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WAEA Keynote Address
Behavioral Environmental Economics: Money Pumps & Nudges

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Herein we explore how money pumps from rational choice theory and nudges from behavioral economics work toward helping create better environmental policy. We examine the role of money pumps in environmental policy, and whether policymakers can use nudges to "supercharge" incentives. We summarize insight that has emerged from both camps in the areas of conflict/cooperation and mechanism design.

Key words: behavioral economics, conflict, cooperation, incentives, mechanism design, money pumps, nudges

Introduction

For the last twenty-five years I have worked on understanding the behavioral underpinnings of environmental policy. My work has explored how institutions, incentives, and nature interact, with the goal of finding tools to help provide environmental protection at lower cost. The research revolves around a Rule of One: one rational person can move society toward predicted market equilibria; one irrational person can move a game away from the predicted game-theoretic equilibria (Shogren, 2006). This razor's edge matters for environmental policy because society allocates these resources in a sphere of missing markets or no markets at all. We cannot necessarily rely on one rational person—fictional or representative—in a market to move society closer to efficiency if allocation decisions involve strategic interactions without markets. Assuming rational behavior for environmental policy is problematic when nature's goods and services lack the active market-like arbitrage needed to encourage consistent choice. Instead, we might need to revisit whether rational choice theory remains the most useful guide for understanding efficient environmental policy, a point long stressed by Jack Knetsch (1990). Perhaps the lessons emerging from the field of behavioral economics should play a bigger role in our work (e.g., Tversky and Kahneman, 1986). The practice of using rational choice theory to model decisions is vulnerable without the social context that either rewards consistent choice or overcomes any inconsistent choices in aggregation (Arrow, 1987).

My research focuses on creating the missing institutional context, or "money pumps," to create rational choice rather than on documenting biases and heuristics. These institutions are designed to help people help themselves by learning what it means to be the rational agents we presume inhabit our models (e.g., Cherry, Crocker, and Shogren, 2003). We designed these money pumps to either extract resources from inconsistent decisions or to lower the transaction costs of consistent

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decisions. We made no presumptions on optimal preferences, and we did not presume to know what was best for the decision maker. If a person decides if he or she likes more money to less after she has been run through the money pump, we have increased the consistency of choice closer to the assumptions. The money pump itself does not care about optimality. In this light, we were less interested in documenting "behavioral failures" than in understanding how institutional context sharpens behavior. If we can create an institution that allows one rational person to drive society toward efficiency, perhaps we can better understand the power and limits of market-like arbitrage mechanisms to remove biases, heuristics, aversions, and limits that exist in social interactions (Shogren and Taylor, 2008; Metcalfe and Dolan, 2012; Shogren, Parkhurst, and Banerjee, 2010).

While I was busy building institutions, behavioral economists blew past me. They identified more and more behavioral failures we can cluster into three broad self-explanatory categories: bounded rationality, bounded willpower, and bounded self-interest (Mullainathan and Thaler, 2000). Behavioral failure reflects the idea that when people behave differently than rational choice theory assumes, resources can be inefficiently allocated. I use the term behavioral failure to draw parallels to the familiar economic idea of market failure and inefficiency and to stress the normative notion in behavioral economics that society can "fix" these failures given some third-party expert who knows the optimal outcome and can create cues and nudge people toward that outcome (Thaler and Sunstein, 2008). These nudges try to help people help themselves by accounting for predictable human foibles without removing freedom of choice; for example, opt-in versus opt-out of some energy saving program (Allcott and Mullainathan, 2010). The "green nudge" community is a new and spirited voice in whether behavioral economics can contribute to better environmental policy.[1] They are asking whether we use social norms, moral licensing, moral cleansing, opt-in vs. opt-out, social isolation, trust, peer pressure, contagious cooperation, optimal unselfishness, teachable moments, self-perpetuating perceptions, and other strategies to move us toward more cost-effective environmental policy. They ask whether we could create more effective incentive mechanisms by designing environmental policy differently through "nudges" or whether we should continue to focus on market-based "money pumps." The key difference between a money pump and a nudge is that nudges help save a person from their inconsistent decisions: society knows people make personally harmful decisions and wants to help individuals correct these errors themselves. The intervention to fix behavior occurs through the new wave of "soft" paternalism (i.e., you know what is good for you, we are here to help).[2]

Several general questions motivate the rest of the paper. What do we know about the role of money pumps in environmental policy? Do nudges have a role in environmental economics? Can policy makers use nudges to "supercharge" incentives? Are money pumps and nudges substitutes or complements? Or are they such different philosophical ideas that they cannot work together (see for example Sugden, 2008; Smith and Moore, 2010)? Or as frankly summarized by Frijters (2008, p. 29): "has our more intimate knowledge of human frailties got us any further than the road set upon by the classical economists?" This brief review explores aspects of these questions for incentive design in two areas: conflict/cooperation and mechanism design. I summarize some of the "lessons" that have emerged from the literature. For a discussion of behavioral economics and valuation work, see Carlsson (2010) or Jacquemet et al. (in press).

Conflict and Cooperation

Nudge 1: The effectiveness of collaborative processes designed to address environmental problems can be improved by drawing on recent behavioral research into how people bargain in practice:

[1] See the set of papers at the recent conference on Behavioral Environmental Economics held at the Toulouse School of Economics in October 2012, http://idei.fr/display.php?r=25378.

[2] Given that *Nudge* author Cass Sunstein is returning to academics from his role within the Obama administration, it will be interesting to see how he uses behavioral economics to explain cost-savings in government during his time in Washington, DC.

individuals' altruism, experience with property rights structures (or lack thereof), and preferences for fairness all affect bargaining outcomes. Even before Howard Raiffa's (1982) pioneering work, scholars have long recognized that resolving conflicts requires an understanding of how people cooperate and negotiate a solution. Environmental policy is no exception. In fact, some scholars argue that a Coasean-style collaboration and negotiation is the future of environmental policy (Rhoads and Shogren, 2003, for one overview). Examples of devolution in the environmental arena abound. Refinement of the more traditional decision-making processes grew primarily out of dissatisfaction with their costly consequences. Heavy reliance on litigation from both sides in the environmental debate began to escalate legal fees and prompt long delays in enacting changes in the environmental arena. Less adversarial methods of problem solving are attracting considerable attention in the environmental arena. Negotiation, mediation, arbitration, and facilitation are just some of the techniques that are now used extensively in resolving environmental disputes and designing natural resource management plans. Furthermore, the use of relatively new decision-making processes that incorporate these techniques, such as regulatory negotiation and collaborative decision making, is becoming more common.

The effectiveness of collaboration can be facilitated by a better understanding of behavior within Coasean bargaining and transaction costs (Coase, 1960). The Coase theorem states that disputing parties will bargain until they reach an efficient private agreement, regardless of which party initially holds unilateral property rights. As long as these legal entitlements can be freely exchanged and transaction costs are zero, government intervention is relegated to designating and enforcing well-defined property rights. But Coase was not promoting a world of zero transaction costs. Instead, Coase wrote that since a zero-transaction-costs world does not exist, we need to study the world that does exist—the one with transaction costs. A behavioral economist would say we also need to study the world of cognitive bounds (see Sunstein, 2000). The challenge is to separate out what is a transaction cost from a cognitive bound (Hoffman et al., 2002).

Policy makers are interested in how different bargaining rules and protocols affect behavior and outcomes. The question is whether these social preferences play a key role in nonmarket allocation decisions under alternative institutional structures (Shogren, 1997). Concerning environmental collaboration, behavioral economics has explored how rules affect or are affected by bounded self-interest (entitlements and fairness) and bounded rationality (endowment effects; self-serving bias leading to an impasse). The first behavioral-style paper exploring the Coase theorem observed efficient outcomes, but found that bargainers were rather selfless, splitting outcomes equally rather than rationally (see Hoffman and Spitzer, 1982). This suggested that institutional context affected other-regarding (altruistic) behavior toward the policy.

Since then, behavioral economics has, with limited success, pushed bargaining models to the limit in an effort to isolate and identify selfless versus selfish behavior in bargaining games. The Dictator game is the extreme example of a bargaining game. Self-interested strategic behavior is controlled by giving a person complete control over the distribution of wealth. While theory predicts that people with complete control will offer up nothing to others, Hoffman, McCabe, and Smith (1996) found that they still share the wealth in about 40% of observed bargains. Such other-regarding choice is another example of behavior that differs from what is predicted by standard game-theory models. Results in Cherry, Frykblom, and Shogren (2002), however, suggest other-regarding behavior arises from strategic concerns, not altruism.

A test-bedding approach produced measures of efficiency and the distribution of wealth for certain rules present in the collaborative process. By generating experience and data in the experimental laboratory, this information serves as a means of examining and refining current negotiation methods in the environmental arena. The results from behavioral bargaining research suggest some useful lessons to apply when considering the collaborative decision-making process. Devoting more resources to the design of a collaborative process does not always produce comparable gains in efficiency due to either transaction costs or bounded self-interest or both.

Money Pump 1: Introducing communication rules in negotiation can generate efficiency gains, which can offset the adverse impact of transaction costs. This makes the obvious point that building trust, a common goal of a collaborative process, remains an important means of enhancing efficiency (see e.g., Valley et al., 2002). This point of trust building is crucial and elusive—easy to say, hard to implement (see Cox, 2004, for an overview). While it is expected that some rules of the collaborative process will generate significant efficiency gains, the results from this research suggest that incorporating certain rules into the design of a collaborative process may not generate appreciable gains in efficiency. A relatively unpretentious and inexpensive collaborative process may provide an optimal negotiation framework for generating long-lasting solutions to concerns in the environmental arena. As such, careful design requires attention to the benefits and the costs of each element of the collaborative process. A test-bedding experimental approach can be used to flesh out those rules that add nothing of value to the operation of the collaborative decision-making process. Future experiments will help to further refine Coasean bargaining in the environmental arena.

Transaction costs reduce efficiency in a Coasean bargaining setting. It is fully expected that successful implementation of the collaborative decision-making process will require significant funding for meeting and search fees. Policy makers should promote the use of Coasean-style bargaining, especially when stakeholders are in close proximity to each other and can meet rather inexpensively, keeping transaction costs low. But when high transaction costs are unavoidable, "cheap talk" is a negotiation rule that enhances efficiency in bargaining and partially offsets the dampening effects of the considerable transaction costs present in collaborative decision making (see Valley et al., 2002). Cheap talk, which allows for nonbinding communication of threat points, characterizes efforts that establish trust in collaborative efforts. While cheap talk (and building trust) can be considered important elements of successful collaborative decision making, the level of resources that should be directed to these efforts remains an open question.

Nudge 2: In implementing national environmental regulations, granting more authority to collaborative groups of local stakeholders can improve efficiency. Stakeholders participating in a collaborative process should be selected to maintain a power balance within the group. Efficiency is sensitive to the level of decision-making authority provided to the collaborative group. Our research suggests that efficiency drops significantly as soon as final decision-making authority is taken away from a collaborative group, because people tend to overestimate the low probabilities of contract failure. Efficiency can be maximized in these negotiations by granting final decision-making authority to a collaborative group (also see Charness and Sutter, 2012). Policy makers should explore step-up efforts that provide authority to collaborative groups. For example, allowing local groups to determine liability shares for cleaning up hazardous waste sites (a local issue) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, a federal law) will produce more efficient outcomes if the local group is given final decision-making authority. While existing legislation does not currently permit this, U.S. Environmental Protection Agency (EPA) pilot programs are moving in this direction and can be expected to produce a higher degree of cost effectiveness in the Superfund program. This lesson can also be applied to other legislative mandates, such as the U.S. Endangered Species Act and the National Environmental Policy Act. Future test-bedding experiments should be used to aid in developing efficient negotiation frameworks in amended or new environmental legislation.

When final decision-making authority is granted to a collaborative group, power balance among stakeholders produces significant efficiency gains. This suggests that the efficiency of environmental negotiation can be enhanced by carefully selecting the stakeholders to participate in the collaborative process. The EPA is already restricting certain potentially responsible parties (PRPs) from being assigned liability shares for Superfund cleanup. More generally, policy makers should now begin to develop prerequisites for stakeholder participation in other environmental negotiations.

Money Pump 2: Rationality is a social idea (Arrow, 1987). In economics this idea means we have to judge rationality in the context of markets and exchange. As people become more experienced with markets for environmental services, their aggregate actions will be more like what traditional

economic theory predicts: in aggregate they will behave more rationally, increasing the efficiency of these markets. However, they also become less concerned about fairness and the preferences of others, which can attenuate private contributions to public goods. Behavioural results suggest that learning through experience will generate distributions of wealth that look more like the Nash bargaining solution. The constrained self-interest characteristic in environmental negotiations today can be expected to give way to mutually advantageous splits of the gains from trade as environmental negotiation continues. Stakeholders not holding property rights to the assets in question will be left with negotiated settlements giving them a smaller share of the gains from trade than they had previously seen. The results suggest that as the collaborative decision-making process is used more in the coming years, wealthy landowners will demand more while other stakeholders will receive less. This development may prompt calls for the refinement of the collaborative process or the introduction of other negotiation procedures. Economic experimental research to test-bed alternative protocol strategies remains a useful tool for policy makers to learn about the efficacy of current and proposed environmental negotiation methods.

Nudge 3: Market experience does not always eliminate behavioral anomalies. Preferences among individuals for others' welfare can persist in communities with markets that are more integrated into the local culture. Another strategic behavioral question revolves around cultural and individual traits in exchanges and nonmarket allocations. These traits are embedded in and shaped by the structure and political economy of the exchange institutions in place. The need for market transactions depends on the efficiency of social and cultural norms to facilitate cooperation and endowment allocations across different parties (Noussair and Tucker, 2005). Market transactions are unnecessary in certain situations because of efficient cultural and social rules governing resource allocation, which holds for people in both developed and developing countries.

The intersection of social preference measurement and market economics raises issues related to Smith's (2003) notion of ecological rationality and Bowles's (1998) argument that social preferences are shaped by institutional transactions. While many individual decision-making outcomes may appear irrational or inconsistent in isolation, successful markets bring together decisions so that rational decisions dominate in aggregate. The market provides feedback to its participants and defines what behavior evolves as rational and utility optimizing. The degree to which markets shape behavior depends on the ability to decrease the transaction costs of social exchanges or make visible the opportunity costs of irrational decisions. In a developing-country context, experiments can be a useful tool to define which transactions require greater market intervention and which ones are regulated through the adaptive symbols created by existing social-preference mechanisms.

Experimental evidence supports this line of reasoning. Experiments in developed countries show how market experience and market institution structure shapes subject behavior. Experienced subjects more familiar with certain market procedures and structure behave differently than the inexperienced. Overall market integration is cited as a variable to explain disparate location-bargaining behavior in field experiments in small-scale societies (Henrich et al., 2001). In rural Papua New Guinea, for instance, Tracer (2004) used the ultimatum game to explore whether people with more integration with markets behave more as rational choice theory predicts. The ultimatum game is an experiment in which one person offers to split some resources with another person. If he accepts, they both receive the offered split; if he rejects the offer, both receive nothing. In abstract noncooperative bargaining model, rational choice theory predicts the person will accept any positive offer, such that a person could offer up a 99–1% split. (More recently it has been shown that nearly any other split is a noncooperative Nash depending on beliefs about the other players.) Experimental evidence has not been kind to this strict 99–1 noncooperative prediction. People reject insultingly low offers. Most people are aware of this intuitively, and they make offers closer to a 60–40% split. Tracer runs the ultimatum game in two villages differentiated by market integration. His results suggest people were less rational the more integrated they were with the market. The people in the more isolated village made lower offers more in line with *Homo economicus*. Understanding

how bounded self-interest is affected by the institutional setting in a real community is crucial for environmental policy.

Mechanism Design

Now consider how behavioral failure can affect mechanism design to control for market failure. Mechanism design studies incentive systems that put constraints on behavior and examine the effects on actual outcomes. When being implemented, a mechanism imposes an individual rationality constraint and a participation constraint and assumes rational responses to incentive-based menus or policies (e.g., Bénabou and Tirole, 2003). However, we know people do not always react as predicted if their rationality, self-interest, and willpower are bounded. The economics literature contains a few attempts to account for such behavioral failures in mechanism design. (Esteban and Miyagawa, 2006) construct a mechanism in which a person suffers from self-control problems and temptation. Within this mechanism, this person prefers to choose from a smaller rather than a larger menu, even if the tempting alternatives are off the equilibrium path. This smaller-is-better finding also was found in smokers: U.S. and Canadian smokers said they were happier with higher cigarette taxes (Gruber and Mullainathan, 2005). The argument is that since the majority of smokers want to quit, any mechanism (e.g., a tax) that helps them do so is welfare improving. The tax restricts choice of an addictive good, which increases the welfare of people with bounded willpower. Using date from the U.S. General Social Survey and similar data from Canada, Gruber and Mullainathan find that excise taxes on smoking make those with a propensity to smoke happier (other taxes do not have the same happy effect). Few such examples exist in the environmental literature.

Nudge 4: If people behave as if they are addicted to the good generating the negative environmental impact, an optimal environmental tax should exceed the standard Pigovian tax. Analogously, encouraging less environmentally damaging substitute behavior might be achieved through policies that incorporate mechanisms providing incentives to pre-commit. For example, (Johansson, 1997) considers how bounded selfishness—altruism—affects the design of a Pigovian tax. However, in general he finds that the existence of altruism itself is insufficient to justify the use of a lower Pigovian tax. An analogous example might relate to cases in which people choose to pre-commit to behavior which is less environmentally-damaging, such as commuting via public transport or cycling. In policy terms this might include provision of a stream of benefits such as subsidies which are dependent upon habitual use. The desire to add altruism to our standard models, however, does raise the issue of double counting in benefit-cost analysis (see Bergstrom, 2006).

Nudge 5: Regarding tax policy, research suggests that complexity can trigger different behavioral responses than simpler taxes which have the same effect on relative prices. Complexity can be used as a screening mechanism to promote efficiency to attain social goals. Congdon, Kling, and Mullainathan (2009) address how behavioral economics might affect (1) the welfare consequences of taxation, (2) using the tax system as a platform for policy implementation, and (3) employing taxes as an element of policy design. Their message is that behavioral economics shows how people respond to taxes themselves and how they interact with the features of the system in place for tax collection. They argue that the behavior of imperfectly rational people is less straightforward than supposed by the standard models which, in turn, will possibly change the conclusions about optimal taxation in a wide variety of ways. With regards to the aspect of tax simplicity, they demonstrate that the behavioral approach suggests that the degree of simplicity enters optimal tax calculation directly, contrary to the traditional case for indirect tax simplicity. While the traditional approach views complexity adding to the costs of tax compliance and administration, behavioral economics allows for behavioral responses to complexity which in some cases tend to overturn this result. They conclude that although behavioral economics does not yet provide definite answers to the issue of how tax policy should best reflect the point that individuals are not always rational, it raises relevant and important questions.

This is directly relevant because many environmental taxes and charges are complex. For example, few environment-related taxes and charges target the externality or resource directly and at a uniform price. Differentiated vehicle taxes and escalating water tariffs are just two examples. In other cases, the tax or charge may not be visible at all to those bearing the burden. More generally, direct, transparent, and explicit pricing of the bad (through a tax or charge) may generate behavioral responses that differ from those that would be predicted relative to a pure relative price effect.

Money Pump 3: People's preferences for taxes and charges as environmental policy instruments are affected by their beliefs about the use to which the revenue is likely to be put—whether to achieve environmental or social objectives. Kallbekken, Kroll, and Cherry (2011) examine how people react to the idea of Pigovian taxation in a laboratory study. They consider how aversion to paying taxes affects the framing and functioning of the classic Pigovian tax. Two key results emerge from their laboratory experiments: First, people were not confused about the nature of Pigovian taxation; they understood how these taxes work and why society might need them, but they did not like the "t-word"—tax. Second, reframing the tax as a fee increased support, especially when revenues were earmarked for the environmental problem. A targeted rebate that reduced inequalities in the distribution of wealth was also preferred by the subjects, which supports the behavioral economics notion of inequality aversion. An aversion to paying taxes is not necessarily a behavioral economic result; if individual think money will be wasted on some project, they will be averse to paying the tax.

Nudge 6: Monetary incentives may crowd out some people's willingness to protect the environment voluntarily, with possible implications for policy choice and stringency. However, since it is difficult to know whose behavior is likely to be crowded out by a given policy instrument and for which reasons (intrinsic or social), this remains an area requiring further research. We further illustrate how one might use behavioral economics to design incentives for environmental protection. We consider Banerjee and Shogren's (2012) model of mechanism design for environmental protection given the existence of social preferences. Behavioral economics has worked to identify behavior driven by self-interest and social motives such as altruism, fairness, isolation, norms, inequality aversion, reciprocation, and intrinsic motivation (see for example Charness and Rabin, 2002). People think about and act on other people's well-being or approval. The economic literature is substantial on social preferences such as fairness, altruism, and warm glow in public-good provision (e.g., Bergstrom, 2006).

Less attention has been given to the behavioral role of social context like isolation and approval in nonmarket valuation (see e.g., Andreoni and Petrie, 2004). But examples exist; one recent study is Alpizar, Carlsson, and Johansson-Stenman (2008), who explore how social context affects actual contributions to a national park in Costa Rica. They find that contributions stated in public were 25% greater than contributions stated in private. Isolation is common in valuation exercises, but people make environmental decisions in social settings and groups. The isolated survey respondent is removed from reality, which is a drawback in much of the stated preference work (also see Jacquemet et al., 2011).

Mechanism design is a formal approach to understand how monetary incentives affect behaviour. But behavioral economists have argued monetary rewards weaken intrinsic motivation, in dramatic terms: the hidden cost of reward, the over-justification effect, or the corruption effect (see Deci and Ryan, 1985). Some people have social preferences to protect the environment without needing or wanting to be paid. Paying them to protect nature might be counter-productive. Money crowds out their willingness to do the good deed (see Bowles, 2008; Bowles and Hwang, 2008) and rewards reduce the ability to indulge altruistic feelings or cause others to doubt their true motive for doing a good deed (Bénabou and Tirole, 2006). If the crowding-out effect holds, money reduces effort, which is the opposite of what standard economics predicts. For example, in case of forest habitat preservation in Finland, private property owners with positive attitude towards environmental protection actually claim less monetary transfer (Mäntymaa et al., 2009). Different factors motivate people to participate in social projects otherwise seen as undesirable: expectations of future returns

(Trivers, 1971), indirect reciprocity (Alexander, 1987), a warm glow (Becker, 1974), enjoyment of donating and giving (Andreoni, 1989), or appreciation of the importance of the work (Martín-López, Montes, and Benayas, 2007).

Other people do not have strong social preferences for the environment or they might find that money actually triggers more good deeds in general—a crowding in effect. These individuals are unwilling to pick up the tab to protect a public good. Unfortunately, it is difficult to identify who falls into each camp by observing people's behavior with respect to a social project. Is their behavior due to intrinsic motivation or social motivation, since people care about reputation as well? These people might want to protect the environment in order to buy a good reputation. A good reputation might be useful to attract new customers, better access to capital or credit markets, entice new property buyers, and so on. Offering up monetary rewards to these people could be counter-productive if they wish to avoid being viewed as greedy instead of generous.

The regulator's dilemma is that he or she does not know which person is which. How does a regulator design a mechanism given the knowledge that both types exist but an inability to differentiate the types? Regulators do not want to chase away people with social preferences by crowding out their incentives to do the right thing; they do not want to reward reputation seekers by paying out extra money that could be spent elsewhere. The open question is whether regulators can design a mechanism that specifies a menu of monetary transfer-to-effort that gets the best out of both types of people. The interaction between extrinsic and intrinsic motives matters to environmental policy. This is a complicated issue that I cannot give full justice to in this paper, but worthy of future research.

Money Pump 4: Designing efficient policy instruments that account for both behavioral and market failures is difficult. What we need instead are flexible institutional designs or adaptive regulatory schemes that would allow policy makers to adjust market-failure regulation for behavioral failures that may become apparent in the future. The other key incentive mechanism is tradable permits, or cap-and-trade. In Shogren and Taylor (2008), we speculated that this may be because the tradable permit mechanism designed to correct market failure also works to correct behavioral failure. We raised the question about incentive design given the theory of second best as related to the interaction between market failure and behavioral failure. The theory of second best says if you have two imperfections, correcting only one failure does not guarantee that social welfare will increase. One could conjecture that if behavioral and market failures exist simultaneously for an environmental good, correcting one failure without correcting the other could actually reduce overall welfare.

The set of challenges would be enormous if we had to design environmental and resource policy to correct both market failure and behavioral failure simultaneously. In the world of *ex ante* policy design, where natural experiments are prohibited and *ex post* policy changes are difficult if not impossible in the near term, constructing policies or markets that promote efficiency without consideration of relevant behavioral failures would likely result in inefficient outcomes. For example, if policy makers introduce a Pigovian tax or subsidy to address climate change externalities without accounting for the fact that people overestimate low-probability and high-severity events, they could create a behaviorally ineffective tax that reduces total welfare (Brekke and Johansson-Stenman, 2008). In theory, policy makers might be able to resolve this problem by adjusting the tax to account for the probability-weighting issue, which would generate a behavioral first best out of a market failure, but then they would need more information than is normally assumed about the representative person (i.e., what is the curvature of the probability-weighting function?).

These arguments might not convince the reader to completely rethink economic analysis on account of the identified behavioral-environmental second-best problem, but analysts should be aware of instances in which the evidence points to a problem and they should rigorously address these realities to advance the science of economics. Considering all possible simultaneous behavioral-market failure combinations in *ex ante* policy design is surely too costly to undertake in meaningful policy settings. This suggests the use of adaptive regulatory schemes in which

policy makers adjust market-failure regulation for behavioral failures that may arise. Researchers need to explore options for flexible institutional design that could be used to account for key failures, including both market and behavioral failures. Perhaps this is all pointing to marketable permits as the best institution to avoid the behavioral second-best problem in environmental policy. Marketable permit systems, provided they are active-exchange institutions, could be the most effective behavioral disciplining device, or at a minimum, the institutional design least affected by behavioral failures.

Concluding Remarks

Behavioral economics can help guide how incentives are designed to protect the environmental good if the insight generated leads to lower health risks and environmental conflicts, encourages more coordination and cooperation, and helps us design better incentive systems. Three big challenges exist when thinking about all this: (1) markets and rationality, (2) the theory of second best, and (3) the moving baseline against which to judge success.

The role of behavioral economics in environmental policy depends on how one views behavior inside and outside of market operations. If one believes that market experience pushes people toward more rational choices, behavioral economics has a limited role in incentive design. Market experience affects behavioral failure by focusing on poor choices with high opportunity costs; behavioral failure affects the creation of new markets if behavioral biases prevent policy makers and people from realizing how to capture potential gains. Behavioral researchers interested in environmental policy might want to think more about the power and the limits of the ideas of rationality spillovers and rationality crossovers. Recent research shows people respond to the feedback and discipline of an active exchange institution by adjusting their behavior to more closely match rational choice theory (e.g., Cherry, Crocker, and Shogren, 2003). Second, I reiterate the concern about a new second-best problem. If both market failure and bounded rationality exist, do policy makers need to think about designing incentives systems to correct both an externality and the list of behavioral biases simultaneously (e.g., our tendency to overestimate low probability/high severity risks)? Otherwise, are we running the risk of a new set of unintended consequences associated with second best beyond just market failure?

Finally, a further concern with applying behavioral economics to environmental policy is the ever-expandable baseline and context-depended preference. Science needs two baselines—an upper and lower bound—against which observed behavior can be compared. In economics, rational-choice theory sets the upper baseline, random behavior the lower baseline. With rational choice theory the baseline is fixed and clear: predicted behavior given optimization over fixed preferences, resource endowments, and relative prices. For a century, the major modification to preferences was to allow for risk aversion. Today, researchers assume people are averse to more than just risk: averse to loss, ambiguity, inequality, lying, myopic loss, guilt, regret, disappointment, inflation, and so on. The challenge is to justify why some aversions are in some models but not in others. The challenge is to separate out one aversion from another if they have similar behavioral effects (i.e., what is the structure difference between guilt aversion and lying aversion?). Re-establishing a new upper behavioral economic baseline that meets various stress tests imposed by economists and policy makers will require more evidence on robustness and more structural theory (see Tversky and Simonson, 1993; Sugden, 2004; Bernheim and Rangel, 2005). In the meantime, behavioral economics offers up ideas on how to design more effective environmental policy for real people. The question is whether these behavioral nudges will stick with people in the long run or whether people really only learn with market-like arbitrage acting as a mirror helping them to discover their preferences (Plott, 1999). A person who has been arbitraged decides on reflection whether he or she likes the preferences that lead to these alternative outcomes.

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