Incentives, green preferences, and private provision of impure public goods

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A B S T R A C T

Pro-environmental preferences are being used increasingly in environmental policy. In this paper, I consider the role of heterogeneous green preferences for private provision of environmental goods that have both private and public characteristics. Under different assumptions of information available to a regulator, I characterize equilibrium properties of several mechanisms. I find incentive-compatible Nash equilibria that provide socially optimal public goods provision when the regulator can enforce individual consumption contracts, as well as when reported consumption contracts are supplemented with group penalties. Throughout the paper, I ground the exposition with examples of consumer behavior in the context of green electricity programs and goal setting for energy conservation.

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Introduction

Environmental policy often appeals to an individual's attitude towards the environment by relying on social norms to influence behavior. By encouraging individuals to "do the right thing," voluntary provision of environmental public goods is acquiring a larger role as a policy instrument (Glaeser, 2014; Allcott, 2011; Ferraro and Price, 2013; Brennan, 2006). However, preferences for public goods are difficult to observe, free riding is a common problem in the provision of public goods, and mechanisms to induce socially optimal provision of impure public goods remain under-explored.

In this paper, I develop a general model of impure public goods provision that facilitates optimal provision under heterogeneous preferences for the environment. Specifically, I posit a model of consumer behavior in which individuals, in addition to their collective value of environmental quality, reap private benefits from their own provision to the public good. "Green" preferences are defined as the differential benefit that arises from both contributing to and consuming an environmental public good (Kotchen, 2005, 2006; Chan and Kotchen, 2014). Previous work has considered mechanisms for optimal voluntary provision of pure public goods (Varian, 1994; Falkinger, 1996; Kirchsteiger and Puppe, 1997; Falkinger et al., 2000), but this literature has not been extended to the realm of public goods for which consumers receive private, or

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"warm glow," benefits from their contribution. Further, my model contains pure public goods provision and "warm glow" only provision as special cases.

Several studies have attempted to quantify tastes for the environment by revealed preference indicators. For example, Kotchen and Moore (2007b) and Jacobsen et al. (2012) examine the conservation behavior of electricity customers who opt into green electricity programs. Additionally, Kahn (2007) uses the proportion of Green Party voters within a county to examine fuel-efficient vehicle sales in California. Further, Sexton and Sexton (2014) characterize private signaling benefits that arise from green consumption for the case of hybrid vehicle purchases. Moreover, recent theoretical work emphasizes the potential cost-effectiveness of quantity over price regulation when heterogeneous preferences for the environment are present (Jacobsen et al., 2014). Other work, however, contends that regulatory tools that aim to affect environmental preferences confound our ability to measure their effectiveness (Brennan, 2006). Clean electricity, energy efficient and renewable energy technology adoption, and fuel-efficient vehicles are salient examples of economic goods that provide both private and public benefits. Throughout the study, I ground the conceptual analysis with examples of consumer behavior in the context of green electricity programs and goal setting for energy conservation.

In contrast to the existing literature in environmental and resource economics, I approach the policy relevance of green preferences as a problem of demand revelation among heterogeneous consumers. Optimal public goods provision is not attained in a laissez-faire economy. Thus, there are attainable efficiency gains by constructing policy instruments that elicit true preferences for the environment. In this effort, I consider the equilibrium and efficiency properties of several mechanisms that fall within the general class of Clarke–Groves mechanisms under different regulatory scenarios. In particular, I relax progressively the information available to a regulator. In the mechanisms considered, I find incentive compatible contracts that support Nash equilibria and induce socially optimal public goods provision when the regulator can contract upon either (1) individual provision or (2) individual reported provision paired with observable group output. I show that a contract conditional on individual reported provision alone is not incentive compatible.

The model I develop in this paper complements previous research that designs incentive contracts to regulate nonpoint source pollution. In particular, I draw insight from the general formulation of team production by Hölmstrom (1982), and its application to environmental regulation through collective penalties by Meran and Schwalbe (1987) and Segerson (1988). Both rely on group penalties that apply when realized emissions levels exceed some desired level of pollution. The parallels to public goods provision are in constructing contracts conditional on the observability of group provision of abatement and its deviation from individual reports. A primary distinction is that emission levels are determined exogenously for nonpoint source pollution, whereas optimal provision of the public good in this paper is constructed from consumer preferences.

I extend the literature on public goods by examining privately provided impure environmental goods in a mechanism design context. Several researchers have examined the implementability and comparative statics of privately provided (pure) public goods (Varian, 1994; Falkinger, 1996; Kirchsteiger and Puppe, 1997; Falkinger et al., 2000). Much of this research, however, relies on strong informational assumptions. I contribute to this literature by examining weaker informational constraints imposed on the regulator. Additionally, I model heterogeneous agents explicitly to provide intuition for incentive compatibility in the case of privately provided impure public goods when consumers exhibit heterogeneous preferences over their own contribution as well as total provision.[1]

While I use examples of green electricity markets to elucidate the results of this paper, the mechanisms put forth extend more generally to the class of goods for which there is a role for ex-post monitoring and enforcement in obtaining efficient private consumption and public goods provision. Some environmental contexts in which these mechanisms might apply are: (i) fuel efficient vehicle purchases, and their corresponding usage; (ii) energy and water efficient technology adoption (e.g., compact fluorescent or LED light bulbs, Energy Star appliances, low-flow shower heads, rain barrels, etc.); (iii) installation of solar water heaters and photovoltaic panels; and so on. Common attributes of these goods include private benefits (e.g., reduced consumption costs of electricity), public benefits (e.g., cleaner air), and the ability for an external party to monitor usage (e.g., periodic utility bills). The latter point is key to allow regulators to construct incentive schemes based on observable provision to the public good. Other environmentally friendly retail goods (such as shade-grown coffee, for example) do not provide a natural market characteristic that regulators can contract upon. Thus, while there are many privately provided public goods to which this model applies, it is not fully general to all impure public goods.

In the next section, I develop a general model of privately and socially optimal provision of impure public goods for two agents differentiated by their value over private and public aspects of an environmental good. I then consider the efficiency properties and incentive compatibility of various contracts under progressively weaker informational constraints on a regulator in the third section. In the last section, I conclude.

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[1] While I motivate this model with environmental preferences, this model applies for the general case of privately provided impure public goods with heterogeneous preferences.