Symposium:
Decentralized Approaches to Environmental Management

Voluntary- and Information-Based Approaches to Environmental Management: A Public Economics Perspective

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Introduction

Interest in decentralized approaches to environmental management has grown significantly in recent years. Along with the standard instruments of environmental policy—quantity, price, and technology regulations—a growing number of voluntary- and information-based approaches (VIBAs) to environmental management have emerged. These include more decentralized policies, programs, and market trends, such as programs that disclose information about potential environmental liabilities, markets for "green" goods and services, third-party eco-labeling, and programs that provide "reputation" benefits in exchange for meeting voluntary environmental standards. Information disclosure programs include the US Environmental Protection Agency's (EPA) Toxics Release Inventory and the US Department of Energy's (DOE) Voluntary Greenhouse Gas Reporting Program. There are more than 400 widely recognized eco-labeling programs in 197 countries and 25 industrial sectors, reflecting the growing demand for environmentally friendly goods and services.[1] The EPA has also created more than a hundred voluntary programs (Borck and Coglianese 2009) that acknowledge environmental performance, and these coexist with other programs sponsored by industry or third-party nongovernmental organizations (NGOs).[2] Taken together, such VIBAs are considered part

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[1]See the Ecolabel Index online at http://www.ecolabelindex.com.
[2]Industry-sponsored programs include the American Textile Manufacturers Institute's Encouraging Environmental Excellence (E3) and the American Forestry and Paper Association's Sustainable Forestry Initiative. Third-party nongovernmental programs include the Audubon Society's Cooperative Sanctuary Program and the Environmental Defense Fund's Alliance for Environmental Innovation Program.

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of the "third wave" of environmental policy, following the first wave of command-and-control regulations and the second wave of market-based instruments (Tietenberg 1998).

This article, which is part of a symposium on decentralized approaches to environmental management,[3] provides a perspective on VIBAs through the lens of public economic theory. The unifying theme is that VIBAs are based on market arrangements where goods and services are based on the simultaneous production of private benefits and the provision of environmental public goods. The innovation of these arrangements is the way in which the jointly produced private benefits of a standard good or service effectively "subsidize" the voluntary provision of public goods. From this perspective, VIBAs can be viewed as a property rights approach because they privatize some aspect of public good provision in order to make such provision more incentive compatible with firm or individual decision-making. We will see that the incentives created through such joint production apply to firms that join voluntary environmental programs and consumers that purchase green goods and services.

In what follows, I first examine why VIBAs are becoming increasingly common. Second, I briefly discuss the concept of bundling and how it has long been fundamental to environmental and resource economics. Third, I introduce the theory of impure public goods as a generalization of bundling and a way to understand markets for environmentally friendly goods and services. Fourth, I consider further applications of the joint production framework to illustrate decentralized opportunities for the efficient provision of public goods and international climate policy. Fifth, I consider how the economic theory of "clubs," which is also based on joint production, relates to familiar topics in environmental management. Sixth, I discuss how club theory provides a way to understand further features of VIBAs. I conclude with a summary of common themes.

Why Voluntary- and Information-Based Approaches?

VIBAs take many forms and can be government sponsored top-down arrangements or private bottom-up activities. For example, the sponsors of eco-labeling programs include governments, industry associations, and NGOs. From an economics perspective, government-sponsored VIBAs, like other types of environmental policy, are responses to market failures. In contrast, private bottom-up VIBAs might be more accurately described as *market* responses to *potential* market failures because the VIBAs themselves are market-based solutions, or perhaps partial solutions, to a market failure. In these cases, the question of interest concerns how the forces that cause markets to fail may instead create opportunities for decentralized activity that promote economic efficiency. Regardless of whether we focus on centralized or decentralized VIBAs, it is useful to begin with the two main (potential) market failures that are the starting point for any analysis of VIBAs.

[3]The other articles are Banzhaf, Fitgerald, and Schnier (2013), which provides an introduction to the symposium and an overview of the Coasean (property rights) and Pigouvian (public economic theory) perspectives, and Anderson and Parker (2013), which takes a Coasean property rights perspective to improving environmental quality and focuses on the role of environmental entrepreneurs.

Potential Market Failures

One source of market failure is incomplete or asymmetric information. There is ample evidence that consumers are generally unaware, or are unable to observe, how their consumption choices affect the environment. Markets will not function efficiently with such incomplete information. For example, individuals who want to reduce their personal carbon footprint may prefer goods and services with lower carbon intensities, but these individuals can only find the low-carbon alternatives if the information is available or at least not too costly to obtain. Hence, without complete information, inefficiencies arise because consumers have a difficult time matching choices with preferences. VIBAs seek to solve this market failure through the improved provision of information, which in turn promotes efficiency through various adjustments in product, capital, and labor markets, as well as by spurring judicial and legislative action (Tietenberg 1998).

The public goods nature of environmental quality creates the second potential market failure. Economic theory tells us that public goods will be underprovided when left to private provision. This is due to the free-rider problem: economic agents have little incentive to voluntarily provide things like environmental protection when they believe others will pick up the slack. Yet everyone would be better off with greater provision—hence the market failure. VIBAs respond to this market failure by trying to make the provision of environmental public goods more incentive compatible. As an example, consider the common structure of programs under which firms meet more stringent environmental standards in exchange for a certification that improves their reputation—the value of which may help preempt future regulation, capture the willingness to pay of green consumers, decrease liability and financing costs, and even increase motivation among employees.[4] Indeed, such programs use certification or reputation "membership" as a carrot to effectively subsidize greater environmental performance.

Political Support for VIBAs

Several factors explain the proliferation of VIBAs and why they are now considered to be a key instrument in the toolkit of environmental management. One reason for the increased popularity of government-sponsored VIBAs is that they are likely to face less political opposition than attempts to impose new taxes or regulatory standards. Typically, there are fewer reasons to oppose information disclosure or voluntary programs. Thus VIBAs have emerged as a popular policy quite simply because they can make it through the political process. For example, failed attempts at national climate policy in the United States led to the Bush administration's pursuit of voluntary greenhouse gas (GHG) intensity targets and the EPA's voluntary Climate Leaders Program. The fact that VIBAs are also perceived as relatively inexpensive to implement and administer further enhances their political feasibility.

[4]There is a large literature on this subject. Theoretical research that considers these different benefits includes Arora and Gangopadhyay (1995), Segerson and Miceli (1998), Maxwell, Lyon, and Hackett (2000), Lyon and Maxwell (2003), Graff Zivin and Small (2005), Baron (2007), and Besley and Ghatak (2007).

Private Politics and VIBAs

As noted earlier, VIBAs are not restricted to the public domain. In fact, they are central to the emerging trend toward "private politics." Baron (2001, 2003) describes private politics as arrangements among private agents that seek to resolve conflicts and govern conduct through self-regulation, with a focus on mitigating problems of commitment, coordination, information, and free-riding. Third-party eco-labeling programs and markets for environmentally friendly goods and services, both of which are often private bottom-up activities, clearly fit this description. It is also becoming increasingly common for private politics to be manifested through VIBAs because of a trend among interest groups and NGOs to seek influence outside of conventional regulatory frameworks. For example, the Environmental Defense Fund (EDF), a leading environmental advocacy organization in the United States, works directly with companies such as FedEx, McDonald's, Levi-Strauss, and Walmart. In fact, the EDF-Walmart partnership led to the opening of an EDF office near the Wal-Mart headquarters in Bentonville, Arkansas, to promote further collaboration.

Effectiveness of VIBAs

VIBAs have become increasingly popular in both the public and private domains, but are they an effective form of environmental management? There is an extensive empirical literature that focuses on program evaluation of VIBAs, but the results have been mixed, ranging from finding that VIBAs produce measurable improvements in environmental performance to finding that VIBAs provide a public relations cover for poor environmental records.[5] The mixed results are not surprising, however, given the diversity of program designs, sponsors, and objectives. This is complicated further by the often significant empirical challenges, including the need to obtain data on the appropriate measures of environmental performance, identify counterfactuals, and address self-selection bias from voluntary participation in VIBAs. Moreover, there are fundamental questions about cost effectiveness and efficiency that require not only empirical study, but also a better understanding of the theoretical basis for VIBAs.

Bundling the Environment

Consider a common marketing strategy: bundling goods together and selling them as a package. Software companies sell multiple programs in an office suite; telecommunication companies bundle television, Internet, and telephone services; tickets are often sold as a seasonal subscription; and restaurants frequently offer multiple courses at a fixed price. There is a substantial literature within the economics of industrial organization that focuses on bundling and the optimal strategies for profit maximization, with an important strategic decision being whether firms should offer goods as a pure or mixed bundle (see, e.g., Adams and Yellen 1976; McAfee, McMillan, and Whinston 1989; Nalebuff 2004; Schmalensee 1984; Stigler 1968). Pure bundling occurs when consumers must purchase the complete bundle or nothing at all. Mixed bundling occurs when consumers can purchase either the complete bundle or its items separately. As we

[5]I do not provide a comprehensive review of this literature here. Some useful references include Khanna and Damon (1999), King and Lenox (2000), Gamper-Rabindran (2006), and the edited volume by Morgenstern and Pizer (2007).

will see, the distinction between pure and mixed bundling is also important for understanding green markets.

Characteristics Approach to Consumer Behavior

A closely related way of conceptualizing bundled goods—with more of a focus on the demand side—is the characteristics approach to consumer behavior (Gorman 1980; Lancaster 1971). In contrast to standard consumer theory, the characteristics approach assumes that individuals obtain utility from characteristics of goods rather than from goods themselves. To illustrate, consider how one thinks about purchasing a new car. A prospective buyer cares about various vehicle characteristics, including but not limited to, safety, comfort, fuel efficiency, and horsepower. On the supply side of the market, each car model consists of a bundle of these characteristics provided at different levels in exchange for the car's price. The consumer would thus obtain different levels of satisfaction from each model depending on its menu of characteristics, and the decision about which to purchase will be based on a comparison of different bundles (cars) at their respective prices. The point here is that consumers often value a good or service across multiple characteristics, some of which may relate to environmental quality, as with markets for environmentally friendly goods and services.

Bundling versus the Characteristics Approach

Although there are similarities between bundling and the characteristics approach to consumer behavior, the two strands of the literature have different emphases. Because research on bundling tends to focus on firms, and the question of whether and how to bundle, the goods under consideration are usually produced separately, as with season tickets to different events and courses on a prix fixe menu. Thus, in these cases, the questions of interest are about bundling, not production technologies. In contrast, models that employ the characteristics approach tend to focus on consumers, and the goods and services under consideration often arise through the technology of joint production. For example, a vehicle's size will affect its fuel efficiency, just as the recycled content of a good may affect its quality. In these cases, the production technologies are usually taken as given, at least in the short run, and thus constrain bundling options.

Environmental Quality and Bundling

It turns out that treating environmental quality as a characteristic within a bundle is not new to environmental economics. In fact, recognizing that the environment is bundled provides the foundation for much of nonmarket valuation (Bockstael and McConnell 2006; Freeman 2003). For example, the hedonic price method seeks to explain the prices of goods and services using a vector of defining characteristics over which consumers derive utility. Many applications of the hedonic price method use differences in property values and property characteristics to infer the value of nonmarket environmental amenities (characteristics) such as scenic views, open space, and pollution. Multisite travel cost studies are also based on site characteristics, although the measure of price is less explicit. These studies use people's travel expenditures to visit recreational areas that have different amenities to measure the willingness to pay (WTP) for environmental characteristics. Stated-preference analyses ask respondents to choose among hypothetical scenarios (bundles) with defining attributes (characteristics at different levels)

to elicit tradeoffs and infer WTP. Finally, the characteristics approach underlies valuation through averting expenditures, but here the relationship between "goods" and "characteristics" is described as "inputs" and "outputs" in a so-called household production framework. These examples demonstrate how treating environmental quality as a characteristic within a bundle has been fundamental to nonmarket valuation. I next examine other ways in which this approach can be useful for understanding VIBAs and other issues related to environmental and resource economics and policy.

The Theory of Impure Public (Green) Goods

The theory of impure public goods, which we now consider, provides the basis for generalizing the characteristics approach to consumer behavior and captures key features of the demand for green goods and services. Cornes and Sandler (1984, 1994, 1996) developed the first version of the impure public good model in which individuals obtain utility from the *characteristics* of goods (rather than from the goods themselves). In their model, one good (i.e., the impure public good) is based on the joint production of two characteristics—one private and one public—which can be obtained jointly and exclusively through the technology of the impure public good. Kotchen (2005, 2006) considers the applicability of this model for understanding the demand for green goods and extends the approach to allow substitutes for the impure public good, which means that the jointly produced characteristics may also be obtained separately, consistent with the mixed bundling approach described earlier.

The Basic Model

To show how the theory of impure public goods can be useful for understanding consumer behavior in green markets, it is helpful to use a little notation. Following the model structure in Kotchen (2006), assume that individuals have preferences consistent with a standard utility function, $U(X,Y)$, where utility (or satisfaction) increases with both X and Y. The difference from a standard model setup is that X and Y are characteristics rather than goods, and the former is private while the latter is public. That is, X represents private consumption of some characteristic and Y represents the level of a public characteristic (that is both nonrival and nonexcludable among all individuals). In this model, three market goods are available for consumption: a conventional good c that provides X, direct donations d that provide Y, and a green good g that is characterized by the joint production of X and Y (i.e., it is an impure public good). The goods have exogenously given technologies such that one unit of c produces one unit of X, one unit of d produces one unit of Y, and one unit of d jointly produces $\alpha > 0$ units of X and $\beta > 0$ units of Y. To further simplify the model, all prices are normalized to unity.

To illustrate how this model works, let's think of X as coffee consumption (or caffeine for those who are addicted), Y as biodiversity conservation, good c as conventional coffee, and good d as a donation to, say, Rainforest Alliance to conserve biodiversity. Note that if the consumer is able to allocate income to c and d only, the model's setup is equivalent to the standard model for private provision of a pure public good (Bergstrom, Blume, and Varian 1986), in which case the characteristics would be equivalent to the goods because one unit of the former would generate one unit of the later. However, because of the availability of the green (impure public) good g, the characteristics X and Y can each be obtained in more than one way. Continuing with our

example, let's think of g as shade-grown coffee (i.e., coffee grown under the canopy of tropical forests rather than in open deforested fields), which is known to promote the conservation of biodiversity. This means that the technology parameter α is the amount of X (coffee or caffeine) that one unit of shade-grown coffee provides and β is the amount of jointly produced Y (biodiversity conservation).[6] More specifically, because of the price normalizations, the parameters α and β represent the amount of the respective characteristic that comes with each unit of income spent on shade-grown coffee. These technologies also reflect the fact that one unit of income spent on either conventional coffee or a direct donation yields one unit of the respective characteristic.

Bundling and Market Viability

The green good's technology parameters yield several insights. First, a consumer would never buy the green good if $\alpha + \beta < 1$ because, in this case, it would be more cost effective to obtain X and Y separately through c and d. In other words, the green good would be inefficient; so buying conventional coffee and making a donation to Rainforest Alliance would be more cost effective than purchasing shade-grown coffee. Thus the condition $\alpha + \beta \geq 1$ is necessary for the *market viability* of a green good.

A second insight, and perhaps the most interesting, concerns the case when the impure public good g has a technological advantage (i.e., $\alpha + \beta > 1$). In our example, this means that purchasing shade-grown coffee is a more cost-effective way for consumers to enjoy coffee and protect biodiversity than purchasing these characteristics separately. It is also worth noting that in this case a consumer would never purchase *both* c and d because it would be more cost effective to purchase g and either c or d to obtain the desired combination of characteristics. Importantly, this result holds even when both c and d are the most efficient way to generate their own characteristics—that is, $\alpha, \beta < 1$. If, however, the green good is the most efficient way to produce one or both characteristics, it would crowd out the market viability of one or both of the other goods. For instance, if shade-grown coffee was cheaper and tasted better, individuals would never purchase conventional coffee. Similarly, if green electricity from renewable sources of energy was cheaper than conventional electricity from fossil fuels, even consumers who care nothing about reducing pollution would always go green. Of course, such scenarios, where technological advances decrease the cost of green goods, are the goal of many environmental advocates.

Another insight concerns the special case where $\alpha + \beta = 1$. This case is of interest because it represents the condition under which bundling and joint production are equivalent. That is, if the technology parameters sum to 1, the cost to the consumer of obtaining X and Y through the green good is the same as obtaining them separately through the conventional good and a direct donation. Therefore, from the consumer's perspective, purchasing a unit of shade-grown coffee would be a perfect substitute for purchasing α units of conventional coffee and making a donation of size β to Rainforest Alliance. This scenario is, of course, the rationale for a familiar marketing strategy, where private goods are bundled with donations to a social or

[6] An important assumption here and throughout the article is that these technology parameters are perfectly observable to consumers and that they reflect true features of the good—that is, there is no "greenwashing." While other studies have focused on the importance of greenwashing (e.g., Lyon and Maxwell 2011), this article focuses on the positive and normative consequences of information provision that is accurate and complete.

environmental cause. Two examples are the *Product Red* merchandise (popularized by Bono from the rock band U2), with proceeds given to the Global Fund to Fight AIDS, Tuberculosis and Malaria, and the *1% for The Planet* program, in which companies agree to donate 1 percent of their annual sales to environmental causes. In the context of our model, these are cases where the impure public good does not have a technological advantage, and the market arrangement is consistent with a mixed bundling strategy that, in theory, should have no impact on a consumer's chosen allocation of X and Y.

Why, then, is mixed bundling such a common marketing strategy, one that is justified on the basis of promoting the provision of (environmental) public goods? One likely explanation is based on transaction costs. For many people, donating to an environmental cause of interest is not a simple task. It takes time and energy to decide how much to give, identify a worthy cause, and make the actual donation. These are real transaction costs that can deter donations. When one's likely donation is relatively small, the willingness to incur these costs is even lower. Bundling donations with goods and services that consumers are likely to purchase anyway makes the task much easier, perhaps even prompting consumers to make donations that they would not have made otherwise. There are also reinforcing incentives on the supply side that make this explanation even more plausible. Bundling sends a positive signal to consumers about a company—that it cares about things like social responsibility, environmental protection, or both—which creates the potential for increased sales and other reputation benefits.[7]

While transaction costs on the consumer side of the market may help explain the prevalence of mixed bundling with public goods, it is also worth noting that the model can readily account for transaction costs using a broader interpretation of the technology parameters. Although the "sticker" price of obtaining X and Y through the green good g might be identical to doing so through c and d, the *effective* price, which includes transaction costs (such as time spent gathering information), might be lower. After normalizing the inclusive prices, the result is the effective condition that $\alpha + \beta > 1$, even with simple bundling, thus creating more cost-effective opportunities for consumer choices that have real potential for public-good benefits, such as the promotion of greater environmental quality.

The Consequences of Green Goods

There are two key questions to address when examining the consequences of markets for green goods and services. Are green products good for the environment? And how do green products affect social welfare? While environmental advocates and economists are likely to place different weights on the importance of these two questions, they are related and necessary for understanding the impacts of markets for environmentally friendly goods and services. The discussion here summarizes the basic insights from Kotchen (2006), which examines these questions in detail.

The first step in considering the consequences of markets for green goods and services is to examine how introducing green goods affects the implicit prices of characteristics, which is what consumers ultimately care about. The basic model described earlier is useful in this regard

[7]An alternative explanation is that bundling public goods influences behavior because it helps alleviate consumer guilt from consumption. For empirical evidence, see Kotchen and Moore (2008) and Jacobsen, Kotchen, and Vandenberg (2012). However, this explanation is more in line with the model of an impure public bad (Kotchen 2009).

because it demonstrates the mechanisms at work in familiar microeconomic theory terms. Consider for a moment the consumer choice problem *without* a green good. With the prices of c and d both normalized to unity, and one unit of each good producing one unit of its respective characteristic, the implicit prices of obtaining X and Y are both unity as well, yielding a price ratio of $P_Y/P_X = 1$. Thus the consumer's implicit demand for each characteristic (which in this case is the same as the good) is a function of this price ratio and personal income.[8] Now consider what happens when we introduce a green good. As discussed earlier, if $\alpha + \beta = 1$ (simple bundling), there is no change in the relative or absolute cost of obtaining characteristics when the green good is introduced, which implies no change in the price ratio of X and Y. Thus introducing a simply bundled green good (assuming no transaction costs) has no effect on the prices of the characteristics of X and Y, meaning that the consumer's demand for characteristics and the consumer's level of utility would remain unchanged.

In contrast, if we introduce a green good with $\alpha + \beta > 1$, things change in interesting ways. Two scenarios are of particular interest because they are cases in which the consumer chooses to consume g and either c or d. If the consumer chooses the conventional good, c still determines the implicit price of X (unity), but the tradeoff between c and g determines the implicit price of Y. The result is a decrease in the implicit price of Y, which (through standard microeconomic reasoning) causes the consumer to choose goods in a way that results in an increased demand for Y.[9] Thus, in this case, introducing the green good increases demand for (provision of) environmental quality. That is, the logic is consistent with shade-grown coffee prompting greater implicit donations than would have occurred through direct donations alone because protecting biodiversity is relatively less expensive when it is jointly produced with coffee.

In the alternative scenario, the consumer's preferences are such that when the green good is introduced, the chosen allocation involves consumption of g and d (i.e., there is no consumption of the conventional good). In this case, d (direct donations) determines the implicit price of Y (still unity), while the tradeoff between d and g determines the implicit price of X, which decreases.[10] Here the effect of introducing the green good will be an increase in demand for the private characteristic. But the effect on demand for Y—the environmental, public characteristic of interest—depends on the cross-price effect. By definition, if Y is a gross complement for X, demand for Y will increase, but if it is a gross substitute, demand will decrease. The latter result is rather counterintuitive because it implies that introducing a green good can actually cause a decrease in demand for environmental quality.

In the context of our example, this finding implies that introducing shade-grown coffee decreases the implicit price of X, causing an increase in demand for coffee consumption. This also means that the consumer's provision of biodiversity conservation through shade-grown coffee will be less than the amount that would have been donated otherwise. That is, the availability of shade-grown coffee causes the consumer to decrease direct donations to Rainforest Alliance, which has a net effect of less biodiversity conservation.

[8]Here we ignore the fact that Y is a public good and that others' provision of Y will affect consumer demand, but we consider this feature of the model shortly.

[9]To see how the implicit price of Y decreases, notice that purchasing one more unit of g yields β units of Y at the cost of $1 - \alpha$ units of X. Thus the implicit price of Y becomes $\beta/(1 - \alpha) < 1$.

[10]In this case, purchasing one more unit of g yields α units of X at the cost of $1 - \beta$ units of Y, so the implicit price of X becomes $\alpha/(1 - \beta) < 1$.

In addition to understanding changes in demand for environmental quality, it is important to examine how introducing green goods affects consumer welfare. On first glance it may seem that introducing green goods will make consumers better off because the availability of green goods expands the choice set and increases the production possibilities frontier. Although, as we have seen, demand for environmental quality may increase or decrease, standard economic intuition suggests that more choices should make consumers better off. It turns out, however, that this intuition is correct only if any decrease in demand for environmental quality is sufficiently small. If the decrease in demand for Y is large enough, the public good feature of environmental quality becomes important. Because Y is a public good, the utility that each consumer derives from provision of the good depends on the *aggregate* level of provision. This implies that a decrease in one individual's contribution to provision of the public good, ceteris paribus, has a negative effect on others' utility. Thus it follows, rather counterintuitively, that introducing a green good can cause a decline in social welfare despite the fact that it expands both the choice set and the production possibilities frontier.[11]

Further Discussion of Impure Public Goods

The previous discussion considered how impure public goods capture the defining features of environmentally friendly goods and services, and how extensions of the basic model can be useful for understanding the positive and normative implications of green markets. In this section we apply the joint production framework to two other topics that rely on voluntary incentives combined with the joint production of private and public characteristics: production decisions and climate policy.

Production Decisions

The literature on impure public goods in general, and applications to green products in particular, have focused primarily on the consumer side of the market. Nevertheless, there are important questions on the producer side of the market, specifically how the green technologies of joint production arise and the implications of different market structures for environmental quality.

Using an approach that is similar to the approach in the industrial organization literature, Heal (2003) examines the bundling of private and public goods as a strategic decision for profit maximization. He finds that if a firm can price discriminate perfectly, it will provide the bundle that is Pareto efficient with respect to the allocation of both private and public goods. That is, when there is perfect price discrimination, the market will solve the problem of allocating public goods efficiently. The intuition for this result is that even without a market for the public good, bundling it with a private good affects consumers' WTP for the latter, and as long as that WTP can be captured by the firm selling the private good, the firm's optimal strategy will be to provide the public good at the socially optimal level. Thus, in effect, demand for the private good subsidizes provision of the public good. While this may strike some readers as similar to classic Lindahl pricing for efficient provision of a public good, the difference is that here pricing

[11]Although the particulars of this result depend on the comparative statics of Nash equilibria (described more fully in Kotchen 2006), highlighting the range of possible results here provides a sense of the potential advantages and disadvantages of green markets.

happens indirectly through bundling with a private good rather than through individualized prices for the public good. Indeed, this difference makes the insight that perfect price discrimination leads to an efficient allocation of public goods more applicable to real-world settings. Potential applications of Heal's result include markets for ecotourism and smart growth developments. For example, he writes that

> [I]n southern Africa it has often proven most profitable for ranchers to stop cattle ranching and restore their land to its natural state, with native vegetation and animals, so as to charge tourists to view the animals. In restoring the native flora and fauna they are providing a public good, biodiversity conservation, and this good is enhancing the willingness of tourists to pay to visit their land. So they capture at least some of the value of the public good in enhanced willingness to pay for private goods—beautiful scenery, cultural heritages, unique biodiversity and other generators of tourism all are public goods whose existence generates demand for private goods such as transportation, accommodation, and food. (554)

Heal (2003) also describes how smart growth housing developments fit the model because developers provide public goods associated with housing, such as open space and scenic views, that enhance value and the WTP of prospective buyers. More generally, Heal's result hints at the opportunities for further research on the producer side of the market to more fully characterize the incentives that promote efficient provision of bundled and jointly produced environmental public goods.

International Climate Policy

The case can be made that *international* environmental agreements should also be considered as VIBAs. The sovereignty of nations suggests that international coordination to solve environmental problems is inherently voluntary, and thus the challenge is to overcome free-riding in the provision of global public goods (Barrett 2007; Sandler 2004). Climate change is the most obvious example: maintaining a stable climate is clearly a global public good that benefits all nations, but each nation has little incentive to incur the costs of reducing its own GHG emissions. No nation can solve the problem on its own, and each would prefer others to shoulder the burden. However, with GHG emission reductions there are often benefits that go beyond the global public good of climate stabilization.

Most methods for reducing GHG concentrations are associated with ancillary benefits (sometimes called co-benefits) because other pollutants or otherwise undesirable activities are reduced as a by-product.[12] There is a substantial empirical literature on the ancillary benefits (and sometimes costs) of reducing GHG emissions (e.g., OECD 2000).

The point here is that from a theoretical perspective, the impure public good is again the relevant concept. Rübbelke (2002) treats the primary and ancillary benefits as joint production that gives rise to an impure public good from a nation's perspective, with reducing the stock of GHGs in the atmosphere being the public characteristic (which benefits all nations) and the

[12]Examples include improved health and visibility due to greater efficiencies and the use of cleaner fuels; improved national security because of greater energy independence and fewer imports of foreign oil; and habitat conservation because of initiatives for Reducing Emissions from Deforestation and Forest Degradation (known as REDD).

ancillary benefits that accrue to a nation from undertaking the reductions (e.g., health improvements from the reduction of more localized pollutants) being the private characteristic. This impure public good approach highlights many of the incentives for unilateral climate policies and explains the willingness of some nations to engage in international agreements. That is, joint production of private benefits provides an additional incentive for a nation to provide global public goods.

Club Theory in Familiar Territory

We now discuss a second strand of the public economics literature—club theory—which is also relevant for VIBAs. Although it is related to the notion of impure public goods, club theory captures additional features of decentralized arrangements for solving environmental and natural resource problems, in particular eco-labeling and voluntary environmental programs.

Basic Concepts in Club Theory

The seminal paper on club theory (Buchanan 1965) defines clubs as private nongovernmental mechanisms for providing goods that are excludable yet subject to some degree of congestion—that is, public goods that eventually exhibit some of the rivalry associated with private goods. Common examples of such clubs are country clubs, day-care centers, cinemas, and social or religious organizations. A fundamental question of club theory is whether it is more efficient to replicate provision of the "public" (i.e., club) good for smaller groups or to provide it on a larger scale and incur the eventual congestion costs. Buchanan (1965) shows that the answer to this question is not only yes, but that under certain conditions, decentralized clubs result in Pareto optimality through a balancing of club size and the level of provision of the club's good.

A closely related result that is likely to be more familiar to many environmental economists is Tiebout's (1956) model about how people "vote with their feet."[13] Tiebout assumes a large number of communities, with each having its own fixed bundle of local public goods, and that for each community there is an optimal size at which the cost per person is minimized. The implication is that in equilibrium, the population "sorts" itself into different communities—that is, clubs—that achieve a Pareto optimal allocation. Again, this is a decentralized mechanism that yields the efficient provision of public goods. What is more, Tiebout's sorting mechanism is based on the bundling of private and public goods: people cannot enjoy a community's public goods without having purchased the private goods of land or housing in that community.

Clubs also provide useful insights into many of the solutions to environmental and natural resource problems. Not surprisingly, many of these solutions seek to address inefficiencies that arise from congestion; for as Buchanan (1965) notes, "the theory of clubs is, in one sense, a theory of optimal exclusion, as well as one of inclusion" (13).

[13]For a detailed discussion of the similarities and differences between Buchanan (1965) and Tiebout (1956), see Cornes and Sandler (1996).

Clubs as Property Rights

The ability to exclude members from a club assumes some degree of established property rights that allows the club to monitor utilization of the good, charge for membership, and keep nonmembers out. This notion of property rights is central to Knight's (1924) early application of club theory, which offers strategies for managing open-access and congestible resources. Knight considers two highways that run between the same two locations. One is wide enough to accommodate all vehicles that might use it but is of low quality. The other is of better quality, enabling faster speeds, but is narrow and subject to congestion. Knight argues that with open access to the highways, motorists will distribute themselves between the two roads such that commuting times on each will be identical.[14] However, this equilibrium is not Pareto optimal because shifting some motorists to the uncongestible road would make them no worse off while making those on the congestible road better off.

Knight's proposed solution is to establish private property rights over the congestible road so that its owner could set a profit-maximizing toll and thereby turn the congestible road into an excludable club good. The particularly insightful implication of this proposal is that the profit-maximizing club would set the toll equal to the Pigouvian tax and result in Pareto optimality. More generally, one can think of this result as the standard sole ownership solution to the "tragedy of the commons," which arises because congestion externalities are fully internalized and the incentives for profit maximization align with socially efficient management. It is important to note, however, that Knight's insight also suggests a different possibility: sole ownership could be for the right to establish a club and charge a membership fee, which means the profit-maximizing fee results in efficient management of the commons.

Individual transferable quotas (ITQs), another solution to the open-access problem that is increasingly common in fisheries management, can be viewed as another application of basic club theory.[15] ITQ programs have been established around the world and have proven effective (Costello, Gaines, and Lynham 2008). Key issues in the design of ITQ systems concern the number of permits to issue and the units of catch admissible per permit. Thus an ITQ system is essentially a "Buchanan" club, focusing on exclusion through membership (number of permits) and the level of club good provision (limited total allowable catch).

Clubs as Institutions for Self-Regulation

Regardless of the mechanism, when it comes to solving the tragedy of the commons, economists often assume the need for rules that are externally established and enforced so that agents will coordinate behaviors in their collective self-interest. But there are numerous real-world examples and an entire literature that questions this assumption in a variety of settings. Research in this area is generally associated with the extensive work of Elinor Ostrom, corecipient of the 2009 Nobel Prize in Economics. A primary theme of Ostrom's research (along with numerous coauthors) is that users of a common-pool resource frequently organize themselves

[14]This follows because motorists will keep choosing the faster high quality highway until congestion slows traffic enough so that motorists are indifferent between roads, and travel on both will be at the speed of the slow uncongestible road.

[15]ITQs are transferable property rights in the form of permits that allow a designated level of catch per permit; only those possessing a permit have access to the resource.

to effectively manage use of the resource, and they do so in ways that are often more sustainable than externally imposed rules.

The challenge, of course, is to identify the circumstances under which the institutions for successful self-regulation are likely to emerge and be sustained. To address this, Ostrom (1990, 2000, 2010) provides a list known as the Design Principles Illustrated by Long-Enduring Common-Pool Resource Institutions. The relevant point here is that several of Ostrom's principles relate directly to club theory—namely that arrangements must be made for property rights that enable monitoring utilization, charging club members, and excluding nonmembers. Other principles focus on how the club-like institutions for self-regulation are administered, maintain legitimacy, and relate to larger systems. Indeed, the case can be made that examination of decentralized institutional arrangements for solving the commons problem can be understood broadly as theoretical and empirical studies of club theory.[16]

Clubs with Environmental Externalities

I now turn to the ways that club theory is useful for understanding VIBAs as a new approach to environmental management. The innovative idea is that many VIBAs are essentially clubs with positive environmental externalities. VIBAs also pose new questions for club theory and offer opportunities for further research.

Green Clubs

As part of many VIBAs, participating firms agree to meet a standard of environmental performance that is above and beyond what government regulations require. As discussed earlier, the reasons for participation are the perceived benefits of affiliation with the program's "brand name." Firms may participate to earn a green price premium because although consumers may value certain environmental attributes, they generally do not view a firm's environmental claims as credible unless those claims have been certified. Another possible motive for participation, one that is well established in the industrial organization literature, is that voluntary environmental programs may help preempt more costly environmental regulations (Maxwell et al. 2000).

A participating firm may also enhance a VIBA's brand name by increasing its visibility, credibility, or both. Thus, from a firm's perspective, participation in a VIBA may be an impure public good with private benefits to its bottom line and shared benefits with other program participants. But these shared benefits are excludable in a way that effectively makes voluntary environmental programs clubs. The program's standard sets the provision rule—the stringency of which influences the club's reputation and conveys benefits to members only. Congestion is also likely to be a feature of voluntary environmental programs. That is, the reputation benefits of membership are based on differentiation, and until a critical mass of participation (or membership) is reached, more members are beneficial. Eventually, however, the number of members may become sufficiently large so that differentiation is no longer valuable, and having more members begins to erode the reputation benefits.

[16]Interestingly, Ostrom (2010) begins her Nobel lecture by mentioning how, along with her husband and colleague Vincent Ostrom, working with Charles Tiebout had a significant influence on her thinking.

Voluntary programs and positive social externalities

There is, however, a fundamental way in which voluntary environmental programs differ from standard clubs. As Potoski and Prakash (2009, 20) argue, "Voluntary programs (or voluntary clubs) differ from traditional "Buchanan" clubs because their central purpose is not to produce club benefits for their members. Instead, their intention is to induce members to produce positive social externalities beyond what government regulations require them to produce."

These positive social externalities are, of course, greater environmental protection. This feature of voluntary environmental programs led Potoski and Prakash (2005, 2006) to coin the term *green clubs* to characterize VIBAs that provide club benefits to members along with positive environmental benefits that are nonexcludable even outside the club—that is, environmental public goods enjoyed by society at large—such as cleaner air or water.[17]

Because green clubs produce positive environmental externalities, evaluation requires careful attention to the distinction between the "within-club" and "economy-wide" viewpoints. That is, should the utilities of club members and nonmembers be considered when evaluating the normative implications of green clubs? Some of the literature, including Buchanan (1965), adopts the within-club viewpoint, which considers only the utility of club members, while others adopt the total-economy viewpoint, which takes into account the utility of nonmembers as well (Sandler and Tschirhart 1997).

This distinction matters for green clubs because there are tradeoffs concerning club features. That is, features beneficial for club members are not necessarily beneficial for overall social welfare. For example, a more rigorous club standard creates reputation benefits and means better environmental performance from each participating member, but participation will be lower in such cases because membership is more costly. It follows that more rigorous standards need not produce greater environmental protection that benefits society as a whole. Similarly, larger clubs may not increase provision of the environmental public good. Congestion may imply that larger clubs need to relax the club standard in order to maintain membership, and more members complying with a weaker standard can increase or decrease the provision of environmental quality. Similar tradeoffs may arise with more stringent monitoring and enforcement, which can increase a club's reputation, encouraging membership, but at the same time make it more costly to join, thereby discouraging membership.

The impact of club sponsors

How a green club manages these tradeoffs will depend on the objectives of the institution that sponsors the club's creation. Program sponsors of green clubs tend to fall into three groups: government agencies, industry associations, and third-party NGOs.[18] It is natural to assume that government agencies will take an economy-wide viewpoint and seek to maximize overall social welfare, balancing the benefits of club members against those outside of the club that experience the spillover benefits of environmental public goods. In contrast, industry-sponsored clubs are likely to take the within-club viewpoint, making management decisions that seek to maximize the benefits of club members. Finally, third-party NGOs sponsors are likely to

[17]The collection of papers in Potoski and Prakash (2009) considers VIBAs from a club theory perspective and presents several empirical case studies.

[18]See van't Veld and Kotchen (2011) and Kotchen and van't Veld (2009) for a detailed discussion of the implications within a club theory framework,

have neither of these objective functions. Rather, environmental organizations may establish green clubs with the sole intent of maximizing provision of the environmental public good (i.e., without concern for club members or nonmembers beyond the constraints they impose on the club's viability).

The different objective functions of club sponsors lead to different conclusions about the positive and normative characteristics of green clubs, both of which are necessary for evaluating the likely environmental consequences and economic efficiency of VIBAs. In this context, van't Veld and Kotchen (2011) find that there is an important tension between the congestion externality from conventional club theory and the free-riding externality from the theory on private provision of public goods. One policy-relevant implication of this finding is that if monitoring of the club standard is perfect, governments should leave sponsorship to industry if the potential public-good benefits are sufficiently low,[19] but to third-party NGOs such as environmental organizations if the public-good benefits are sufficiently high.[20] If, however, monitoring of the club standard is imperfect, an important issue is whether consumers can infer that a club is too large for its standard to be credible, and that only if consumers cannot gauge credibility do the results hold about government preferences for delegating sponsorship.

Research implications

While van't Veld and Kotchen (2011) and Kotchen and van't Veld (2009) show that club theory is useful for understanding VIBAs, their model is limited because it considers only one club at a time. To generalize these results, future research should incorporate many clubs using a Tiebout sorting approach. Another useful extension would be to consider (simultaneously) the impact of multiple clubs with different institutional sponsors (and therefore objective functions) competing with one another. Such a model would help to explain the evolution of different and competing standards in markets such as the one for certified organic foods (see Strom 2012).

Partnerships in the Commons

The notion of multiple clubs, each with positive externalities, has also been applied in a common-pool resource framework. Although the connection to club theory has not been made explicit, this perspective can help further our understanding of the intuition underlying some important results. For example, Heintzelman, Salant, and Schott (2009) consider a partnership solution to the common-property problem that they call "putting free-riding to work."[21] Their analysis is of interest here because of the way it implicitly combines club theory with theory on the private provision of a public good—that is, club theory with a positive externality. Heintzelman, Salant, and Schott (2009) consider a fishery facing the familiar common-property problem of overfishing: none of a fixed number of agents (totaling N and

[19]This is because industry is better equipped to manage congestion, which is the primary concern when public-goods benefits are small. This could apply to cases where product quality is more of an issue than environmental externalities.

[20]This is because, unlike an industry-sponsored club, an NGO-sponsored club will have an interest in promoting public-good provision, say pollution reductions, at the expense of club benefits.

[21]This idea was also developed earlier by Schott et al. (2007), which presents the results of a laboratory experiment that evaluated the performance of the partnership solution.

assumed to be identical) has an incentive to restrain his effort for the benefit of others but at a cost to himself. In this context, Heintzelman, Salant, and Schott (2009) define a "partnership" as a subset of agents that pool their catch and divide the gross revenue equally, regardless of individual contributions to the catch.[22] These partnerships are essentially clubs, identified by both their membership and provision conditions.

But how can such partnerships solve the tragedy of the commons? The easiest way to examine this issue is with two extremes. The first is the case of N partnerships, with each consisting of a single agent. The second is a single partnership consisting of all N agents. We know that the first case will result in overfishing, as nothing has changed to deviate from the standard "tragedy of the commons" result. In the second case, however, the result is too little fishing effort because the shared catch is a public good and thus each agent has an incentive to free-ride on the fishing effort of others. The insight of Heintzelman, Salant, and Schott (2009) is that at some intermediate point between these extremes, there exists some number of partnerships (i.e., clubs) that partitions the N agents such that the equilibrium will sustain the optimal level of fishing effort. Intuitively, the partnership solution arises because the creation of free-riding incentives counteracts the incentives for overexploitation.

The point here is that this partnership solution is essentially club theory (with multiple clubs) from an economy-wide viewpoint. We have already established that the partnerships are clubs. Notice, however, that each club imposes an externality on those outside the club (i.e., members of the other clubs). The externality is still based on congestion because, as in the case of single agents, if one club increases its catch, it becomes harder for the members of other clubs to find and catch fish for themselves. Thus intuition suggests that optimization from the within-club and economy-wide viewpoints will result in different solutions. We might expect the former to take no account of the costs external to the club and the latter to result in overall efficiency in management of the commons. However, similar to the findings of Buchanan (1965), the partnership solution indicates that there exists a stable equilibrium of clubs that is efficient from both viewpoints—a particularly useful result for management of the commons.

Summary and Conclusions

VIBAs have become increasingly popular as instruments of environmental and natural resource management. The rise of VIBAs has been accompanied by the emergence of a substantial literature on this subject. Much of the theoretical literature has grown out of the field of industrial organization. This article has provided a different, although complementary, perspective on VIBAs through the lens of public economic theory. In particular, I have shown how the economic theory of impure public goods and clubs can be used to analyze many of the positive and normative questions about VIBAs. We have seen that introducing markets for environmentally friendly goods and services can either increase or decrease demand for the voluntary provision of environmental quality. Moreover, the same mechanisms that underlie these results (i.e., joint production of private and public benefits) help explain both the role of bundling the environment as a strategic production decision and the ancillary benefits of international climate policy. Club theory is based on the provision of impure public goods,

[22]They note that such partnership arrangements characterize real-world institutions such as catch-sharing among Japanese fisheries.

and the concept of clubs offers a useful way to view various solutions to managing common-pool resources and the incentives of different sponsors to create many types of voluntary environmental programs—or "green clubs."

The unifying theme throughout this article has been the argument that many VIBAs use the joint production of private benefits to subsidize the voluntary provision of public goods. It is well understood that markets are very effective at allocating private goods efficiently; this is because private goods are both rival and excludable. However, most environmental and natural resource problems arise because the goods under consideration are either public or owned in common, and public goods are neither excludable nor rival. The standard instruments of environmental policy—including quantity, price, and technology regulations—seek to correct market failures by mandating changes or creating incentives to encourage more efficient outcomes. VIBAs seek to accomplish similar objectives but use more decentralized approaches. In effect, VIBAs create mechanisms to harness what is economically desirable about private goods and combine them with public or club goods to promote more efficient outcomes. Thus green markets combine environmental public goods with the consumption of otherwise private goods and services. Moreover, as we have seen, many voluntary environmental programs are clubs that promote green markets and create private incentives for firms to join, thereby taking advantage of club efficiencies.

The enthusiasm for VIBAs to promote environmental quality needs to be balanced with economic questions about cost effectiveness and efficiency. A solid argument can be made that in most contexts and on a large scale, VIBAs are unlikely to be effective substitutes for more centralized policy instruments. Again, the reason is the public goods nature of the problem. Even the most successful VIBAs—those that make a cost-effective difference—still face powerful disincentives for private provision of environmental public goods. And while VIBAs may indeed help mitigate environmental problems in many settings, the instances in which they themselves will produce economically efficient outcomes in practice are likely to be few and far between. The focus on VIBAs is still important, however, because they clearly have the potential to make meaningful contributions to environmental protection, promote significant expenditures on the environment, and create new opportunities for eco-entrepreneurship. From a policy perspective, identifying the circumstances under which VIBAs are likely to be most effective should continue to be a priority among environmental and resource economists. Moreover, from a theoretical perspective, VIBAs create institutions that make for interesting economic analysis and often pose new questions for microeconomic theory.

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