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Re-evaluating the role of energy efficiency standards: A behavioral economics approach ☆

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ABSTRACT

The economic models that prescribe Pigovian taxation as the first-best means of reducing energy-related externalities are typically based on the neoclassical model of rational consumer choice. Yet, consumer behavior in markets for energy-using durables is generally thought to be far from efficient, giving rise to the concept of the "energy-efficiency gap." This paper presents a welfare analysis of energy policies that is based on a behavioral model of temptation and self-control, introduced by Gul and Pesendorfer [23,24]. We find that, in the presence of temptation, (i) Pigovian taxes alone do not yield a first-best outcome, (ii) when viewed as substitutes, energy efficiency standards can dominate Pigovian taxes, and (iii) a policy combining standards with a Pigovian tax can yield higher social welfare than a Pigovian tax alone, implying that the two instruments should be viewed as complements rather than substitutes.

1. Introduction

The importance of reducing energy use has been widely acknowledged as a means for both meeting future energy needs and addressing environmental problems. Historically, the U.S. and many other countries have relied heavily on energy efficiency standards to reduce energy consumption. Examples include the appliance standards developed and enforced by the U.S. Department of Energy (DOE) and the minimum efficiency standard for light bulbs recently established by the U.S. Energy Independence and Security Act. While commonly used, energy efficiency standards have been widely criticized by economists, who have long argued that the first-best policy for reducing the externalities that result from energy use is a Pigovian tax on energy consumption. Among recent papers, Linares and Labandeira [36], Parry et al. [42], and Anderson et al. [5] discuss the advantages of implementing energy taxes over efficiency standards. Arguments against the use of standards include the existence of a "rebound effect" [19,47] and the inefficiency induced when a uniform standard is imposed on heterogeneous consumers [25].

The argument that taxes are superior to energy efficiency standards is typically based on the neoclassical model of rational consumer choice, which assumes that, when faced with proper price signals, consumers will make efficient choices. Yet, observed consumer behavior with regards to energy use and the purchase of energy-using durable goods is often

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thought to be far from efficient, giving rise to the concept of the "energy-efficiency gap." In particular, the individual discount rates that would make the observed purchases of energy-using durable products economically rational in the absence of market failures tend to be excessively high.[1]

There is a large body of literature that seeks to explain this puzzling behavior. One explanation is that inefficient purchases could stem from consumers undervaluing future energy costs.[2] For example, McManus [40], Fan and Rubin [15], and Allcott and Wozny [3] provide evidence that consumers undervalue future fuel costs when purchasing automobiles.[3] This type of behavior can arise when individuals exhibit a rate of time preference that declines with time (e.g., [26]),[4] which can be modeled formally through preferences that exhibit hyperbolic or quasi-hyperbolic discounting [38,34,8]. These represent a formalization of the preference structure originally introduced by Strotz [48], under which the agent's preferences differ across periods and in each period the agent can be viewed as a separate "self" choosing *current* behavior to maximize *current* preferences. As a result, agents have different preference orderings at different points in time, implying time inconsistency (e.g., [26]).[5] This poses a challenge to the traditional welfare analysis based on the revealed preference approach, since in the presence of time inconsistency there is no universally accepted welfare criterion based on consumer sovereignty to use in evaluating alternative outcomes [48,24,41].

For finite decision problems, the above models of time-varying preferences can be viewed as preference structures under which individuals face temptation and always give into it [24,37]. Gul and Pesendorfer [23,24] present a more general model of temptation that allows for the possibility that individuals will resist temptation (albeit at a cost). In contrast to the hyperbolic and quasi-hyperbolic preference structures, agents with Gul and Pesendorfer preferences do not have different "selves" at different times. Rather, at each point in time individuals rationally (and consistently) choose among alternatives, recognizing that they will incur *disutility* (i.e., self-control costs) if they resist temptation. This yields a set of time-consistent preferences in the presence of temptation that allows for both succumbing to and resisting temptation as possible choice outcomes.

People may face temptation in a variety of decision contexts. For instance, the existing evidence shows that individuals experience self-control problems due to their tendency to pursue immediate gratification [52,50,39,53]. A key behavioral implication of temptation is that consumers may actually prefer to restrict their choices so as to avoid the temptation that short-term gains create in some contexts. For example, illiquid assets (e.g., housing, IRAs, etc.) and social security serve to reduce the temptation of immediate consumption [24]. Alternatively, some people achieve commitment through self-imposed restrictions, such as rationing purchases of tempting goods even when they are sold with quantity discounts [52], avoiding visits to restaurants offering unhealthy food [23], or self-imposing earlier deadlines than necessary for class assignments [6]. There is an extensive literature demonstrating that people often have a preference for commitment (see, for example, [9,17] for surveys of this literature). Such preferences can have important policy implications.[6]

In this paper, we use an adaptation of the Gul–Pesendorfer model of temptation to evaluate policies used to improve energy efficiency, including energy efficiency standards, Pigovian energy taxes, and product subsidies or taxes. We model consumers' purchase decisions in markets for energy-using durable goods, where a less energy-efficient product with a low purchase price appears "tempting", in spite of its relatively high use costs that will be incurred in the future.[7] While some people may overcome this temptation and in the process incur a self-control cost, there are others who succumb to it and make decisions that could be *ex-ante* inefficient.[8]

We suggest that product price-driven temptation can be another possible factor contributing to the energy-efficiency gap. To our knowledge, we are the first to suggest this. Furthermore, the preference for choice restriction that some

[1] Studies have estimated implied discount rates ranging from 25% for air conditioners to 300% for refrigerators. See Frederick et al. [18] and Carson and Tran [10] for a summary of these studies.

[2] Other possible explanations include market failures (such as liquidity constraints and information problems), hidden adoption costs, consumer heterogeneity, and landlord–tenant problems. For related discussions, see, for example, Hausman and Joskow [25], Carson and Tran [10], Gillingham et al. [20], and Davis [12].

[3] See Greene [21] for a review of studies estimating consumers' valuations of fuel economy. The evidence he finds is mixed: some studies report undervaluing and some overvaluing of fuel costs.

[4] Alternatively, undervaluation of energy costs might be due to consumer misperceptions. See Fischer et al. [16], Parry et al. [42], and Allcott et al. [4] for models based on this assumption.

[5] Time-inconsistent preferences can, however, lead to time-consistent policy outcomes in some contexts, as shown by Karp and Tsur [29].

[6] For example, Shapiro [44] observes that food stamp recipients tend to over-consume during the early days of the stamp month and discusses the role of policy as a commitment device. In particular, he suggests that an increase in the frequency of transfer payments, while reducing the amount of each payment, could benefit consumers. Kan [28] finds empirical evidence that smokers intending to quit would support public policies that impose costs on smoking, such as cigarette excise taxes or smoking bans in public places.

[7] This notion of temptation is consistent with the recognition that consumers may focus on paying low initial purchase prices [35]. Such behavior can be represented through the Gul–Pesendorfer framework, as demonstrated by Esteban et al. [14]. While our study is similar to Esteban et al. [14] to the extent that both consider temptation in the context of product purchases, Esteban et al. [14] do not incorporate an intertemporal component (i.e., consideration of product use costs) into the purchase decision, and they offer no welfare analysis of policies.

[8] A previous study by Heutel [26] examined energy efficiency standards using a model with quasi-hyperbolic preferences. However, as noted earlier, although such preferences are consistent with temptation, unlike the Gul and Pesendorfer model, they do not allow for the possibility that individuals will resist temptation when faced with it. To date, there do not exist empirical tests to determine whether the Gul and Pesendorfer model is a better representation of individual behavior than alternative models with time-varying preferences, such as the quasi-hyperbolic discounting framework. As discussed by Lipman and Pesendorfer [37], such a test would require evidence that individuals prefer commitment devices even in contexts where they do not give into temptation.