Do Consumer-Directed Tax Credits Effectively Encourage Green Investment? Experimental Evidence of Conditional Success

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ABSTRACT

We investigate whether consumer-directed tax credits effectively motivate green investment by manipulating the form of purchase inducement (tax credits *versus* sales discounts *versus* net pricing). In our experiments, consumers choose between relatively expensive energy-efficient products ("green" products) and less expensive standard products. Consistent with negative views toward taxation (Moon 2009) and intuitive "Type 1" mental processing (Evans and Stanovich 2013), when the price difference between green and standard products is small, tax credits are an ineffective way to encourage green investment. Conversely, when the price difference between green and standard products is large, tax credits are relatively effective at encouraging green investment. We detect tax-credit-specific evidence of deliberative "Type 2" mental processing (*ibid*) when green products are relatively expensive, consistent with decision-makers who more fully consider factors that influence a relatively difficult choice. Our results suggest that tax policy can be improved by considering the economic setting of tax-incentivized items.

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I. INTRODUCTION

Tax incentives are frequently used by governments at all levels to encourage socially

desirable investment[1], but documenting direct cause-and-effect relationships attributable to tax

incentives is econometrically challenging when analyzing information from the natural world

(Hines 1998; Hanlon and Heitzman 2010). Given the prevalence and annual magnitude of tax

incentives, it is somewhat surprising that little direct evidence supports their basic economic

efficacy.[2] In this study, we capitalize on the advantages of experimentation in order to focus on

the ability of consumer-directed tax credits to encourage green investment relative to traditional

retail promotions (e.g., price discounts) that offer equivalent price concessions. To the extent that

individuals find tax credits aversive relative to alternative purchase inducements, subsidizing

intermediate taxpayers (e.g., manufacturers and retailers) and allowing these intermediaries to

pass price reductions on to consumers is a sensible policy choice, all else being equal.

Unfortunately, intermediary taxpayers often retain substantial portions of governmental

incentives that are intended to stimulate end-user consumption (Goolsbee 1998). As such, if

consumer-directed tax credits are no less effective than standard retail promotions or net pricing

at encouraging desired behavior, we argue that consumer-directed tax credits are a sensible

policy choice.

We further contend that public policy can be improved by identifying market conditions

that are more versus less amenable to specific types of government tax incentives. Based on dual

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[1] Socially desirable behavior is defined as behavior benefitting the economy, the environment, or the social fabric of the tax base. Examples include tax credits for research and development activities (economically beneficial), energy-efficient products (environmentally beneficial), and higher education (beneficial to the social fabric of the tax base).
[2] The annual magnitude of U.S. tax incentives is large. Based on a five-year average, individuals claim over $88 billion in total tax credits per year (through 2013, the most recent IRS Publication 1304 available). Residential Energy Credits (the setting of our experiments) average over $3 billion per year, with a low of $1.3B in 2012 and a high of $6.1B in 2010.

process theories of cognition – which distinguish intuitive, automatic, or heuristic-based "Type 1" thinking from deliberative, logical, or reason-based "Type 2" thinking (Evans and Stanovich 2013; Evans 2012a) – consumers' perceptions of tax credits (and by extension, how consumers are influenced by tax credits) should vary based on the difficulty of the market choice they encounter. Although green investment has perceived societal benefit beyond basic financial value (Martin and Moser 2015), in situations where a green investment choice should be relatively easy (e.g., when green investment is only marginally more expensive than a standard alternative), aversive views of the U.S. tax system (Hardisty, Johnson, and Weber 2010; Moon 2009) will partially inhibit a relatively straightforward decision. This expectation is consistent with dual process theories' Type 1 responses, which are generally automatic, associative, and based on highly accessible features of the decision context (Griffith, Kadous, and Young 2015). To use a marketing analogy, we believe tax credits, while appealing for the subsidy value that they offer, will trigger aversive expectations (e.g., administrative tedium), similar to relatively cumbersome retail promotions such as mail-in rebates, which have been shown to inhibit purchasing intentions compared to immediate sales discounts (Munger and Grewal 2001; Davis and Millner 2005).

In contrast, we expect that more difficult product choices (e.g., when green investment is substantially more expensive than a standard alternative) trigger more deliberative Type 2 decision making (Evans 2012a) as consumers more fully consider the costs and benefits of their product choice. When engaged in Type 2 thinking, consumers engage working memory and should place greater emphasis on value perceptions associated with green investment (such as future cost savings), thereby minimizing automatic, associative aversion to a tax context. In total, we expect that tax credits will become competitive with typical retail promotions in terms of

2

encouraging targeted purchases when the decision choice that consumers make is relatively difficult.

Our experimental investigation allows us to control features of the decision environment (e.g. the product choice set and tax subsidy delivery method) which complicate the analysis of data from the natural world.[3] In two laboratory experiments, we evaluate individual purchase intentions in response to various subsidies offered on green investments that have higher prices than standard, "non-energy-efficient" alternatives (e.g., high-priced energy-efficient HVAC systems vs. low-priced standard HVAC systems). We manipulate consumer-directed purchasing incentives (tax credits, mail-in rebates, price discounts, and reduced net-pricing), but hold the dollar value of the incentive constant across these formats. We also manipulate the magnitude of the price difference between green and standard products (at high vs. low levels), which mirrors conditions under which the price premium paid for innovative green investment is initially large, but declines as products mature.

Our results generally support our hypotheses. When green products are only slightly more expensive than standard alternatives, consumer-directed tax credits are significantly *less likely* to induce green investment relative to equal-valued concessions that come in the form of sales discounts and reduced net prices. This suggests that as green product costs decline (due to economies of scale and/or product maturation) and the price difference between green and standard products becomes relatively small, consumer-directed tax credits are an increasingly inefficient means to encourage green investment.[4] In contrast, we find that consumer-directed tax

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[3]For example, the perceived failure of some tax incentive programs has been attributed to the administrative offering format; see Davis (2002) on education credits and Maag (2010) on the Earned Income Credit.

[4] We highlight two related points. First, legislators anecdotally appreciate that individual tax credits may lose effectiveness over time. For example, hybrid vehicles were excluded from the tax credits offered by §30D (Internal Revenue Service 2009b) because hybrid technology was considered "sufficiently mature" (Kessler 2015). Second, to the extent that intermediary taxpayers retain substantial portions of end-user-directed tax subsidies (Goolsbee 1998), administering incentives through intermediaries (rather than end-users) is ineffective. As such, our use of the

credits are relatively effective when green products are appreciably more expensive than non-energy-efficient products, as is often the case with innovative, non-established goods (e.g., hybrid vehicles circa 2000). Consistent with dual process theories, we find evidence of Type 2 thinking when the price premium for green products is large *and* we find an idiosyncratic effect when products are incentivized by tax credits. Specifically, long-term value perceptions appear to influence green product selection the most when tax credits are the form of purchase incentive and when green product price premiums are relatively high. This effect offsets negative perceptions that make tax credits a relatively poor incentivizing mechanism in our low-price-differential settings.

From a methodological perspective, we believe this to be the first study that documents how the form of a purchase incentive can vary in effectiveness based on the relative price of the incentivized items. Given that cutting-edge products are commonly associated with high nominal introductory prices and large price differentials (relative to standard product alternatives) followed by lower price differentials as products mature, we contribute to public policy by identifying market conditions that are most amenable to government tax incentives. While recent research directly investigates the welfare effects of specific green investment subsidies (e.g., Allcott and Taubinsky 2015), our study is agnostic regarding the cost/benefit tradeoff of tax incentives. Instead, we provide guidance for when consumer-directed tax credits offer "bang for the buck" in terms of encouraging green investment. To the extent that our findings generalize beyond green investment and tax credits, our results suggests that tax subsidies directed at end consumers *can be* a relatively effective policy choice, but these incentives should either systematically sunset, be revisited at regular intervals as incentivized

term "increasingly inefficient" consumer-directed tax credits does not necessarily imply such incentives should be discontinued (e.g., better alternatives may not exist).

4

technologies mature, or automatically scale with observable market prices (if possible).[5]

The remainder of the paper is structured as follows. In the next section, we review prior literature and develop our hypotheses. We then present our experimental design and results in section three. Section four concludes.

II. PRIOR LITERATURE AND HYPOTHESES

Tax credits have long been used by governments at all levels to encourage socially desirable behavior, but many primitive questions about the economic influence of tax incentives are unresolved. For example, although the economic logic of increased demand in response to tax incentives (i.e., price decreases) seems irrefutable, little empirical evidence exists that tax incentives increase aggregate investment (Desai and Goolsbee 2004).[6] Explanations such as economic cycles (i.e., endogenous tax incentives are offered during slack economic times), inelastic supply (i.e., quantities purchased are unable to change in response to tax incentives), and product substitution (i.e., increases in tax-favored investment are offset by decreases in non-tax-favored investment) have been offered to explain the lack of success in documenting a link between tax incentives and investment using aggregate data (Hanlon and Heitzman 2010). A more troubling possibility is that intermediary recipients of tax incentives simply retain government subsidies, leaving consumer demand unaffected. Goolsbee (1998) provides partial support for this explanation, noting that suppliers retain 35% to 70% of investment subsidies intended to stimulate end-user capital equipment purchases.

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[5] Ho (2016) argues that the solar investment tax credit is "smart" because the effect of the tax credit per watt of produced power becomes smaller as solar power becomes more efficient.
[6] Similarly, archival sales and marketing research suggests price promotions have a negligible long-term effect on brand sales (Jedidi, Mela, and Gupta 1999; Nelslin 2002). Thus, failure to empirically document an intuitive cause-and-effect relationship between price reduction and increased consumption in the natural world is not restricted to the tax incentive literature.

We seek to inform tax policy and avoid macroeconomic measurement issues by investigating the *relative effectiveness* of consumer-directed tax incentives compared to alternative purchase inducements. We note that all non-consumer-directed tax incentives speak to the primary policy alternative. To explain, a well-intentioned government can either (1) subsidize the end user directly (e.g., consumer-directed tax credits) or (2) subsidize an intermediary taxpayer, such as a manufacturer or wholesaler, who ostensibly lowers prices charged to end users. If consumers are averse to tax-related incentives relative to equal-valued alternatives such as sales discounts, then all else equal, intermediary-directed tax incentives would be the preferred policy choice. However, because intermediary taxpayers tend to retain large portions of government subsidies (Goolsbee 1998), consumers are left with only a fraction of government-intended incentives when incentives pass through intermediary taxpayers. As such, consumer-directed tax incentives become a more preferred policy choice if consumers are not averse to tax-related incentives. Below, we discuss why consumer-directed tax credits might be *relatively* unattractive to individuals in some settings, but not in others.

Prior research in psychology and marketing finds that the form of price concessions impacts purchasing behavior. Consistent with prospect theory, Thaler (1985) provides evidence that segregating price discounts from gross prices encourages consumer spending through a "silver lining effect" that draws specific attention to the loss reduction afforded by the discount relative to a baseline "net price" format. Subsequent studies (Munger and Grewal 2001; Davis and Millner 2005) find further variation in purchase intentions based on the form of purchasing incentives offered to consumers; specifically, sales rebates are less effective than conventional (and mathematically equivalent) price discounts. This "rebate aversion" exists because consumers expect to spend more time and encounter greater difficulty when submitting rebate

claims compared to more immediate promotional methods. Intuitively, the relatively cumbersome administrative and delay aspects of tax credits would make consumer-directed tax credits more similar to marketing rebates, as opposed to price discounts, in terms of rank-ordering the desirability of price concessions.

Although heuristic choices have been shown to operate when large dollar amounts are involved (Lacetera, Pope, and Sydnor 2012), it is possible that the incentive format effects found in "small-dollar" rebate vs. discount marketing settings (e.g., the *chocolate bars* investigated by Davis and Millner 2005) will not apply to "large-dollar" settings. Consumer-directed tax credits are typically sizeable and apply to relatively expensive purchases (as they do in our study). We are unaware of research comparing tax credits to other purchase incentives (e.g., standard marketing incentives); however, U.S. taxpayers have idiosyncratic and largely negative views about tax-related issues (Hardisty et al. 2010) and the vast majority of taxpayers find the federal income tax process, of which tax credits play a part, to be administratively complex (Moon 2009). Based on the preceding, we predict:

> **H1:** *Ceteris paribus*, consumer-directed tax credits will be ineffective at encouraging green investment relative to equal-sized, immediate non-governmental purchase inducements such as sales discounts.

A primary contribution of this study relates to the "all else equal" nature of H1. To explain, when a consumer considers green investment, fundamental economic principles clearly dictate that price matters and larger subsidies are more appealing than smaller subsidies. We argue that another critical and generally underappreciated factor in this purchasing decision is the net price of a subsidized, energy-efficient product *relative* to the price of an unsubsidized (i.e.,

non-energy-efficient) alternative. Consistent with this notion, dual process theories[7] suggest that

the use of cognitive heuristics will vary based on the form of incentive offered (consistent with

H1) *and* based on the difficulty of the choice at hand. While many qualitative and quantitative

factors might contribute to the difficulty of a real-world purchasing decision, we experimentally

operationalize choice difficulty via the size of the price premium between green and standard

product alternatives.[8] Thus, we place choice difficulty on a monetary scale that is both easily

recognized and objectively measurable.

In our experimental setting (which we describe in greater detail in the next section), we

offer a green product and a standard product, both of which perform the same basic function

(e.g., heating and air systems). These options only differ in that the green product offers a

socially desirable benefit that the standard product does not (i.e., energy savings), but this benefit

comes at a price that we manipulate to be either slightly or markedly more expensive than the

standard product. At low price differentials, the future energy savings and/or the environmental

benefits of green investment would likely dominate the small price premium for most decision

makers. Observing that a high percentage of consumers select green investment would be

consistent with the choice overload literature (Chernev et al. 2010; Townsend and Kahn 2014)

because a dominant choice precludes decision conflict (thereby avoiding overload).

Alternatively stated, dual process theories suggest that a "small price difference" decision is a

fairly straightforward Type 1 decision for which little deliberative reasoning is required.

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[7] Dual-process theories is plural given that numerous philosophers and psychologist developed, largely in ignorance of one another, very similar ideas (Evans 2012a). Put more simply, "there is, in fact, no singular agreed version of dual-process theory" (Evans 2012b; p. 23).

[8] Because a high price can be an indicator of product quality (Monroe and Krishnan 1985; Rao and Monroe 1988; Zeithaml 1988; Leavitt 1954), we manipulate price differences by adjusting the price of the *standard* product. This avoids altering baseline perceptions of the green product that are unrelated to comparative price differentials.

Although extensive evidence from social neuroscience supports the view that implicit vs. explicit forms of judgment activate different parts of the mind (see Lieberman 2007 for a general review and Farrell et al. 2014 for a recent application in accounting), such activation is *not* an "all or nothing" trigger. Specifically, Type 1 intuitive responses serve as a default which may or may not be moderated by subsequent intervention with deliberative, Type 2 reasoning (Evans 2012a, Stanovich 2009). In our experimental setting, purchasing decisions become more difficult for the average consumer as the relative prices of green versus standard products diverge. At high price differentials, the consumer must weigh the perceived benefits of socially desirable investment (some of which may be difficult to quantify) against a much larger and easily identifiable sacrifice of current wealth. Such a comparison will likely force consumers to engage in more deliberative Type 2 thinking and carefully consider myriad factors such as expected utility cost savings, comparative product durability, current household budget constraints, etc. In short, dual process theories suggest that deeper thoughts involving working memory will occur for such relatively difficult choices.

To be clear, we expect fewer energy-efficient purchases when the price premium for green investment increases (consistent with economically rational behavior); however, we also expect that deliberative Type 2 thinking will lead decision makers to more fully consider important elements of their decision. While economic costs and benefits almost certainly come into play, both prior research and industry practice suggest that consideration of "tax savings" can accentuate non-negative thoughts about tax credits.[9]

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[9] For example, Ayers et al. (1999) and Bobek et al. (2007) investigate why individuals deviate from economically optimal behavior and systematically over-withhold interim tax payments above safe harbor levels, despite guaranteed increases in investment income and the relative ease of making safe harbor adjustments. Bobek et al. (2007) explain that the emotional benefits of over-withholding, of which anxiety reduction and personal enjoyment of refund checks are both major components, offset direct financial concerns that have been considered by decision makers (i.e., they do not detect a naïve emotional reaction). Recent industry anecdotes also suggest that tax-related incentives might have relative attraction to consumers. For example, Lowe's Home Improvement's 2011 "tax refund

We posit that aversive aspects of tax credits will take on less importance as decision makers give deeper consideration to a relatively difficult choice, thereby making tax credits more effective (or, alternatively, less aversive) when the relative price of green investment is high. When green products are only marginally more expensive than lower-priced standard products, we expect tax credits to be relatively ineffective purchase inducements because the aversive aspects of tax compliance disturb what is otherwise likely to be an easy Type 1 choice (H1). In contrast, when green products are significantly more expensive than lower-priced standard products, we expect fewer overall energy-efficient purchases (due to basic laws of price and demand), but we also expect decision makers will engage in more rigorous comparison on multiple attributes, a feature of Type 2 thinking (Kahneman 2011, p. 36). This additional consideration should mitigate concerns over reactionary negative tax compliance issues (e.g., administrative burden and time delay) and accentuate more positive aspects of tax credits (e.g., future tax savings and environmental benefits), thereby putting tax credits on more equal footing with alternative purchase inducements. Formally, we posit:

> **H2:** *Ceteris paribus*, relatively large price differences between green and standard products will reduce the advantage of non-governmental immediate purchase inducements (e.g., sales discounts) over tax credits in terms of encouraging green investment.

To clarify, H2 is not driven by the marginal cost and benefit of the purchase incentive offered. Instead, we posit the *relative price difference* between green and standard products (which is analogous to "novel" versus "mature" technology) will differentially impact consumer

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card" advertising campaign offered to match 10% of each customer's prepaid balance on gift cards purchased within a designated promotional period in February and March. While this advertising campaign had little to do with taxation (other than the title and time of year), the practice-based belief that "tax refund" labeling might encourage consumer purchasing is not an isolated event.

choice. To explain, we expect that most consumers believe the marginal cost of claiming tax credits exceeds the marginal cost of claiming a sales discount (this is one way to frame the tax aversion prediction in H1). However, the offsetting benefit has constant nominal value across conditions (e.g., a $700 tax credit / sales discount / mail-in rebate) and this price incentive relates to a consistently-priced green product. As such, the marginal cost and benefit of the purchase incentive remains constant regardless of whether the relative price difference is small (the "easy decision" setting of H1) or large (the "more difficult" choice contemplated by H2).

To the extent H2 is supported, we should be able to detect additional evidence of Type 2 thinking (i.e., evidence beyond relative changes in purchase intentions). We attempt to gather such evidence by capturing process variables related to the perceived long-term value of the purchase options available to consumers. We focus on two fundamental value-related components of energy-efficient product quality, expected cost savings and product durability, and note that their joint product produces an estimate of quantifiable future benefits. Similar to prior studies that depict price as a product quality cue (Monroe and Krishnan 1985; Rao and Monroe 1988; Zeithaml 1988; Leavitt 1954), if relatively high price differentials cause enhanced consideration of an energy-efficient product's long-term value, we should see evidence to this effect regardless of price concession format.[10] Formally:

> **H3:** *Ceteris paribus*, when relative price differentials between green and standard products are large, future cost savings and expected durability play a larger role in green investment decisions.

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[10] We do not claim that measured long-term value perceptions comprehensively capture Type 2 thinking. Rather, we claim that deeper analytic thought is likely associated with differences in value perceptions. Alternative proxies for Type 2 thinking include (1) monitoring activity in the lateral prefrontal cortex (see Farrell et al. 2014, p. 1986) and (2) assessing incremental time spent per decision when Type 2 thinking is expected. Unfortunately, we do not have these measures. We do, however, capture a decision-by-decision assessment of green-versus-standard product quality, which offers an alternate (albeit less experimentally clean) view of Type 2 thought process. We discuss this alternative means of capturing Type 2 thought processes in our results section.

We (again) note that support for H3 would not be attributable to changes in the underlying green investment option because green product prices are held constant. Any change to the value perception of the green product is attributable to the manipulated price of the standard alternative product.

Regarding our value-based process variables and price concession formats, both H1 and H2 predict a unique level of analytic processing when tax credits are the incentive form. Thus, similar to our discussion of H3, to the extent *both* hypotheses are supported we should be able to detect additional evidence of Type 2 thinking for conditions involving tax credits, regardless of price differentials, that is *not* present for conditions involving more immediate purchase inducements. This would be consistent with Pennycook et al. (2015), who find that conflict detection is an important low-level cognitive factor that causes at least some people to engage in some level of analytic reasoning. In our setting, the aversive aspects of the tax system (Moon 2009) likely present some level of conflict regarding the purchase of green products incentivized by tax credits. Further, when comparing consumer-directed tax credits to alternative purchase incentives, only tax credits connote an implicit government endorsement for green investment (e.g., sales discounts do not convey authoritative support for a product). Prior research has shown that brand name and store reputation can enhance views of perceived quality (Rao and Monroe 1989; Dodds et al. 1991) – it is similarly possible that tax credits uniquely lend weight to the long-term value perceptions of green investment options. Specifically, we expect:

> **H4:** *Ceteris paribus*, when green products are incentivized by tax credits as opposed to immediate non-governmental incentives, future cost savings and expected durability will play a larger role in green investment decisions.

III. EXPERIMENTAL METHODS AND RESULTS

Experimental Setting

To test our hypotheses, we use green investment as the topical setting for two laboratory experiments. In addition to being a frequent target for tax policy,[11] green investment is of current interest in terms of voluntary financial disclosure (Martin and Moser 2015) and social welfare (Allcott and Taubinsky 2015; Allcott, Mullainathan, and Taubinsky 2014). Given that environmental concerns will likely remain critical for generations (Oreskes 2014), government sponsorship of green investment is likely to grow over time.[12] From a practical perspective, incentives related to consumer-directed green investment are easily understood.

To illustrate, consider the choice between a green heating, ventilation, and air conditioning (aka "HVAC") system and a standard system. Dual process theories suggest that the price of the *standard* HVAC system fundamentally influences purchase option consideration. On one hand, the choice might be relatively simple and automatic, characterized by Type 1 thinking (Evans 2012a; Evans 2012b), if the green HVAC system has a subsidized net price of $7,300 and is compared to a standard alternative priced at $7,100.[13] In this case, the future energy savings and/or the environmental benefits of green investment would likely dominate the small price premium for most decision makers.

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[11]Our experimental examples stem from the Energy Policy Act of 2005, which added Section 25C to the Internal Revenue Code and provided consumer-directed tax credits for qualified energy-efficient residential improvements (Internal Revenue Service 2009a).

[12] Recent consumer-directed, energy-efficient tax credits are already large in dollar amount. The 2012 extension of Section 25C contains over $18 billion in expected future credits (Deloitte 2013).

[13] Unlike Farrell et al. (2014) but consistent with Griffith et al. (2015), we do not use Kahneman's (2011) popular "System 1 vs. System 2" labeling (Stanovich and West 2000; Kahneman 2011) because multiple cognitive systems underlie the performance observed in dual-process tasks (Evans 2012b). Specifically, System 1 is not responsible for all Type 1 processing (*ibid*) and, germane to this study, System 1 is typically associated with decision bias. In contrast, the more general Type 1 processing can lead to "good" normative answers (our predictions do not rely on any form of negative decision bias associated with Type 1 cognitive processing) and Type 2 processing is not equivalent to "normatively correct" decision making (our experiments examine purchasing intentions that cannot be categorized as normatively correct or incorrect).

Integrating dual process theories with the Thaler (1985) "silver lining effect," the prediction is that a green HVAC system will become *more* appealing if the net price of $7,300 arises due to a gross price of $8,200 offset by a $900 sales discount. We note this process is based on heuristic, Type 1 thinking. However, replacing the $900 *sales discount* with a $900 *mail-in rebate* should have a negative effect (Munger and Grewal 2001, and Davis and Millner 2005), again for reactionary, heuristic reasons (e.g., rebates are "cause for pause" in an otherwise easy decision).[14] Our H1 prediction is based on tax credits having reflexive, Type 1, negative responses – similar to what rebates have been shown to produce.

In contrast to the preceding "easy choice" example, as the relative prices of green versus standard products diverge, the purchasing decision becomes more difficult for the average consumer. To illustrate, if the net price of the green HVAC system remains at $7,300[15] but the standard HVAC system is now priced at $5,400, then consumers will likely engage in more deliberative Type 2 thinking and carefully consider myriad factors such as expected utility cost savings, comparative product durability, current household budget constraints, etc.

Experiment 1 Design and Participants

In our first experiment, we utilize a 4×2 repeated measures design, with price concession (tax credits, discounts, mail-in rebates, and reduced net pricing) and the relative price differential between green and standard products (high versus low differential) as manipulated independent factors.[16] We introduce the mail-in rebate condition for completeness, but offer no

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[14] This line of research has not considered *relative* pricing.

[15] As previously mentioned, we are not testing whether the size of a given subsidy impacts behavior (we assume it does). As in the current example, our experiments control for the raw size of a subsidy while varying its format and we manipulate *price differential* by changing the price of the standard product. As such, we control for cost/benefit considerations associated with the time and effort required to claim a subsidy (e.g., we control for whether decision makers believe the administrative hassle associated with a $900 tax credit is "worth" $900).

[16] We establish relative price differentials by holding the nominal price of the green product constant (except for minor rounding differences, which we introduce to avoid monotony and demand effects in our repeated measures

formal expectation regarding how rebates will differ from tax credits (as previously mentioned, both are relatively slow and cumbersome purchase inducements). That said, recall that each of our non-tax credit formats (discount, rebate, and reduced net pricing) represent a best-case scenario for what an individual consumer would experience if a government agency awarded tax incentives to an intermediary taxpayer who passed *the entire subsidy* on to end consumers by lowering price. As such, comparisons between the tax credit and alternative price concession formats have practical relevance.

Participants were recruited by Qualtrics, as part of a Qualtrics Panel, at a fixed cost of U.S. $7.10 per participant for a voluntary study that was expected to take less than 30 minutes.[17] Participants were screened to include only (1) U.S. citizens, (2) current homeowners, and (3) those at least 25 years old. As shown in Table 1, we received usable responses from 300 U.S. homeowners between the ages of 25 and 82 (mean=51), with an average of 23 years of working experience. 91 percent of our participants indicated they had previously replaced home appliances, and 78 percent indicated they had made substantial improvements to their homes. Our participants also exhibited relatively favorable environmental attitudes (mean 4.71 on a 7-point scale) and reported a high level of effort on the experimental task (mean 91.44 on a 101-point scale).

[TABLE 1]

Participants were asked to play the part of a homeowner in need of home upgrades and repairs. Each participant responded to eight scenarios (corresponding to our 4×2 design) that offered a relatively expensive green product and a relatively inexpensive standard product of

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design) and we adjust the nominal price of the standard product. In our high (low) relative price differential settings, the green product price is 33% (3%) greater than the standard product.

[17] Our Qualtrics panel provider replaced 20 participants who completed the experiment in less than 7 minutes (the average completion time was 19 minutes). We exclude these participants from our analyses.

identical brand.[18] We randomly assigned participants to one of eight Qualtrics surveys with randomly ordered questions, thereby controlling for potential order effects and ensuring even dispersion among brands in terms of our 4×2 design.[19] An example purchasing scenario is provided in Appendix 1, and the complete instrument is available from the authors upon request.

Experiment 1 Results

Our dependent variable of interest, *GREEN*, is the reported likelihood, on a 7-point Likert scale, of purchasing the energy-efficient product instead of the standard product. Figure 1 graphically displays unadjusted means for the dependent variable. In the low price differential setting, tax credits encouraged less green investment than (reduced) net pricing, sales discounts, and rebates (4.94 vs. 5.62, 5.47, and 5.21, respectively). However, as evidenced by the convergence in *GREEN* responses, tax credits became a competitive means to encourage green investment when green price premiums were large (3.98 vs. 4.05 for net pricing, 4.15 for discounts, and 4.03 for rebates). In short, Figure 1 provides visual support for both H1 and H2.

[FIGURE 1]

We formally test our hypotheses with a restricted maximum likelihood analysis.[20] Our initial results are presented in Table 2, where Models A and B use participant ratings of expected

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[18] To enhance realism, we used Trane and Carrier as HVAC brands and GE and Whirlpool as appliance brands (holding brand constant within a given choice). We observe a significant effect for product (more green HVAC selections than appliances); however, in untabulated analyses, we find no significant differences in quality perceptions between brands for either product type. As such, we omit "brand" from our formal analysis.

[19] While each participant experienced all cells of interest (i.e., high vs. low price difference × four price concession formats), we use an orthogonal Latin square order-4 design to disperse our manipulated variables that were intended to be innocuous. Specifically, product and brand (see prior note) and minor price differences (2 versions each of "large" and "small" relative price differences; see note 16) were disbursed in an effort to avoid confounding our main variables of interest. Recall the intent of these minor variations was to avoid participant monotony &/or demand effects.

[20] While each participant makes eight product choice decisions, these decisions are not strictly identical across participants. In total, 64 unique combinations are used in Experiment 1 (product/brand (4) × concession format (4) × price premium (4, two versions of high and low)). Thus, no single subject provides responses across the entire range of possibilities. Brand and "distractor" versions of price premium are distributed orthogonally (see prior note); however, missing values create difficulties for a standard ANOVA/ANCOVA analysis. To avoid these

cost savings (*CS*) and product durability (*DURA*), respectively, as constructs for the expected

utility of green investment. Consistent with H1 and prior marketing research, the coefficient

estimates for *TC* and *REBATE* are negative and significant (p<.001 and p<.02 in both models,

respectively), indicating that consumer-directed tax credits and rebates are less effective at

encouraging green investment than simple net pricing. Discounts (*DISC*) show no difference

from net pricing in their ability to influence an energy-efficient purchase (p=.180 in Model A and

p=.390 in Model B).

[TABLE 2]

Consistent with the downward sloping lines in Figure 1, the coefficient for *DIF*, a binary

variable indicating scenarios with a large green product price premium, is negative and

significant (p<.001 in both models). This simply indicates that participants are less likely to

purchase the energy-efficient product when it is relatively expensive to do so. The coefficient on

HVAC is positive and significant in both models (p=.003), indicating that participants are more

likely to make green investments in HVAC systems compared to home appliances. In support of

H2, we find a significant positive interaction for *TC*DIF* (p<.001 in both models), suggesting

that tax credits are a more effective energy-efficient product inducement when price differentials

are large.[21] This positive relationship also exists for the *REBATE*DIF* interaction (p=.005 in

Model A and p=.007 in Model B), but not for the *DISC*DIF* interaction (p=.144 in Model A and

p=.207 in Model B).

Environmental (*ENV_PROD)* and quality (*QUALITY*) assessments were captured using a

7-point Likert scale at the time of each product selection in Experiment 1 (see Appendix 1). The

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complications, we test our hypotheses using a maximum likelihood approach, which is the preferred technique when dealing with incomplete repeated measures (Everitt 1995).
[21] In an untabulated least squares means analysis, we compare mean likelihoods of selecting energy-efficient products by concession type and price premium, finding no significant differences between any pair of concessions in large price premium settings.

coefficients for *ENV_PROD* indicate that participant beliefs about the environmental benefit of green products are positively and significantly related to green investment (p<.001 in both models). Similarly, green product *QUALITY* assessment is also positively associated with energy-efficient product purchase intentions (p<.001 in both models).[22]

Our process variables of interest with respect to H3 and H4, cost savings (*CS*) and product durability (*DURA*), represent assessments regarding the quantifiable value of selecting the energy-efficient product. As illustrated in Appendix 1, *CS* is modeled as the average likelihood rating of three questions regarding the expected reduction in utility bills that would result from buying the energy-efficient product and *DURA* reflects views on product longevity. Model A in Table 2 shows that the main effects for cost savings and durability are associated (p<.001 and p<.061, respectively) with intentions to purchase energy-efficient products. Consistent with H3, Model A yields a positive and significant coefficient for the two-term interaction *CS*DIF* (p=.039), lending support to the contention that Type 2 cognitive processing occurs in our high price premium settings because expected cost savings play a more prominent role in green investment selection when consumers face a relatively difficult product decision. Consistent with H4, the positive and significant *CS*TC* coefficient (p=.016) suggests that cost savings expectations play a more prominent role in green investment selection when energy-efficient products are subsidized by tax credits. [23]

The results presented in Table 2, Model B, are similar in nature. Consistent with H3, the positive and significant coefficient on the two-term interaction *DURA*DIF* (p<.001) suggests

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[22] To ensure green investment is not equivalent to high quality product selection, we estimate a model similar to those in Table 2 using *QUALITY* as the dependent variable but find no results similar to those reported here.

[23] In untabulated analyses, we performed a median split on our participants' self-reported effort in Experiment 1 and re-performed our maximum likelihood analyses on high and low reported effort groups. While our participants reported very high effort levels (the median was 94 on a 101-point scale), we note that - generally speaking - high effort is consistent with Type 2 mental processing. Although we observed rather consistent results across both our high- and low-effort subsamples, coefficients on variables predicted by Type 2 processing are heightened in the high-effort participant subgroups. We explore this result in more detail later in our second experiment.

that product durability expectations play a more prominent role in green investment selection when consumers face a relatively difficult product decision (i.e., when the green product price premium is relatively large). Consistent with H4, the positive and marginally significant *DURA*TC* coefficient (p=.057) suggests that product durability expectations play a more prominent role in green investment when energy-efficient products are subsidized by tax credits.

We note one unexpected change relative to Model A: the main effect for *DURA* in Model B is negative and significant (p=.036). Given that Model B contains two-term interactions between perceived durability and each explicit price incentive format, this *negative* coefficient on *DURA* implies that in the reduced-net-price condition, energy-efficient purchasing is more likely when the expected durability of the product is *shorter*. Because the sales discount and rebate conditions are not significantly different from the net pricing baseline, as reflected by the insignificant coefficients on *DURA*DISC* and *DURA*REBATE* (p=.613 and p=.327, respectively), *only* when the purchase inducement is a tax credit do consumers appear to think about the durability of their energy-efficient purchase in an economically sensible manner.

We conclude our analysis of Experiment 1 by estimating an aggregate utility construct using the product of our cost savings and durability measures. The aggregate measure, *NPV*, reflects the average of the minimum and maximum estimates of total expected utility from each decision made by each participant.[24] Table 3 presents Model C, which is a summary measure of the value constructs shown in Table 2. In further support of H3, the coefficient on *NPV*DIF* is positive and significant (p<.001), suggesting that consumers place a higher future value on energy-efficient products when the price difference between products is large (consistent with

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[24] We elicit three cost savings likelihoods ($50 per year, $150 per year, and $250 per year) and two durability likelihoods (5 years and 10 years) after each product decision (see Appendix 1). In untabulated analyses, we also estimate *NPV* using the average of all reported combinations of expected cost savings and product durability provided for each decision. Our statistical inferences remain unchanged with this alternative specification of *NPV*.

Monroe and Krishnan (1985) and Rao and Monroe (1988)). Regarding H4, the coefficient on

NPV*TC is also positive and significant (p=.014), suggesting that consumers place a higher

future value on energy-efficient products when the price concession format is a tax credit.

[TABLE 3]

While our NPV analysis offers a specific and plausible process variable to capture tax-

credit-specific Type 2 cognition (i.e., no other concession format contains a significant

interaction with NPV), we caution against making inferences given the durability aspect of

NPV.[25] Further, we note that the design of Experiment 1 does not accommodate an investigation

of nominal price effects, as our purchase scenarios featured two randomly assigned classes of

products (HVAC systems and household appliances) that were both "big ticket" items with

equally high nominal prices.[26] While we define high and low price differentials as a percentage

gap between the net price of energy-efficient and standard products, we cannot confirm from

Experiment 1 whether our observed patterns in consumer response would hold for "little ticket"

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[25] Further, we find in untabulated analyses that the durability aspect of *NPV* contributes to a negative *TC*DIF*NPV* three-term interaction (p=.023) in a fully crossed model, without changing the sign or significance of our lower-order terms. While this three-term interaction is not critical to our study (i.e., our theory and hypotheses do not require the presence of tax credits, high price differentials, and heightened value perceptions in concert), its direction suggests some degree of cannibalization among our lower-order interactions. In other words, while our hypothesized two-term interactions all exert significantly positive influence on green purchase intentions consistent with Type 2 thinking, the presence of all three component variables does not appear to uniformly increase the amount of deliberation required. We examine effect sizes in our fully crossed model using a median-split indicator for *NPV* in place of its continuous measure and find that, despite the negative three-term coefficient, the cell including all three indicators produces higher purchasing likelihoods than those involving only high price differentials or both tax credits and high price differentials. We also replace the *NPV* indicator with our participants' reported *QUALITY* assessments of the green product relative to the standard product and find that the fully crossed *TC*DIF*QUALITY* interaction is insignificant while the lower-order terms corresponding to our hypotheses remain qualitatively and quantitatively unchanged.

[26] Experiment 1 extended an extensive pilot study that utilized commercially posted prices for products specifically mentioned in IRC Section 25C (e.g., HVAC systems, a wood-burning stove, a patio door, and replacement windows). Using actual prices creates a mechanical relationship between nominal prices and relative price differentials. That is, when nominal prices of standard products are high, so too are price differentials between standard and energy-efficient products. Our pilot test contained other realistic features such as (1) real incentive to *forgo* costly socially desirable investment, (2) a full range of decision options (energy-efficient purchase, standard purchase, and no purchase options), and (3) real time and effort requirements that structurally correspond to our price concession manipulations (e.g., claiming tax credits required more effort on the part of participants than did claiming price discounts) that were excluded from the experiments reported in this study in order to simplify our design. In spite of these differences, we note that results from the pilot study are largely consistent with those reported here.

tax-incentivized items (e.g., replacement windows and patio doors), where incentives and price differentials of similar proportions manifest in small nominal values. We also cannot confirm whether other design choices from Experiment 1 (e.g., utilizing actual brand names, requiring round-by-round cost savings, durability, quality, and environmental perception assessments) impact our main results. As such, to test the robustness of our findings and to explore more detailed causation possibilities, we design a separate experiment.

Experiment 2 Design and Participants

In our second experiment, we utilize a $3 \times 2 \times 2$ repeated-measures survey design, with price concession (tax credits, discounts, and reduced net pricing), relative price differentials between green and standard products (high versus low differential), and nominal pricing levels for each product (relatively high versus relatively low) as manipulated independent factors. One hundred and forty-seven participants from MBA courses at a large private university in the U.S. Northeast were asked to play the part of a homeowner in need of home upgrades and repairs.[27] As expected, our Experiment 2 participants are younger (average age of 27 years), report a lower proportion of home ownership (18%), and have less work experience (average of 4 years) compared to our Experiment 1 participants. However, similar to Experiment 1, our Experiment 2 participants report favorable environmental attitudes (average 5.63 on a 7-point scale) and a high level of effort on the experimental task (average 78.05 on a 101-point scale). Descriptive statistics for our participants are presented in Table 4.

[TABLE 4]

Participants took part in the survey via Qualtrics. In each of the twelve decision exercises corresponding to our revised design, participants were told that a home-related purchase was

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[27]Experiment 2 participants received a travel mug featuring their university's logo in exchange for their thoughtful participation. IRB approval was obtained from the institutions where experiments were conducted.

required and they were presented with an energy-efficient product option and a standard product alternative. Participants were then asked to indicate the probability on a 101-point scale that they would select the green product (our primary dependent variable). In roughly half of our online instruments, labels were switched for both high and low nominally-priced products to control for potentially disparate consumer attitudes toward our selected (and generically-labeled) products and to control for minor variations in nominal pricing which were purposely implemented to avoid monotony and demand effects. For example, labels describing appliances for the high nominal price decision scenarios presented to the first half of our participant pool were changed to describe heating and air systems for the second half of our participants, and vice versa. We similarly switched label descriptions for replacement windows and patio doors in our low nominal price scenarios. Example scenarios are included in Appendix 2.

Experiment 2 Results

Figure 2 provides visual results of reported green product purchase likelihoods for the tax credit, discount, and reduced-net-pricing conditions at high and low price differentials. We find visual evidence that discounts induce higher purchasing levels than net pricing (consistent with Thaler (1985)), but untabulated pairwise comparison shows this difference is not significant. Tax credits have a visual slope difference relative to alternative purchase inducements and untabulated pairwise comparison confirms that tax credits induce fewer energy-efficient purchases than alternative conditions in both low relative and nominal price settings (p< .01). Except for a marginally significant difference between tax credits and sales discounts in the high nominal price setting, remaining pairwise comparisons between inducement conditions at both relative and nominal price differences are insignificant. We explore the net effect of these marginal differences below.

[FIGURE 2]

Table 5 presents the results of our comprehensive analysis for two estimation models. The dependent variable is the reported likelihood of selecting the green product on a 101-point scale (*GREEN_LIKE*) and we use Restricted Maximum Likelihood Analysis to model the response.[28] Model D employs indicator variables for both explicit purchase inducements (i.e., discounts and tax credits relative to the baseline net pricing group), while Model E collapses discounts and reduced net pricing into a single group in order to focus on multiple interactions involving tax credits.[29]

[TABLE 5]

We observe consistent results regarding control variables common to both models. Specifically, neither gender (*MALE*, p=.239 in both models) nor home ownership (*HOME*, p=.443 in both models) has a significant impact on green investment while higher levels of environmental preference (*ENV_IMP*, p<.001 in both models) significantly increase the likelihood of making an energy-efficient product purchase.[30] As previously noted, we explicitly control for nominal pricing (*PRICE*, p=.136 in Model D, p=.004 in Model E) in Experiment 2 and find a negative effect that is significant in Model E, suggesting that participants are less likely to select energy-efficient products when absolute product prices increase. We find this sensible given that the energy-efficient product premium is nominally larger when nominal

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[28] Restricted maximum likelihood analysis is necessary for Experiment 1 and appropriate for both experiments; as such, we use maximum likelihood for consistency.

[29] We note that the Pseudo R^2 for Experiment 2 is markedly lower than for Experiment 1. The exclusion of round-by-round variables (e.g., cost savings, durability; compare Appendices 1 and 2) explains the difference. If we remove round-by-round variables from Experiment 1 (making the model comparable to Experiment 2's design), our Pseudo R^2 becomes comparable to Experiment 2 (.06 vs. .04). Importantly, removing these variables from Experiment 1's analysis does not affect our primary inferences (i.e., H1 and H2 are still supported).

[30] Participants' environmental preferences averaged 5.63 on a 7-point Likert scale. In the interest of parsimony for participants, we capture *ENV_IMP* using the single Likert-scale question that exhibited the most varied responses in our untabulated pilot test ("How important do you think it is for people to use energy-efficient products in their homes?"). In contrast, our pilot test used a six question factor (Cronbach's alpha = .76) taken partially from the 1999 European Values Study.

prices are high, driven by a consistent 33% (3%) price premium over standard products in the high (low) relative price manipulation.

As in Experiment 1, high price differentials (*DIF*) produce highly significant and negative effects in both models (p<.001), supporting the intuitive notion that green product purchases are less likely when they are markedly more expensive than standard products. Consistent with H1, the negative coefficient on *TC* (p<.001) suggests that tax credits are less effective than net pricing (Model D) and both non-tax-credit conditions (Model E) at inducing green investment when price differentials are low. Consistent with H2, the significantly positive coefficient on the interaction *TC*DIF* (p<.01 in Models D and E) indicates that tax credits become relatively more effective as price differentials between energy-efficient and standard products increase. As in Experiment 1, this effect is not present with respect to the *DISCOUNT*DIF* interaction (p=.240), suggesting that higher price differentials have no incremental impact on green investment when discounts are the incentive format.[31]

Finally, we note minimal change between Models D and E and few incremental effects on energy-efficient purchases stemming from our explicit control over nominal price levels. That said, the *TC*PRICE* interaction produces a significant and positive coefficient in Model E (p=.040), when our discount and reduced net pricing conditions are collapsed. Although not hypothesized and not robust to both models, we find some evidence that decision makers incentivized by tax credits are more likely to make green investments in "high stakes" choices (e.g., a $1,000 after-tax, energy-efficient product vs. a $600 standard product) relative to "low stakes" choices ($100 vs. $60).

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[31] As shown in Table 4, the majority of Experiment 2 participants are non-homeowners. In untabulated analyses, we replicate the analyses shown in Table 5 exclusively on homeowner participants and obtained qualitatively and quantitatively similar results.

Although numerous differences between Experiments 1 and 2 exist (participant background, generic vs. specific purchase options, presence vs. absence of round-by-round control variables), our findings once again suggest that tax credits are most effective when green products are appreciably more expensive than standard alternative products. While our main findings (H1 and H2) appear quite robust, we sought additional insight into the process underlying these observed outcomes by asking Experiment 2 participants a series of questions after all 12 product selections were made. Our questions included participants' self-assessed effort on the task (a proxy for Type 2 cognition) as well as their views on trusting the government, the appropriateness of tax incentives, and how energy-efficient products affect their societal status (Griskevicius et al. 2010). None of these variables have significant main or two-way interactive effects when added to the analysis shown in Model E (Table 5).

We further explored a median split design for each post-experiment variable and re-perform the analysis shown in Model E. While our main results are robust across various median splits, we detect no evidence that high vs. low government trust, beliefs that tax incentives are appropriate, or views about the social status of green investment help explain our findings. We find weak evidence consistent with Type 2 cognition driving our tax-related findings (the coefficient on *TC*DIF* is highly significant in the high-effort split, but loses significance (p = .102) in the low-effort median split); however, our additional questioning was largely unable to successfully identify more specific drivers of the behavior we observe.

IV. SUMMARY AND DISCUSSION

Governments at all levels frequently incentivize socially desirable behavior through tax policy. For example, each year, the U.S. federal government forgoes billions of dollars in tax

revenue via consumer-directed tax credits in an effort to encourage programs such as energy conservation. Unfortunately, little is known about the overall efficacy of these programs and, to our knowledge, prior research has neither investigated the relative effectiveness of existing programs nor how to make existing programs more effective. Our study investigates a primitive question related to tax incentive programs: how well consumer-directed tax credits encourage the purchasing behaviors they are designed to motivate. We create a series of experiments to test the prediction that the effectiveness of tax credits in promoting energy-efficient purchases is positively related to the price differential between incentivized and standard products.

While our experiments vary in terms of complexity, participant incentives, and participant experience level, our results are robust across experimental settings. We consistently find that tax credits are *less likely* to motivate energy-efficient product purchases when energy-efficient products are only slightly more expensive than standard products. In these settings, equal-sized price discounts and net pricing dominate tax credits as a means to encourage green investment. In contrast, when energy-efficient products are markedly more expensive than standard products, tax credits become a relatively effective means to induce desired purchasing behavior. We provide evidence that tax credits become relatively effective because the tax context interacts with cognitive processing in a somewhat idiosyncratic manner – tax credits appear to trigger future value considerations for green products in a manner that is not observed for alternative purchasing inducements.

Standard notes of caution are warranted when interpreting our experimental results (Falk and Heckman 2009); however, the controlled variation afforded by experimentation overcomes data interpretation problems inherent to econometric analysis of tax incentives in the natural world (Hanlon and Heitzman 2010). As a specific limitation of this study, we investigate only

consumer-directed energy-efficient tax credits related to IRC Section 25C and compare

simplified tax credits to generic marketing alternatives in the form of price discounts and rebates.

We note that green investment has unique appeal (Martin and Moser 2015; Katzev and Johnson

1984; Scott 1977) and the format of taxation can have unexpected results on decision makers

(Blanthorne and Roberts 2015). Whether similar results would obtain in settings investigating

alternative government inducements such as tax deductions, alternative government programs

such as educational tax credits, non-U.S. tax systems, or using more sophisticated marketing

efforts is left for future research.

With limitations acknowledged, to the extent our results generalize, policymakers should

reconsider the administrative mechanisms used to encourage consumption of socially desirable

products as their price premiums decline over time. Specifically, our findings suggest that

traditional tax credits administered to individual taxpayers might be the most effective choice

during relatively early adoption periods when price premiums are large, but alternative

inducements may become more effective as price premiums decline. In general, documenting

systematic psychological responses to tax incentives should help inform and improve future tax

policy.

We believe our findings offer interesting avenues for future research. Like prior studies

(e.g., Ayers et al. 1999; Blanthorne and Roberts 2015; Bobek et al. 2007; Falsetta et al. 2013),

we document that tax-related stimuli can affect economic behavior in important ways; however,

future research might more specifically identify the underlying mental cause of the behavior

observed in this study. For example, future research could explore "hard-wired" brain activity as

individuals respond to tax-related versus alternative purchase inducements using tools from

neuroscience (Dickhaut et al. 2010). In addition, future research could more fully explore

alternative administrative offering methods.

Specifically, our discount, rebate, and net pricing conditions offer best-case scenarios for individuals if tax credits were given to intermediaries (retailers or wholesalers) who then passed the entire subsidy on to individuals. While our results suggest central taxpayers might be an effective choice when incentivized items have relatively small price premiums, such a conclusion is likely premature. As Goolsbee (1998) notes, suppliers retain between 35% and 70% of investment subsidies by adjusting prices upward. To the extent that centralized taxpayers limit the amount of government subsidy that reaches end users, consumer-directed tax credits are an appealing means to incentivized desired behavior. In sum, the tradeoff between inducement effectiveness, administrative costs, and agency costs requires additional research.

Appendix 1
Experiment 1: Example Decision Scenario

Tax Credit / High Price Differential Condition

Suppose you wish to purchase a new **heating and air system made by Carrier**.

Two options are available.

Option 1: You can purchase an energy-efficient Carrier heating and air system for a gross retail price of **$8,500**. Fortunately, this item qualifies for a **federal income tax credit**. The tax credit will reduce your year-end tax payment by **$1,000**, resulting in a net out-of-pocket cost of **$7,500**.

Option 2: You can purchase a standard Carrier heating and air system for **$5,625**.

Please answer the following questions about this scenario.

I WILL purchase Option 1.   *<Likert Scale from 1 (Very Unlikely) to 7 (Very Likely)>*

Option 1 is a higher quality product than Option 2.   *<Likert Scale from 1 (Very Unlikely) to 7 (Very Likely)>*

Option 1 is better for the environment than Option 2.   *<Likert Scale from 1 (Very Unlikely) to 7 (Very Likely)>*

Compared to Option 2, Option 1 will reduce my utility bills by more than $50 each year.   *<Likert Scale from 1 (Very Unlikely) to 7 (Very Likely)>*

Compared to Option 2, Option 1 will reduce my utility bills by more than $150 each year.   *<Likert Scale from 1 (Very Unlikely) to 7 (Very Likely)>*

Compared to Option 2, Option 1 will reduce my utility bills by more than $250 each year.   *<Likert Scale from 1 (Very Unlikely) to 7 (Very Likely)>*

Option 1 will last more than 5 years.   *<Likert Scale from 1 (Very Unlikely) to 7 (Very Likely)>*

Option 1 will last more than 10 years.   *<Likert Scale from 1 (Very Unlikely) to 7 (Very Likely)>*

The Option 1 product will last longer than the Option 2 product.   *<Likert Scale from 1 (Very Unlikely) to 7 (Very Likely)>*

Net Pricing / High Price Differential / Low Nominal Price Condition

In each decision option, please do your best to report what you would actually do, even if the following situation requires "hypothetical thinking."

You must purchase a **replacement window** for your home.

Two options are available.

Option 1: You can purchase an energy-efficient window for a retail price of **$270**.

Option 2: You can purchase a standard window for a retail price of **$189**.

Although the standard window (Option 2) does not meet Option 1's energy efficiency standards, both options look identical and are expected to have equivalent durability.

What is the likelihood that you would purchase   *<Scale from 0 to 100, Default Position = 50>*
Option 1?

Tax Credit / Low Price Differential / High Nominal Price Condition

Please do your best to put yourself in an "actual decision" mindset and report what you would do.

You must purchase a new **heating and air system** for your home.

Two options are available.

Option 1: You can purchase an energy-efficient heating and air system for a gross retail price of **$8,485**. Fortunately, this item qualifies for a **federal income tax credit**. The tax credit will reduce your year-end tax payment by **$700**, resulting in a net out-of-pocket cost of **$7,785**.

Option 2: You can purchase a standard heating and air system for **$7,551**.

Although the standard heating and air system (Option 2) does not meet Option 1's energy efficiency standards, both options look identical and are expected to have equivalent durability.

What is the likelihood that you would purchase   *<Scale from 0 to 100, Default Position = 50>*
**Option 1?**

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Figure 1: Experiment 1 Reported Likelihoods of Green Purchase Decisions
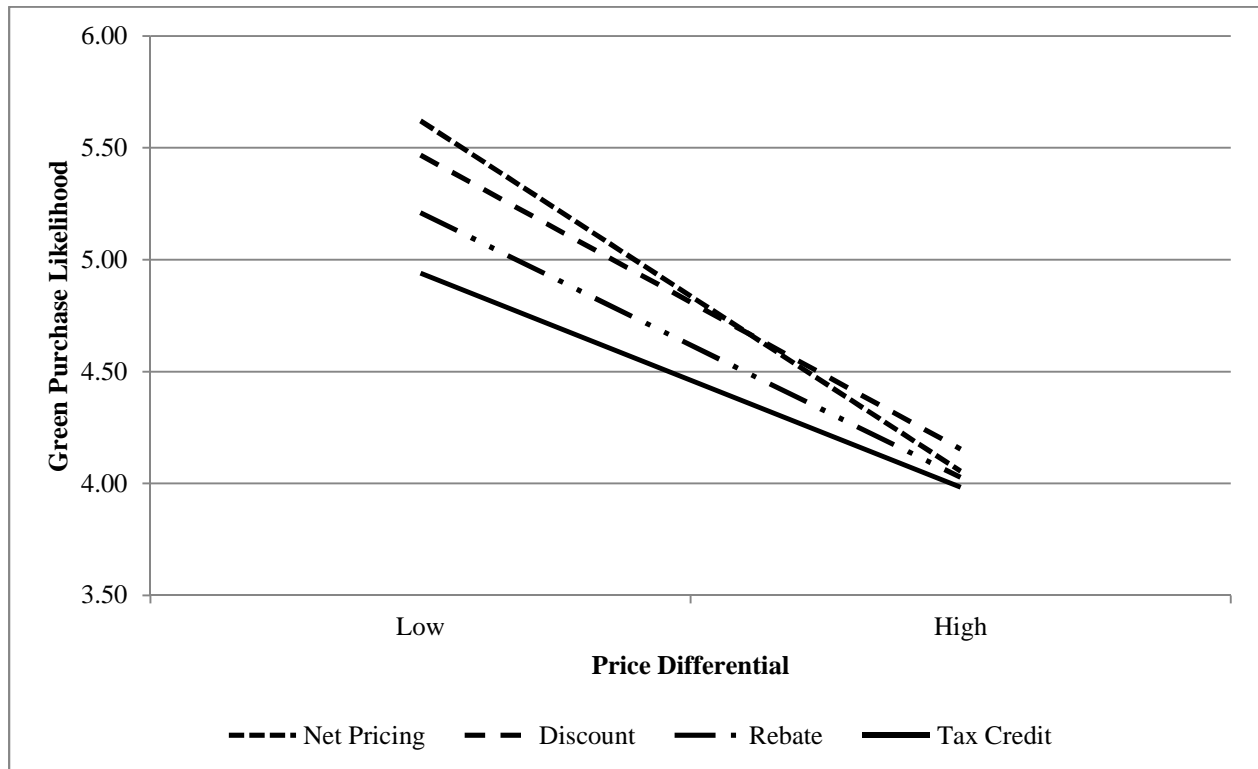
Note: Green (Energy-Efficient) Purchase Likelihood on the y-axis represents the participant reported likelihood on a 7-point Likert scale of purchasing a featured energy-efficient product rather than a standard alternative. Price differentials reported on the x-axis reflect the size of the price premium for the featured energy-efficient product compared to a standard alternative.

Figure 2: Experiment 2 Reported Likelihoods of Green Purchase Decisions
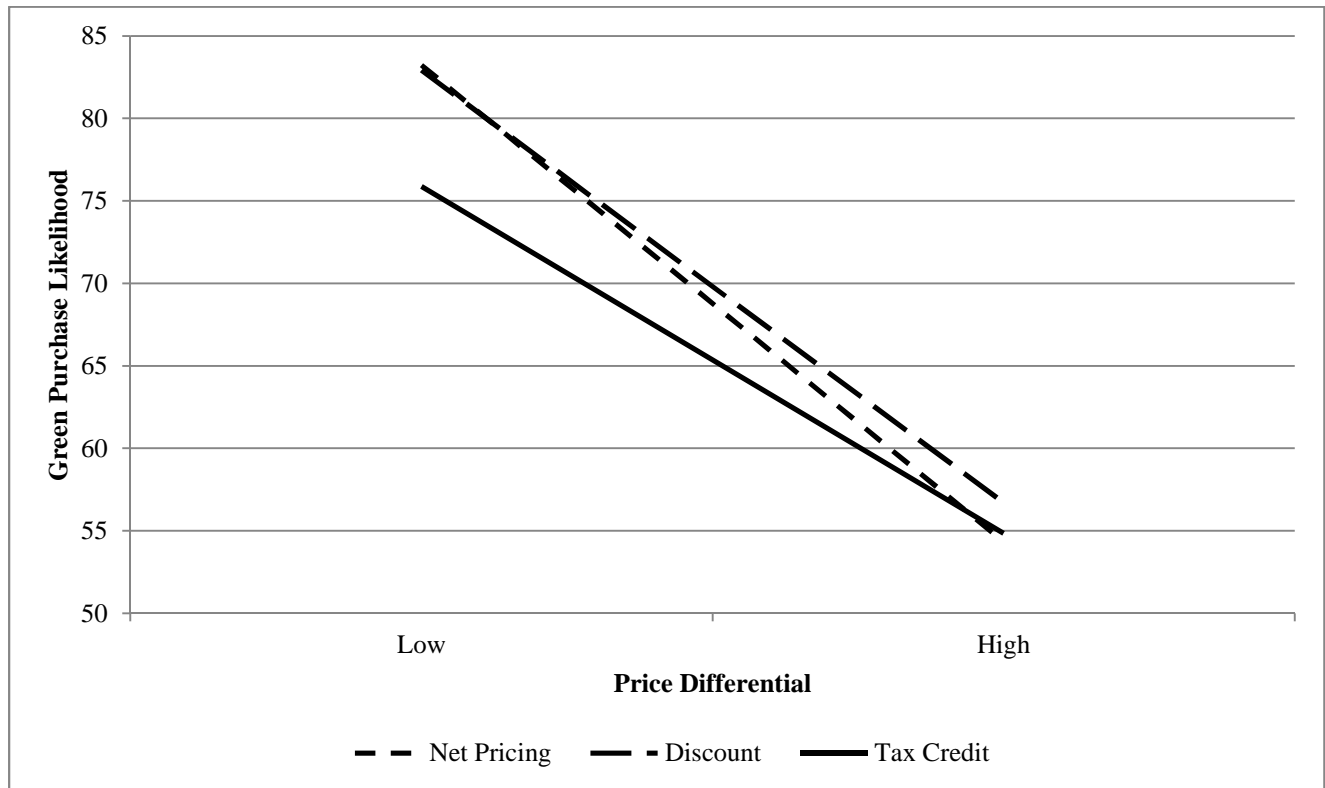
Note: Green (Energy-Efficient) Purchase Likelihood on the y-axis represents the participant reported likelihood on a 101-point scale of purchasing a featured energy-efficient product rather than a standard alternative. Price differentials reported on the x-axis reflect the size of the price premium for the featured energy-efficient product compared to a standard alternative.

Table 1
Participant Demographic Information
Experiment 1 (N=300 Homeowners, Ages 25 and Up)

Males	138 (46%)
Females	162 (54%)
Average Age (in years)	50.98
Average Work Experience (in years)	22.86
Previously Replaced Home Appliances	273 (91%)
Previously Made Major Home Improvements [a]	234 (78%)
Average Environmental Preferences (7-point scale)[b]	4.71
Average Self-Reported Effort (101-point scale) [c]	91.44
Average Minutes to Complete Experiment	18.96

[a] Reflects number of participants who responded "yes" to the question "Have you ever made major improvements to your home (e.g., new heating and air system, roof, windows, etc.)?"

[b] Reflects the average participant response to the question "How important do you think it is for people to use energy-efficient products in their homes?" on a 7-point Likert scale.

[c] Participants were asked to select a value from 0 ("No, I ended up rushing through my responses") to 100 ("Absolutely, I thought about each decision") for the question "Were you able to think independently about each of the 8 purchasing options in this study? (Note: your response to this question cannot harm you – we are simply looking for honesty.)"

Table 2
Restricted Maximum Likelihood Analysis for Utility Constructs in Experiment 1

	Model A: Tax credits, rebates, and discounts compared to control group (net pricing). Cost savings used as utility construct.				**Model B**: Tax credits, rebates, and discounts compared to control group (net pricing). Durability used as utility construct.			
	Parameter Estimate	Std. Error	t-stat	p-value	Parameter Estimate	Std. Error	t-stat	p-value
INTERCEPT	1.37	0.24	5.66	**<.001**	1.51	0.21	7.21	**<.001**
DISC	-0.33	0.25	-1.34	.180	-0.17	0.19	-0.86	.390
REBATE	-0.72	0.25	-2.89	**.004**	-0.49	0.20	-2.44	**.015**
TC	-1.10	0.25	-4.47	**<.001**	-0.88	0.20	-4.47	**<.001**
DIF	-1.69	0.19	-9.10	**<.001**	-2.34	0.15	-15.35	**<.001**
HVAC	0.15	0.05	3.04	**.003**	0.15	0.05	2.96	**.003**
ENV_PROD	0.25	0.03	7.64	**<.001**	0.25	0.03	7.82	**<.001**
QUALITY	0.32	0.03	10.36	**<.001**	0.32	0.03	10.29	**<.001**
CS	0.05	0.02	3.24	**.001**	0.09	0.01	7.22	**<.001**
DURA	0.06	0.03	1.88	**.061**	-0.09	0.04	-2.10	**.036**
*DISC*DIF*	0.19	0.13	1.46	.144	0.16	0.12	1.26	.207
*REBATE*DIF*	0.36	0.13	2.85	**.005**	0.33	0.12	2.67	**.007**
*TC*DIF*	0.58	0.13	4.55	**<.001**	0.56	0.12	4.51	**<.001**
*CS*DISC*	0.02	0.02	1.04	.297	-	-	-	**-**
*CS*REBATE*	0.03	0.02	1.70	**.089**	-	-	-	**-**
*CS*TC*	0.04	0.02	2.42	**.016**	-	-	-	**-**
*CS*DIF*	0.02	0.01	2.07	**.039**	-	-	-	**-**
*DURA*DISC*	-	-	-	**-**	0.02	0.04	0.51	.613
*DURA*REBATE*	-	-	-	**-**	0.04	0.04	0.98	.327
*DURA*TC*	-	-	-	**-**	0.07	0.04	1.90	**.057**
*DURA*DIF*	-	-	-	**-**	0.22	0.03	8.03	**<.001**
Sample Size	300				300			
AIC	7,772.6				7,708.8			
Pseudo R^2	0.146				0.153			

GREEN	=the dependent variable, participant self-reported likelihood on a 7-point Likert scale of choosing the energy-efficient product option in a given decision scenario;
DISC	=indicator variable taking the value 1 if the participant was presented a discount as an incentive to purchase the energy-efficient product;
REBATE	= indicator variable taking the value 1 if the participant was presented a rebate as an incentive to purchase the energy-efficient product;
TC	=indicator variable taking the value 1 if the participant was presented a tax credit as an incentive to purchase the energy-efficient product;
DIF	= indicator variable taking the value 1 if the participant was presented with an energy-efficient product offered at a large premium over the standard product;
HVAC	= indicator variable taking the value 1 if the product was a heating and air system and 0 for household appliances;
ENV_PROD	=7-point Likert scale response to the to the statement that the energy-efficient product is better for the environment than the standard option, with higher values indicating more likely;
QUALITY	=7-point Likert scale response to the statement that the energy-efficient product is of higher quality than the standard option, with higher values indicating more likely;
CS	= average likelihood ratings of 3 questions regarding the expected reduction in utility bills that would result from buying the environmentally friendly option ("Compared to the standard option, the energy-efficient option with reduce my utility bills by more than $50/$150/$250 each year"); and
DURA	= average likelihood rating of product longevity over 5- and 10-year lifespans.

Table 3
Restricted Maximum Likelihood Analysis for NPV in Experiment 1

Model C: Tax credits, rebates, and discounts compared to control group (net pricing). NPV used as utility construct.

	Parameter Estimate	Std. Error	t-stat	p-value
INTERCEPT	1.7398	0.1819	9.56	**<.001**
DISC	-0.1996	0.1543	-1.29	.196
REBATE	-0.4888	0.1550	-3.15	**.002**
TC	-0.8656	0.1530	-5.66	**<.001**
DIF	-1.8337	0.1246	-14.71	**<.001**
HVAC	0.1427	0.0499	2.86	**.005**
ENV_PROD	0.3047	0.0306	9.95	**<.001**
QUALITY	0.3460	0.0293	11.80	**<.001**
NPV	0.0012	0.0005	2.32	**.021**
*DISC*DIF*	0.1873	0.1257	1.49	.137
*REBATE*DIF*	0.3521	0.1257	2.80	**.005**
*TC*DIF*	0.5818	0.1257	4.63	**<.001**
*NPV*DISC*	0.0004	0.0005	0.75	.451
*NPV*REBATE*	0.0006	0.0005	1.21	.226
*NPV*TC*	0.0013	0.0005	2.46	**.014**
*NPV*DIF*	0.0020	0.0004	5.44	**<.001**
Sample Size	300			
AIC	7,783.6			
Pseudo R^2	0.144			

GREEN =the dependent variable, participant self-reported likelihood on a 7-point Likert scale of choosing the energy-efficient product option in a given decision scenario;

DISC =indicator variable taking the value 1 if the participant was presented a discount as an incentive to purchase the energy-efficient product;

REBATE = indicator variable taking the value 1 if the participant was presented a rebate as an incentive to purchase the energy-efficient product;

TC =indicator variable taking the value 1 if the participant was presented a tax credit as an incentive to purchase the energy-efficient product;

DIF = indicator variable taking the value 1 if the participant was presented with an energy-efficient product offered at a large premium over the standard product;

HVAC = indicator variable taking the value 1 if the product was a heating and air system and 0 for household appliances;

ENV_PROD =7-point Likert scale response to the to the statement that the energy-efficient product is better for the environment than the standard option, with higher values indicating more likely;

QUALITY =7-point Likert scale response to the statement that the energy-efficient product is of higher quality than the standard option, with higher values indicating more likely;

NPV = the average of the minimum and maximum participant assessments of expected net present value of energy-efficient investment, implied by the product of a participant's assessed likelihoods of cost savings and product durability. All assessments of cost savings (*CS*) and product durability (*DURA*) were made on a 7-point Likert scale as shown in Table 2 and Appendix 1.

Table 4
Participant Demographic Information
Experiment 2 (N=147 MBA Students)

Males	91 (62%)
Females	56 (38%)
Average Age (in years)	26.50
Average Work Experience (in years)	4.13
Homeowners	27 (18%)
Average Environmental Preferences (7-point scale) [a]	5.63
Average Self-Reported Effort (101-point scale) [b]	78.05
Average Minutes to Complete Experiment	19.07

[a] Reflects the average participant response to the question "How important do you think it is for people to use energy-efficient products in their homes?" on a 7-point Likert scale.

[b] Participants were asked to select a value from 0 ("No, I ended up rushing through my responses") to 100 ("Absolutely, I thought about each decision") for the question "Were you able to think independently about each of the 12 purchasing options in this study? (Note: your response to this question cannot harm you – we are simply looking for honesty.)"

Table 5
Restricted Maximum Likelihood Analysis for Experiment 2

	Model D: Tax credits and discounts compared to control group (net pricing).				Model E: Tax credits compared to all other purchase inducements (discounts and net pricing).			
	Parameter Estimate	Std. Error	t-statistic	p-value	Parameter Estimate	Std. Error	t-statistic	p-value
INTERCEPT	23.5147	9.7008	2.42	**.017**	23.8107	9.6516	2.47	**.015**
MALE	-3.5275	2.9809	-1.18	.239	-3.5275	2.9809	-1.18	.239
ENV_IMP	11.2937	1.6310	6.92	**<.001**	11.2937	1.6310	6.92	**<.001**
HOME	-2.8659	3.7286	-0.77	.443	-2.8659	3.7286	-0.77	.443
DISC	0.5918	1.9521	0.30	.762	-	-	-	-
TC	-8.9337	1.9521	-4.58	**<.001**	-9.2296	1.6905	-5.46	**<.001**
PRICE	-2.3878	1.5939	-1.50	.136	-3.2789	1.1270	-2.91	**.004**
DIF	-28.8707	1.5939	-18.11	**<.001**	-27.5442	1.1270	-24.44	**<.001**
DISC*PRICE	-1.7823	2.2541	-0.79	.430	-	-	-	-
TC*PRICE	3.1599	2.2541	1.40	.162	4.0510	1.9520	2.08	**.040**
DISC*DIF	2.6531	2.2541	1.18	.240	-	-	-	-
TC*DIF	7.8469	2.2541	3.48	**<.001**	6.5204	1.9520	3.34	**.001**
Sample Size	147				147			
Model AIC	15,745.60				15,757.40			
Pseudo R^2	.044				.044			

GREEN_LIKE	=the dependent variable, participant self-reported likelihood on a 101-point scale of choosing the energy-efficient product option in a given decision scenario;
MALE	=indicator variable taking the value 1 for male participants and 0 for female participants;
ENV_IMP	=7-point Likert scale response to the question "How important do you think it is for people to use energy-efficient products in their homes?" Higher values indicate greater importance;
HOME	=indicator variable taking the value 1 if the participant currently or ever owned a home and 0 otherwise;
DISC	=indicator variable taking the value 1 if the participant was presented a discount as an incentive to purchase the energy-efficient product;
TC	=indicator variable taking the value 1 if the participant was presented a tax credit as an incentive to purchase the energy-efficient product;
PRICE	=indicator variable taking the value 1 in cases with higher nominally priced products and 0 for lower priced products; and
DIF	=indicator variable taking the value 1 if a high price differential between the energy-efficient and standard products was presented to the participant and 0 otherwise.