MEASURING FREE RIDERSHIP: DO SOME EXPERIMENTAL DESIGNS CONTROL TWICE FOR FREE RIDERSHIP?

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Summary

The issue of free ridership in DSM programs has been one of the more confounding problems facing researchers responsible for estimating the cost effectiveness of DSM programs. Free riders can be defined as those participants who would have undertaken some or all of the actions promoted by the DSM program, even if the program had not been offered. Since some actions would have been taken even if the program had not been offered, some analysts argue that these non-program induced savings should not be counted when evaluating the program. To further complicate this issue, a DSM program may result in participants displacing certain conservation actions that they would have undertaken with other actions offered as part of the DSM program. Thus, program participants may be undertaking actions that they would not otherwise have taken, but net savings may still be impacted due to the displacement of other conservation actions.

This paper addresses several issues concerning free riders. These are summarized below:

- The estimation issues associated with free riders can usefully be viewed as control group issues. Viewed in this perspective, experimental designs and statistical procedures can be developed to produce more precise estimates of net program savings. The procedures available to address free ridership also address a larger set of control group issues, and the analyst should take this into account when interpreting estimation results.

- Free riders affect two components of DSM program evaluation. They affect the benefits side of the analysis by influencing the magnitude of the difference between gross and net program savings. Free riders also influence the cost side of a DSM evaluation. Controlling for free riders on the benefits side, but not making adjustments in the program-induced costs, can understate the cost effectiveness of certain programs. Recognizing that an adjustment is required is only part of the solution. Estimates of the magnitude of the required adjustment in costs are also required and this can be a difficult, uncertain task. No estimate of the magnitude of the required adjustment in costs is produced internally by most evaluation designs. This adjustment has to be estimated using other information. This may be one reason why some past evaluations have not made this free rider adjustment to the program-induced costs.

- Several experimental designs control for free riders as part of the estimation process. If the researcher believes these controls are adequate, then there is no need to further reduce estimated program induced savings by subtracting additional free rider impacts based on estimates from survey responses.

- Some benefit-cost evaluation perspectives, notably the participant-perspective test, require the use of gross savings estimates. Experimental designs that use control groups as a proxy for the actions participants' would have taken in the absence of the program directly produce ***net*** savings estimates, and there is no good way to back out a gross program impact estimate, *i.e.*, an estimate that includes savings from free riders. An estimate of gross savings can be obtained by using information from other sources on free ridership.

In the evaluation research performed to date, controlling for the influence of free riders on the estimates of program-induced energy savings has been emphasized. This emphasis may, in some cases, have resulted in DSM program evaluations understating benefits relative to the costs. This understatement of program cost effectiveness stems from the non-parallel treatment of benefits and costs, *i.e.*, adjusting savings for free riders but not always adjusting the costs. It also stems from not addressing a second potential problem with the control group, *i.e.*, the possibility that the program has "moved the market." This is also termed the free-driver effect. While many of the statistical techniques employed do address free riders and, in theory, can produce estimates that are net of free

riders, they do not capture impacts on estimated savings from the free-driver effect. Free drivers can be an important bias in the control group and, therefore, in the estimate of baseline energy use.

An analysis of free riders raises two broader policy questions. The first is whether the current focus on estimating program impacts net of free riders is warranted in light of the fact that free ridership is more of a distributional question than a pure efficiency question. If free riders are judged to be important, a second issue concerns how much confidence researchers can have that experimental designs that directly produce net savings estimate do, in fact, control for the influence of free riders.

Background

Many public utility commissions require the use of net savings in certain benefit/cost tests, while other tests require the use of gross program impacts. In this context, these terms are defined as:

- ***Gross program impacts***—the change in energy use resulting from all program-related actions taken by participants; and
- ***Net program impacts***—those impacts solely attributable to participation in the DSM program.

Estimating net program impacts poses several challenges for the evaluation researcher. An estimate of net impacts requires researchers to estimate the change in energy use that would have occurred had the program not existed. This change can never be observed directly. The program was, in fact, offered and customers did participate in the program; therefore, any estimate of the change in energy use that would have occurred had the program not existed must be based on a hypothetical scenario and utilize proxy information.

One of the options available to evaluation researchers for estimating what the participant group actions would have been in the absence of the program involves the use of a control group of non-participants. The use of a control group to serve as a proxy for what actions would have been taken by a participant group sounds straightforward, but there can be many problems in practice.

Free ridership is one of a set of potential control group issues. Free riders, self-selection, and free drivers all can be viewed as biases in the baseline estimates of consumption from which the change due to the program is measured. All three estimation issues stem from the same source—a control group that does not provide a baseline exactly representative of what the participant group would have done in the absence of the program. A perfect control group would solve all three problems, and provide an exact estimate of what the participants' energy consumption would have been in the absence of the program.

Free Riders as a Control Group Issue

If some of the participants would have undertaken conservation actions anyway (*i.e.*, been free riders), then the perfect control group will accurately estimate what the participants would have done and the free rider effect netted out in the estimate of savings. A comparison of the *change* in energy use between participants and the control group for pre- and post-participation time periods would fully account for free riders. Therefore, free ridership is only a problem when the control group is not a good proxy for what the participants would have done without the program.

Self-selection

Self-selection is another representation of the same control group problem. Self-selection and free ridership have been viewed as almost synonymous terms, but there are important differences. Self-selection encompasses a number of potential biases, not just free ridership. For example, self-selection occurs when programs are voluntary and participants are allowed to select themselves into the program. This makes complete random assignment between control and participant groups impossible. Customers choose to participate in the program, choose not to participate, or may not be aware of the program. This volunteerism can result in systematic biases between the participant and any non-participant control group selected for the evaluation. The fact that certain customers chose to participate and others did not is, itself, a systematic difference between participants and non-participants. Free ridership may be one manifestation of this bias in that those individuals who already were likely to undertake the conservation actions promoted by the program are also those likely to choose to participate. This would tend to decrease estimates of net, program-induced savings. However, there are other forms of self-selection bias that can serve to increase estimates of program-induced savings.

Free Drivers

Free drivers also involve a potential bias within the control group. In this case, the issue involves the potential for having a "contaminated" control group. The concern

is that the control group is not isolated from the influence of the program. For example, in a new construction standards program, some builders may decide to build to the program's energy-efficient standards to compete effectively in the new housing market with participating builders. However, while building to the program's standards, these builders decide not to actually participate in the utility's program due to concerns about administrative costs and red tape. Therefore, the program is inducing some "non-participants" into taking conservation actions. If these non-participants are used as part of the control group, their energy use will not be a good proxy for what the consumption of participants would have been had the program not existed. Again, when free drivers are viewed as a control group problem, several potential solutions are suggested.

Approaches for Addressing Control Group Biases

A number of approaches for addressing the self-selection and free rider issues have been developed in the literature on program evaluation. Fewer methods for assessing the impact of free drivers have been developed.

Self-selection and Free Riders

There are two sets of approaches for addressing self-selection and free riders. These involve:

- Obtaining a control group that is as representative as possible of the participant group so that it does, in fact, provide a good proxy for what the participant group would have done in the absence of the program.

- Taking advantage of the available statistical techniques designed to account for systematic differences between the participant and non-participant control groups.

The first set of approaches often involves the experimental design of the evaluation and the selection of the control group. Concern over problems such as self-selection and free ridership has resulted in some utilities evaluating DSM programs to attempt to undertake some form of random assignment to programs and control groups. Concerns about perceived customer inequities stemming from not offering the program to all customers has discouraged some utilities from proposing this approach. However, the need to obtain reliable estimates of DSM programs using viable control groups has resulted in some utilities considering random assignment to programs and control groups as part of the evaluation design.[1]

The second set of approaches take advantage of a number of statistical methods that have been developed in the program evaluation literature addressing self-selection. These approaches typically involve the estimation of two equations—a participation equation and an energy savings equation.[2] These two equations can then be used together to provide a better set of control variables, *i.e.*, a better estimate of what the participant group would have done had the program not been offered.

Free Drivers

Several approaches for addressing this issue have been suggested, while few have been implemented.[3] One approach is to use, as an estimate of baseline energy use, an historical baseline that occurs prior to the inception of the program. For example, if a new construction program has been in existence since 1988, it might be possible to develop average energy usage estimates for 1988 and use those estimates as the baseline from which savings can be measured. This approach clearly is subject to a directional bias. Specifically, this baseline is likely to be biased on the high side since it is likely that new construction in subsequent years would show some improvements in energy efficiency and using the 1988 level as a baseline would tend to overestimate energy use. The net result is likely to be an overestimate of energy savings. However, improvements in baseline energy efficiency are likely to be small over only a three-year time period. As a result, this overestimate is likely to be small unless structural changes occur in the market, such as the establishment of energy-efficiency standards or modifications in the building codes. While this approach may tend to overestimate savings, the direction on the bias is known and it could provide a useful upper bound on savings.

The second approach involves using survey methods to determine whether non-participants have changed their energy use as a result of the program. Surveys have often incorporated a set of free rider questions and it is certainly possible for the non-participant control group to be asked if the existence of the program has impacted their actions.[4] There are difficulties with this approach. A utility's customers may not be aware of the different ways the program may have influenced their energy use. For example, they may not be aware of the extent that the program has changed the energy-efficiency equipment stocked by merchandisers or suppliers. However, this issue could be addressed by surveying trade allies. While the use of survey questions to address contingent actions (*i.e.*, actions that would have been taken under a hypothetical set

of circumstances) are subject to a number of well known biases, it remains true that this has been a standard approach for addressing free riders and there is no reason why it cannot be used to address free drivers as well. This approach can, at least, produce some insights into the presence or absence of free driver effects for certain DSM programs.

Double Counting Free Riders

There are two ways the impact of free riders can be double counted in a DSM program evaluation. The first can occur if the researcher is not aware that the use of a non-participant control group is one way of controlling for free riders. In this case, an estimate of free ridership derived from survey research may be used to further reduce the estimated net savings. While this may seem obviously incorrect, it should be recognized that the control group is used to address a number of issues other than free ridership. The fact that the control group also serves as a proxy for the actions that would have been taken by participants if the program had not existed is not always recognized. The second way in which double counting can occur is when free riders are not treated symmetrically on the benefits side and cost side of the evaluation analysis.

Double Counting Free Riders in the Savings Estimates

It should be recognized that the control group is not only used to control for free riders, but is also used to control for other factors that may have changed. This includes factors that vary over time such as weather, prices, and simple time trends, as well as other systematic differences between the participant and control group that may vary cross sectionally, such as income, size of establishment, conservation ethic, previously taken conservation measures, and stocks of energy-using equipment. Multivariate statistical analysis and self-selection correction methods are meant to address these differences between the participant and control group. However, these procedures typically do not let the analyst separate out and identify the impacts of free riders independent from these other potential biases. As a result, the fact that one purpose of using a control group is to serve as a proxy for the actions that would have been taken by the participant group is not always recognized.

There may also be some circumstances where the analyst does not believe that the control group is a good proxy for the actions that the participant group would have taken and, as a result, chooses to further subtract out perceived free riders. However, a control group should control for free ridership, at least to some extent.

Double Counting Free Riders by Not Adjusting Program-Induced Costs

A second way in which free rider effects can be double counted occurs when program savings net of free riders are used to calculate benefits, but no corresponding change is made on the cost side. Participant costs are a component of many of the basic benefit/cost tests, including the Total Resource Cost Test or All Ratepayers Test. If some participants would have undertaken program actions anyway, and the savings from these customers are subtracted from program savings, then the costs incurred by these participants should be subtracted from the total program-induced costs.[5]

For some programs, these participant costs can be significant. A new construction program where there is cost sharing between the utility and participant is one such example. A study conducted for Central Maine Power Company[6] found that approximately 70% of the program costs were participant costs. With this fraction of costs and the use of net savings estimates, inconsistencies between the free rider treatment of benefits and costs could have a major impact on the cost effectiveness analysis of the program.

Once there is recognition that costs need to be adjusted to be consistent with the free rider treatment on the benefits side, an estimate of the participant costs associated with free riders is needed. Generally, the free rider effect on estimated net program savings cannot be isolated by the statistical models. The free rider effect is mixed in with a number of other influences, all of which are addressed through the control group and the statistical model.[7] If free riders could be assumed to reduce savings by 30%, then it might be reasonable to assume that participant costs should be reduced by 30%. However, when the free rider effects are not isolated, what is the best estimate to use? In some cases, the only available estimate might be the response to a set of survey questions addressing free riders.

Some benefit/cost tests require estimates of gross program savings and gross program costs (both utility and participant). The Participant Test is a test that requires these inputs. Since a statistical model employing a control group produces net savings, the savings estimate must be adjusted *upward* for free riders to provide a gross estimate. Again, the impact of free riders embodied in the net estimate may be unknown. As a result, the only available estimate may come from survey questions.[8]

This may not be an important consideration since the Participant Test usually is not one of the key screening tests for DSM programs.

Conclusions

The issue of free riders has received considerable attention in the evaluation literature. This paper has discussed how free riders can be viewed as a control group issue and how certain treatments of free riders in evaluations have the potential to double count free rider effects. Double counting can be easily corrected simply by understanding the role of free riders within an experimental design that uses a control group as an estimate of baseline energy use and by being careful to address free riders on both the benefits and cost sides of the analyses. One problematic issue remains—how to estimate the appropriate adjustment to participant costs in benefit-cost tests when the free rider effect is not isolated by the experimental design. The only approach available may be to use estimates based on survey research, and these are subject to many well known biases.[9]

A broader question concerns whether it is important to control for free rider effects. Free riders *do* undertake conservation actions and savings *do* occur. What changes is who pays for the conservation action. If the utility subsidizes these actions, in whole or in part, then some of the costs are transferred from the participant to the utility. While this is a distributional question, it is not necessarily a major question for overall efficiency. The utility may incur some unnecessary marketing costs to obtain these savings and this does represent a loss in efficiency. While true, these costs are likely to be less than the direct costs of installation. The importance of accurately addressing and isolating the free rider effect is dependent upon the breadth of the screening test to be used. If a broad societal test is used, then the impact of free riders is reduced. Regulators may want to revisit this issue to see if regulations in their jurisdiction place free riders in the appropriate perspective.

Endnotes

[1]One example of a version of this approach can be found in the "Plan Update for the New England States Gas Evaluation and Monitoring Study (GEMS)," prepared for Boston Gas Company, by RCG/Hagler, Bailly, Inc., April 1991.

[2]References to this work can be found in *Impact Evaluation of Demand-Side Management Programs — Volume 1: A Guide to Current Practice*, EPRI CU-7179, prepared by RCG/Hagler, Bailly, Inc., February 1991.

[3]The issue of free drivers has been very important in evaluations of new construction programs. New construction programs that have achieved high participation rates and have been in existence for a number of years may have a sizable impact on the actions of non-participants. Evidence of this impact was found in two evaluations: *Good Cents Home Program: Impacts and Evaluation*, prepared for Wisconsin Public Service Corporation, by RCG/Hagler, Bailly, Inc., March 1989; and in *Evaluation of the Energy Savings Resulting from Central Maine Power Company's Good Cents Home Program*, prepared for Central Maine Power Company, by RCG/Hagler, Bailly, Inc., November 1990.

[4]This was an approach used in the evaluation of a new construction program performed for Central Maine Power Company (see Endnote 3). In this study, questions about whether the program had changed the new home market were asked of trade allies and individuals involved with program implementation.

[5]However, the costs incurred by the utility in program implementation, marketing and incentives should not be adjusted.

[6]See Endnote 3.

[7]See Ozog, M., and D. Violette. "Using Billing Data to Estimate Energy Savings: Specification of Energy Savings Models, Self-Selection, and Free Riders," In *Proceedings of the ACEEE 1990 Summer Study on Energy Efficiency in Buildings*, Vol. 6, 1990.

[8]This approach was used in the *New Jersey Conservation Analysis Project*, prepared for the New Jersey Conservation Analysis Team, by RCG/Hagler, Bailly, Inc., Final Report, August 1990.

[9]Fang, D.M., and D.W. Lui. "Free Rider Ratios in Conservation Programs: Estimates and Issues," Illinois Commerce Commission, 1989.