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The behavioral response to voluntary provision of an environmental public good: Evidence from residential electricity demand

Grant D. Jacobsen [a,*], Matthew J. Kotchen [b,c], Michael P. Vandenbergh [d]

[a] University of Oregon, Planning, Public Policy and Management, Eugene, OR, United States
[b] Yale University, School of Forestry & Environmental Studies, New Haven, CT, United States
[c] National Bureau of Economic Research, Cambridge, MA, United States
[d] Vanderbilt University School of Law, Nashville, TN, United States

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ABSTRACT

This paper develops a theory of voluntary provision of a public good in which a household's decision to engage in a form of environmentally friendly behavior is based on the desire to offset another behavior that is environmentally harmful. The model generates predictions about (1) participation in a green-electricity program at the extensive and intensive margins, and (2) changes in electricity consumption in response to participation. We test the theory using billing data for participants and nonparticipants in a green-electricity program in Memphis, Tennessee. High-consumption households are more likely to participate, and they participate at higher levels. In terms of a behavioral response, households participating above the minimum threshold level do not change electricity consumption, but those participating at the minimum threshold increase electricity consumption 2.5 percent after enrolling in the program. The result is based on identification strategies that exploit before–after differences between participants and nonparticipants, and differences in the timing of enrollment among participants only. Despite the increase in electricity demand upon the purchase of green electricity for the households with a "buy-in" mentality, the net effect for the buy-in households is a reduction in pollution emissions, as the behavioral response is not large enough to offset the environmental benefit of the green-electricity purchase.

1. Introduction

Why do individuals and households engage in pro-environmental behavior? It often comes at substantial private cost for frequently diffuse and, on its own, inconsequential public, environmental benefit. Such behavior is nevertheless common, especially in the realms of energy efficiency and the reduction of greenhouse-gas (GHG) emissions. Some behaviors, such as the purchase of a hybrid car, solar panels, or home weatherization products, can be justified on the basis of private payback periods, but the rate of return in many cases is too low to fully explain the prevalence of observed purchases. Other behaviors, such as the purchase of many green products, carbon offsets, and participation in green-electricity programs, operate more like charitable contributions.[1] With these behaviors, the primary goal is to promote

* Corresponding author.
E-mail addresses: gdjaco@uoregon.edu (G.D. Jacobsen), matthew.kotchen@yale.edu (M.J. Kotchen), michael.vandenbergh@vanderbilt.edu (M.P. Vandenbergh).

[1] According to survey data, the number of consumers buying "green products" increased from 12 percent in 2007 to 36 percent in 2008, and remained at 36 percent in 2009 despite the recession (Mintel International Group, 2009). The voluntary carbon offset market grew over 15-fold between 2005 and 2008, increasing in size from $45 million to $705 million (Ecosystem Marketplace & New Carbon Finance, 2009). With respect to green

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environmental quality. This paper seeks to broaden the understanding of why we observe the latter type of pro-environmental behavior, referred to here as voluntary provision of an environmental public good.

We begin with a theory of voluntary provision in which a household's decision to engage in a form of environmentally friendly behavior is based on the desire to offset another behavior that is environmentally harmful. The interrelated behaviors that we consider throughout the paper are a household's conventional electricity consumption and participation in a voluntary green-electricity program that provides financing for electricity generation from renewable sources of energy. In this context, the theory is built on the idea—which we ultimately test—that households purchase green electricity in order to mitigate disutility associated with pollution emissions generated through their own consumption of conventional electricity. We consider two variants of the model's setup. In one version, a household cares about the exact amount of green-electricity it purchases. In the other version, a household only cares about whether it purchases the minimum amount required to participate in the green-electricity program. For both cases we derive conditions for participation at the extensive and intensive margins for a green-electricity program that is based on the voluntary contribution mechanism.

The model is also useful for examining how participation in the green-electricity program might affect demand for electricity more generally. Does participation in the green-electricity program affect a household's electricity demand? How might potential changes in electricity demand differ if participation is prompted with an offset motive or an offset motive combined with a "buy-in" mentality? And if electricity consumption changes, what is the net effect on emissions? It is easy to envision cases where households purchase a minimum amount of green electricity that is used to justify an increase in electricity demand; and if the increase in demand is greater than the purchase of green electricity, net emissions increase. With these questions in mind, we use the model to motivate the study of behavioral responses to voluntary provision of an environmental public good.

We then test implications of the model using billing data from the Green Power Switch (GPS) program in Memphis, Tennessee. We obtained data from Memphis, Light, Gas and Water (MLGW) on monthly electricity bills between 2003 and 2008 for all 910 households participating in the GPS program as well as a sample of 30,012 nonparticipating households.[2] In total, the dataset consists of more than 779,037 monthly observations. The GPS program at MLGW began in 2005, so we have billing data for two years before and three years after households could first participate in the program. The first part of our empirical analysis examines the relationship between average electricity consumption and decisions about participation in the GPS program. The models are based on cross-sectional variation in household electricity consumption prior to enrollment in the GPS program, and we evaluate the relationship between consumption and program participation at both the extensive and intensive margins. The second part of our analysis examines whether households that participate in the GPS program change their electricity consumption after doing so—that is, we test for a behavioral response to participation. We employ a fixed-effects research design whereby identification of the behavioral response is based on comparisons between participants and nonparticipants, before and after enrollment in the GPS program. We also estimate models that exploit before–after differences based on the timing of enrollment among participants only.

We find that households with greater electricity consumption are more likely to participate in the GPS program and to participate at a higher level. We interpret the results as consistent with our model—meaning that participating in the green-electricity program is motivated in part by households feeling an obligation to offset, to some degree, the pollution emissions associated with their own conventional-electricity consumption. With respect to evidence of a behavioral response, we find that when participants at all levels are lumped together, GPS participation does not lead to a statistically significant change in electricity consumption. If, however, we consider only participants that enroll at the minimum level, we do find evidence of a behavioral response: these households increase electricity consumption 2.5 percent after enrolling in the GPS program. This result, and the fact that it differs from that for participants at higher levels, is also consistent with our theoretical model, which links a "buy-in" mentality to expected differences in the behavioral response. Finally, given that in some cases the purchase of green electricity causes an increase in electricity consumption, we consider the net effect on emissions. It turns out that the 2.5 percent increase in consumption, which translates into 35 kWhs/month for the average household, is less than the GPS minimum participation threshold of 150 kWh/month in green-electricity production. Hence, despite a behavioral response of increased electricity consumption, the net effect on environmental quality even for the buy-in households is a reduction in emissions.

The remainder of the paper is organized as follows. The next section reviews the most relevant literature and explains the contributions of our theoretical and empirical analysis. Section 3 develops the theoretical framework. Section 4 describes the GPS program and our data collection and preparation. Section 5 describes our empirical methods and reports the results. Section 6 summarizes and concludes.

2. Relation to existing literature

Economists often perceive pro-environmental behaviors, such as the voluntary purchase of green electricity, as examples of private provision of public goods. Important features of the standard model for privately provided public

(*footnote continued*)
electricity, over 5 million residential and commercial customers participate in such programs in order to provide financing for the generation of electricity through renewable sources of energy (REN21, 2009).

[2] These data were provided in such a way that names and address were excluded from each observation to ensure anonymity of MLGW customers.