Study 1. Figure 5 provides descriptive data. The EAB price frame appears to have had a substantial impact on the likelihood of choosing the lower unit price. The effect size is similar to that observed in Study 1, where the discount price frame was compared with a PUR price frame. Again, the difference between the price frames continues despite the provision of the SUR information in Stage 3.

Figure 5: Proportion opting for lower unit price package by price frame in Stages 2 and 3 of Study 2.



We again fitted MEL models, where the dependent variable was whether the participant chose the lower unit price package and participants were assumed to vary normally in their relative weighting of the unit price versus the other attributes. Table 4 reveals a number of interesting and statistically significant effects underlying the descriptive data.

Table 4: Mixed effect logit (MEL) models for Stages 2 and 3 in Study 2. The dependent variable is whether the participant chose the package with lower unit price.

	(2)	(3)
EAB	0.624*** (0.069)	-0.106 (0.146)
Unit price difference	0.419*** (0.041)	0.235*** (0.052)
Stage 3 (SUR)	-0.192*** (0.069)	-0.216** (0.069)
Discount first	0.129 (0.107)	-0.076 (0.107)
<i>Interactions</i>		
EAB* Unit price difference		0.454*** (0.084)
EAB*Stage 3 (SUR)		0.049 (0.139)
EAB*Discount first		0.456*** (0.139)
Constant	-0.253** (0.099)	0.072 (0.115)
<i>Random effects parameters</i>		
Var(constant)	0.068 (0.026)	0.070 (0.027)
Obs.	3,840	3,840
Participants	40	40

Model (2) shows that the EAB price frame significantly increased the likelihood of opting for the lower unit price relative to the discount price frame (the reference case), controlling for the unit price difference, which was unsurprisingly also significant.⁶ This model also confirms that the general decrease in the likelihood of choosing the lower unit price in Stage 3, once SUR information was supplied, was significant. We return to this result in the discussion. The introduction of interaction terms in Model (3) offers greater insight. The significant interactions between price frame and the unit price difference implies that under

⁶ This variable was not included in the equivalent analysis for Study 1 because there were participants who always opted for the lower PUR in some conditions, regardless of the PUR difference between offerings. In Study 2, the additional attributes ensured greater variability in choices, such that in no condition did any participant always chose the lowest unit price, allowing variation in sensitivity to unit price differences to be analysed in the models.

the EAB price frame participants increased the weight they gave in their decision to the difference in unit price between the two offerings. The significant interaction between the price frame and the order of presentation adds a further effect. Those participants who encountered the discount price frame first displayed a greater difference between the two price frames. This may indicate a degree of learning by those who were shown the EAB price frame first, or perhaps a desire on behalf of those shown the discount price frame first to punish suppliers whose high discounts were revealed to be poorer indicators of unit price.

Analysis at the level of individual participants and brands was consistent with the general picture. The proportion of decisions in favour of the lower unit price was unimodally and smoothly distributed across participants, with 33 of the 40 participants more likely to choose lower unit rates under the EAB price frame. The EAB price frame also produced a clear swing in choices away from the suppliers with higher SURs and toward the supplier with the lowest SUR in particular.

Turning to Stage 4, the S-ID task, Figure 6 plots the probability that participants determined that the package on the right was better for the buyer, as a function of the size of the effective surplus, expressed as a proportion of the price range. The sigmoid function demonstrates that participants were better able to perform the task the greater the available surplus in favour of either the left- or right-hand package. These descriptive data also suggest that the EAB price frame increased the precision of participants' judgements, at least for larger surpluses.

Figure 6: Probability of determining that the package on the right was the better package for the buyer as a function of the surplus, in Stage 4 of Study 2.

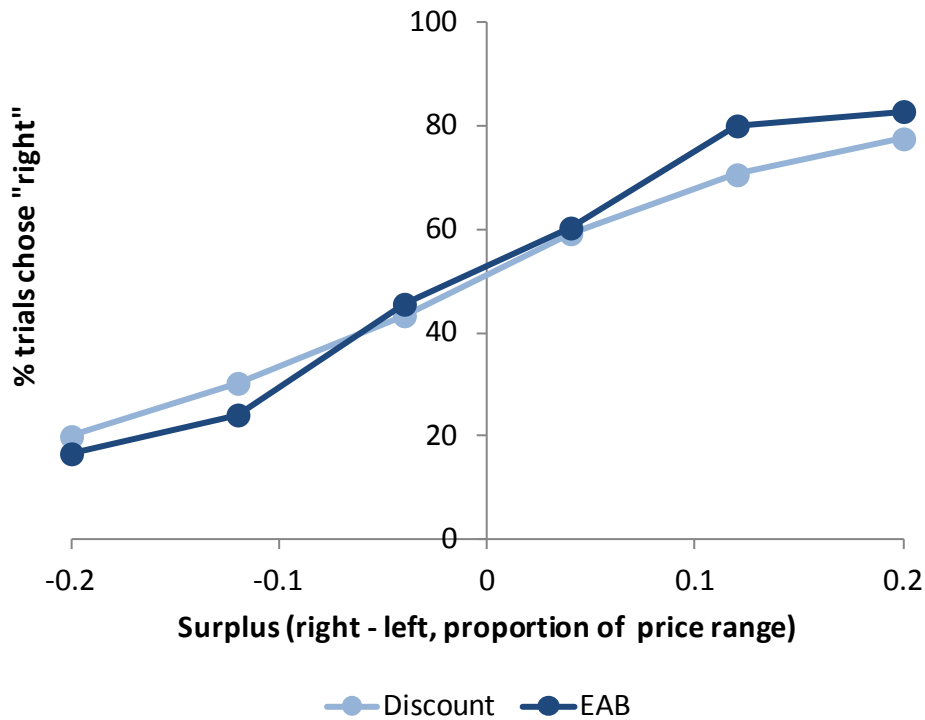


Table 5 presents MEL models for the likelihood that the better offering for the buyer was correctly identified, with participants assumed to vary normally in their ability to identify the surplus. Fixed effects models that relax this assumption produce very similar results. Model (4) confirms the relationship between the size of the surplus and the likelihood of choosing the right package. It shows that the improvement in the precision of judgements under the EAB frame was statistically significant. Model (5) interacts the price frame with the size of the surplus and confirms also that the statistically significant improvement in precision was limited to the two larger categories of surplus. Model (6) adds a variable for whether the participant was buying for the elderly relative (low usage) or family (high usage). This produces a marginally significant difference, suggesting that the EAB price frame may have been slightly more helpful for judging the lower usage packages ($p < 0.1$).

Table 5: Mixed effect logit (MEL) models for the SI-D task, Stage 4 in Study 2. The dependent variable is whether the participant correctly identified the better offering for the buyer.

	(4)	(5)	(6)
EAB	0.198*** (0.069)	-0.410*** (0.122)	0.545*** (0.140)
<i>Surplus (Ref=0.12)</i>			
0.04	-0.747*** (0.081)	-0.539*** (0.112)	-0.540*** (0.112)
0.20	0.399*** (0.090)	0.459*** (0.123)	0.460*** (0.123)
High usage			0.148 (0.113)
<i>Interactions</i>			
EAB*0.04		-0.433*** (0.162)	-0.433*** (0.162)
EAB*0.20		-0.129 (0.182)	-0.129 (0.182)
EAB*high usage			-0.270* (0.138)
Constant	0.960*** (0.075)	0.851*** (0.199)	0.788*** (0.103)
<i>Random effects parameters</i>			
Var(constant)	0.068 (0.026)	0.070 (0.027)	0.037 (0.019)
Obs.	4,320	4,320	4,320
Participants	40	40	40

4.4 Discussion

The broad pattern of these results favours the EAB intervention. Experimental participants were more inclined to judge that adverts were good value, in line with their actual unit prices, when EAB information was added. This effect increased in size when the EAB information was made more prominent. The choice task demonstrated that, compared to the discount price frame, the EAB price frame makes opting for the lower unit price package more likely, by strengthening the weight given to the unit price in decisions. Lastly, the S-ID task revealed that participants were able to integrate product information more precisely under the EAB price frame.

There are a couple of secondary findings, however, that are not straightforward to explain. First, there was a general reduction in the proportion of decisions favouring the low unit price in the choice task once the SUR information was provided (Stage 3). One tentative explanation for this may be that the SUR information added a degree of confusion, given that by this stage participants already had two different indicators of unit price. Consequently, they may have reduced the weight they placed on unit price information relative to the other attributes, which they could be more sure of. Second, and perhaps more problematically, the additional precision associated with the EAB price frame was confined to larger surpluses. This effect almost certainly relates to the relative weighting given to the fixed and unit components of the price. To give an example, suppose a consumer who uses 4,000 kWh is choosing between package A with a unit price of 17.5c and package B with a unit rate of 18.5c, but that package A offers €50 cash-back while package B offers €100. Assuming no difference in standing charges, the EAB for package A will be €3 lower than the EAB for package B [for A $(5,300 \times 0.175) - 50 = \text{€}77.50$; versus B $(5,300 \times 0.185) - 100 = \text{€}80.50$], pointing to package A as the better deal. Yet for the below average user, package B results in a lower overall bill [for A $(4,000 \times 0.175) - 50 = \text{€}50$; versus B $(4,000 \times 0.185) - 100 = \text{€}40$]. The key point is that the EAB is a perfect indicator for average usage only. The further usage is from average and the larger the differences in the fixed components of the price, the less reliably the EAB signals the lowest overall price. In the present experiment, ranges closely matched the market in summer 2016 and this source of imprecision affected only marginal decisions (small surpluses). However, if variation in cash-back or standing charges between suppliers were to increase markedly, this would affect the reliability of the EAB as a signal of good value for consumers with usages away from the average.

5. General Discussion

The two experimental studies provide support for two separate but related conclusions. First, Study 1 implies that unit energy prices expressed as discounts from standardised rates that vary by supplier are likely to cause consumers problems. We presented experimental participants with multiple binary decisions, in which they had only to trade-off their brand preferences and a unit price. They were asked to choose the package they preferred and incentivised to respond consistently. Yet they were unable to do so. When confronted with discounts from variable unit rates, participants choices were hardly influenced by unit prices.

In contrast, when the unit price was made explicit in the offering, participants chose the lower unit price regularly. This pattern was reduced somewhat but nevertheless remained strong even once participants had standard rates for each supplier presented alongside the offers, which is likely to be an unrealistically helpful situation when compared with the context of many real life consumer decisions. The findings are consistent with the operation of a psychological mechanism that gives greater weight in decisions to explicit information or to attributes that do not require a process of calculation or estimation to gauge. While it is impossible to be completely sure that choices made when the unit price was explicit were more representative of consumers' true preferences than choices made when the unit price was discounted, the greater likelihood of choosing packages with cheaper unit prices under the former price frame makes this conclusion hard to avoid. Thus, the implication of Study 1 is that the marketing practice of discounting unit prices from variable standard rates, which is ubiquitous in the Irish energy market, reduces price transparency and is likely to be detrimental to consumer decision-making.

Second, Study 2 provides empirical support for the view that the introduction of a mandated EAB is likely to make it easier for consumers to choose cheaper electricity packages from among available offerings. The EAB is an approximate indicator of price, since it is calculated for a consumer with average usage and becomes less accurate as an indicator the more an individual consumer's usage departs from the average. Nevertheless, the evidence generated here implies that the EAB is likely to result in consumers placing greater weight in their decision-making on the unit price, with the net result that they are more likely to choose cheaper packages. The presence of the EAB also increases the precision of decisions, by helping consumers to integrate product information. In sum, the evidence suggests that the proposed intervention is, on balance, likely to be beneficial for consumer choice.

Some caveats are, naturally, in order. Firstly, it is always reasonable to consider the extent to which laboratory experiments have environmental validity. The designs employed in the present investigation were designed to test consumers' capabilities and to uncover aspects of the mechanisms underlying consumers' choices, not to mimic real life decision-making. We would argue that, given the decisions we asked experimental participants to make and the systematic patterns in the data they generated, the decision-making mechanisms engaged by our tasks are likely also to be employed in consumers' everyday lives. Secondly, there is some suggestion in our data and in the logic of mixing fixed with unit prices, that a mandated

EAB might be less effective in the event that fixed price components such as cash-back develop greater variability in the market. The reliability of the EAB also depends on the accuracy of the average usage specified for its calculation. Thirdly, this investigation considered only the impact of the EAB intervention on consumer choice; we assumed that other aspects of the market would remain unchanged. It is possible, however, that suppliers would alter marketing strategies and price frames in response to the introduction of a mandated EAB. Such strategic responses were not studied here. Lastly, since we addressed only consumer choice, no costs associated with the proposed intervention were considered. Any costs need to be appropriately weighed against likely benefits, for which the present investigation provides evidence.

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Appendix A: Examples of the Experimental Environment in Study 1

Figure A1: Example displays for Stages 1 and 2 in Study 1. Participants chose between offerings described only by brand and price, expressed as a discount or as a PUR.



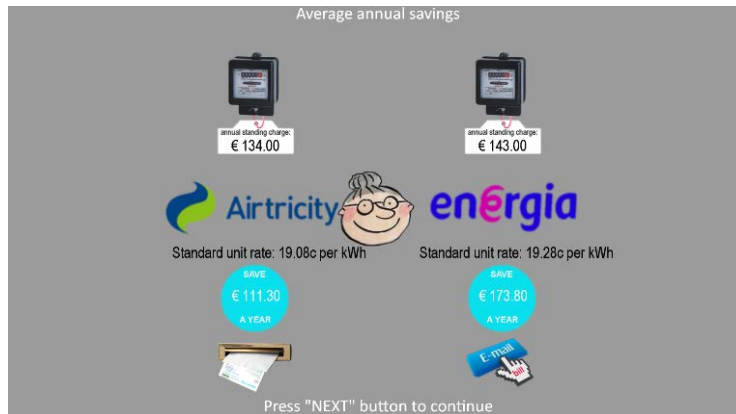
Figure A2: Example display for Stage 3 of Study 1, when SUR was provided.



Figure A3: Example display for Stage 4 of Study 1. Offerings differed by brand, unit cost, standing charge and whether the bill was paperless.



Figure A4: Example display in Stage 5 of Study 1, showing feedback on selecting the “correct” option preferred by the buyer..



Appendix B: Examples of the Experimental Environment in Study 2

Figure B1: Example advertisements used in Stage 1 of Study 2. The top advert includes EAB information in a smaller font below the discount information. The bottom advert includes EAB information of equivalent prominence and an explanatory footnote.



Figure B2: Example display for Stages 2 and 3 in Study 2. Participants chose between offerings described by brand, standing charge, cash-back, a promotional football shirt and a unit price, expressed either as a discount or as an EAB.



Figure B3: Example displays for Stage 4 in Study 2. Participants had to choose which of two offerings would be preferred by a family (high use) or elderly relative (low use) and received feedback on their decisions.



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