RESIDENTIAL CONSERVATION INCENTIVES: A REVIEW OF LOAN IMPACTS

Linda Berry
Oak Ridge National Laboratory
Oak Ridge, Tennessee

ABSTRACT

Althoug incentive effects vary greatly from one program setting to another, it may be possible to set some rough boundaries on the magnitude of the effects, all else being equal, that they are likely to produce. The purpose of this paper is to review evidence on the magnitude of loan effects from a series of utility-sponsored home energy audit program impact evaluations.

The studies reviewed in this paper produced estimates of loan impacts that vary from 20% to 300% more energy savings in loan programs than in audit only programs. Much of the difference in these estimates results from how well one controls for the effects of self selection, program setting, target population characteristics and levels of loan usage. It seems likely that at typical levels of response to loan programs (about 50% of audited customers using loans), with all else being equal, a loan program will produce about twice the energy savings of an audit only program.

INTRODUCTION

Governments and utilities in the United States have spent large sums on financial incentive programs to encourage household investment in conservation retrofits. The Tennessee Valley Authority, for example, provided more than $300 million in zero-interest loans to 366,000 of its residential customers by the end of September, 1984 (Tennessee Valley Authority, 1985), and federal energy tax credits are expected to cost $2.5 billion between 1981 and 1986 (Hirst, Goeltz and Manning, 1982). Hundreds of smaller grant, loan, and rebate programs also exist to encourage more investment in energy efficiency. How effective are these incentives? Unfortunately, little is known. Neither formal demand models nor studies evaluating particular programs provide adequate answers.

The range of variables that are relevant to evaluations of incentive programs are presented in Table 1. Previous literature reviews (Berry 1982; Berry, 1984; Stern and Aronson, 1984; Stern, Berry and Hirst, 1985) indicate the importance of qualitative program features (such as marketing strategies and consumer protection plans) to program outcomes and discuss the probable effects of incentive and target population characteristics on outcomes. Financial variables alone explain little about customer response, since formally identical programs offering zero-interest loans have produced response rates that range from 8% to 90% of eligible households (Lerman, Bronfman, and Tonn, 1983). Although the evidence clearly shows the dominance of the total program context in determining the size of incentive effects, no systematic studies of the essential elements are available.

Even though incentive effects vary greatly from one program setting to another, it may be possible to set some rough boundaries on the magnitude of the effects that they are likely to produce.

Table 1. Program and Outcome Variables Relevant to Evaluating Incentive Programs

Program Variables
Size of incentive
Type of incentive
Size of target population
Type of target population
Stage of program development
Qualitative features:
marketing strategies
credibility of sponsor
consumer protection features (reinspections, guarantees)
other services (audits, bidding)
restrictions on participation
Outcome Variables
Percent of target population attracted to program (e.g. requesting energy audits)
Percent of above using incentive
Investment per household using incentive
Lifetime of conservation measures installed
Energy savings per household using incentive
Incremental savings by those attracted to program
Effects on pace of investment
Administrative costs

ESTIMATES OF LOAN IMPACTS

Several previous evaluations of home energy audit programs show that programs that offer loans have higher net energy savings per participant than programs that offer only audits (Tables 2 and 3). Hirst (1984) reviewed data from studies of Residential Conservation Service (RCS) programs which offer only audits (Table 2) and from mainly zero-interest loan programs sponsored by utilities. Participants in the six RCS audit only programs saved between 3 and 9 MBtu/year for an average savings of about 5 MBtu/year. Participants in the six audit plus loan programs saved between 10 and 20 MBtu/year for an average savings of about 13 MBtu/year. These findings suggest that loan programs produce about three times as much energy savings as audit only programs. Hirst's (1984) findings do not provide clear evidence on the magnitude of loan effects, however, because households that choose to obtain loans differ from households that do not.

Table 2. Summary of Energy-Saving Estimates for Residential Conservation Service Home Energy Audit Programs[a]

State/Utility	Dominant heating fuel	Net energy saving per participant (MBtu/year)[b]
Connecticut	Oil	9[c]
Michigan	Gas	6
Wisconsin/Wisconsin Power & Light	Gas	3[d]
Minnesota/Northern States Power	Gas	5
California/Pacific Gas & Electric	Gas	3
Washington/Seattle City Light	Electricity	5[d,e]

[a]These analyses are based on actual fuel consumption records for samples of both RCS participants and nonparticipants. Only about one year of postaudit data was used in these evaluations to assess savings; additional data and analysis are needed to determne the long-term effects of these programs on energy savings.

[b]These savings are those that can be directly attributed to the RCS program (i.e., the increase in savings beyond that which would have occurred without RCS).

[c]Because of data quality problems with fuel oil data, this estimate is an average of one based on engineering analysis (16 MBtu) and analysis of actual fuel bills (2 MBtu).

[d]These estimates are for RCS-like programs operated in 1978 and 1979.

[e]Electricity at end-use energy.

Source: Hirst, 1984.

Table 3. Summary of Energy-Saving Estimates for Audit-Plus-Loan Programs[a]

State/Utility	Net energy saving per participant (MBtu/year)
Minnesota/Northern States Power	20
Washington/Seattle City Light	11
Washington/Puget Sound Power & Light	13
Oregon/Portland General Electric	10
Pacific Northwest/	
Bonneville Power Administration	12
Pacific Power & Light	12

[a]These analyses are based on actual fuel consumption records for samples of both participants and nonparticipants. The estimates are for electrically heated homes for all cases except for Minnesota (gas-heated homes).

Source: Hirst, 1984.

That is, households that decide to obtain loans have a greater need for retrofit, have more interest/awareness/concern with conservation, and may have already decided to make more extensive installations.

In Hirst's review, loan program participants were defined as only those households that used the loans. Households that chose to obtain loans are a self-selected group that is the most active part of the target population in terms of conservation. The RCS program participants, in contrast, were defined as all households that obtained audits regardless of subsequent investments in conservation measures. This definition includes a broader range of the target population in terms of conservation activity. Thus, these differing definitions of "participants" exaggerate the effects of the loan programs: if the full range of conservation activity by households in both program types were compared, estimates of loan effects would be smaller.

Another problem with these loan/no-loan program savings comparisons (Tables 2 and 3) is that the program context or setting is not uniform. Most of the loan program results come from utilities in the Pacific Northwest. Most of the RCS audit-only program results come from utilities in eastern states.

A recent ORNL study (Berry and Tonn, 1984) attempted to deal with both self selection and program setting as confounding factors. To control for self selection a group of households eligible for loans (whether they chose to use them or not)* was compared with participants in an audit only program. The two programs were conducted by the same utility (Northern States Power), in the same time period (1980-1983), in the same metropolitan area (Minneapolis-St. Paul), and used the same auditors and audit procedures. As a result, the program settings for the two programs were similar and loan effects could be estimated while controlling for most other program factors. There were differences in the composition of the two target populations, however, that could not be controlled.

Ideally, one would control for self selection and program setting by randomly assigning households to loan and no-loan conditions. If the two groups are equivalent in all respects except their eligibility/noneligibility for loans, then differences in their retrofit actions can be attributed to the loan's influence. In practice, utilities are reluctant to implement such experiments. The possibility of customer complaints and of legal difficulties explains much of this reluctance. In addition, most utility program managers lack familiarity with social science research methods and with the advantages of experimental designs. Program managers also are usually so heavily involved in implementation problems--hiring and training staff, developing promotional materials, preparing budgets and

---

*This type of control procedure also has been used in impact studies of remedial education programs. Voluntary remedial programs, like home energy audit/loan programs, can be expected to attract more highly motivated segments of the eligible population. By comparing impacts on all those eligible vs all those not eligible, motivational factors and all other characteristics associated with self selection into the program are controlled.

accounting--that they give little attention to evaluation issues until late in the program development process.

Data collected in an evaluation of the two NSP residential conservation programs in Minnesota (Hirst et al., 1983) allowed for a rough approximation of the experimental situation needed to test for the incremental effect of loan availability. One of these home energy audit programs [Public Utility Conservation Investment Program (PUCIP)] offered loans, while the other program [Minnesota Energy Conservation Service (MECS)] did not. As a result, a group that was eligible for loans and a group that was not eligible for loans could be compared while program setting remained constant. Opportunities to examine the results of such natural quasi-experiments are rare and, thus, of significant value.

Comparisons of customer response to the loan (PUCIP) vs no-loan (MECS) programs in the St. Paul, Minnesota area showed that customers eligible for loans took more retrofit actions and invested nearly twice as much money as customers not eligible for loans (Table 4). The loan program participants (including both those who used loans and those who obtained only an audit) also saved slightly more energy than the no-loan program participants (6 MBtu/year vs 5 MBtu/year) Thus, in the NSP case, the availability of loans stimulated higher levels of retrofit investment and produced about 20% more energy savings.

CONCLUSIONS

As expected, implementing controls for self selection and for program setting produced smaller estimates of loan impacts on energy savings than comparisons that lacked these controls. The PUCIP/MECS comparison may be an underestimate of typical impacts, however, for two reasons. First, the MECS target population was slightly wealthier and better educated than the PUCIP target population. This compositional difference would make customer response to the MECS program higher. Second, marketing efforts for the PUCIP loans were minimal. Bill stuffers were the only marketing vehicle and most PUCIP participants first learned of loan availability from the auditor. In part because of the low level of marketing effort, the proportion of audited households that chose to obtain PUCIP loans was considerably lower than in more aggressively marketed programs. Both Tennessee Valley Authority and Bonneville Power Administration loan programs, for example, usually have half the audited customers going on to obtain loans. In some utility service areas, over 80% of audited customers chose to obtain loans. Obviously, the higher the proportion of audited households choosing to obtain loans, the higher the average level of conservation retrofit investment and energy savings will be for a loan program.

In conclusion, the Hirst (1984) estimates of loan impacts probably exaggerate loan effects because self selection and program setting factors are not controlled. The Berry and Tonn (1984) estimates probably understate typical loan effects because of an unusually low level of marketing and customer response to the PUCIP loan offer.

The studies reviewed in this paper, produced estimates of loan impacts that vary from 20% to 300% more energy savings in loan programs than in audit only programs. Much of the difference in these estimates results from how well one controls for the effects of self selection, program setting, target population characteristics and levels of loan usage. It seems likely that at typical levels of response to loan programs (about 50% of audited customers using loans), with all else being equal, a loan program will produce about twice the energy savings of an audit only program.

Table 4. Post-Audit Retrofit Investment Levels, Energy Savings, and Measure Lifetimes by Program Group

	MECS	PUCIP		
		Audit only	Audit + loan	Weighted average[a] (both groups)
Contractor cost of retrofits installed ($)	550	470	2550	1032
Audit estimate of potential savings for installed measures (MBtu/year)	12	10	52	21
Actual energy savings[b,c] (MBtu/year)				
Total	15	17	33	21
Net	5	0	20	6

[a]These figures are weighted to reflect the proportions of PUCIP-audited customers that also obtained loans. The loan users were 27% of the audited group. Thus the weights are 0.27 for the loan-plus-audit group and 0.73 for the audit-only group.

[b]These figures are based on analysis of actual monthly natural gas bills. Total savings refers to the decrease in consumption between year 1 (1980/81) and year 3 (1982/83). The net saving is the portion of the total saving that can be directly attributed to the NSP audit and/or loan program (i.e., the saving that would not have occurred without the program). Net savings are obtained by subtracting the change in consumption for nonparticipants from that for participants.

[c]A recent update of the NSP energy-saving analysis used an additional year of natural gas data. This analysis (Hirst and Goeltz, 1985) showed a statistically significant net energy savings for the PUCIP audit-only households of 4 MBtu/year two years after participation. Comparable figures for the PUCIP (audit-plus-loan) households and the MECS audit households were 25 and 4 MBtu/year, respectively. The weighted-average net energy savings for PUCIP participants was 10 MBtu/year, considerable higher than the 4 MBtu/year for the MECS participants.

Source: Berry and Tonn, 1984, and Hirst et al., 1983.

REFERENCES

Berry, L. G., 1984, "The Role of Financial Incentives in Utility-Sponsored Residential Conservation Programs: A Review of Customer Surveys," Evaluation and Program Planning 7, 131-41.

Berry, L. G., 1982, The Role of Financial Incentives in Utility-Sponsored Residential Conservation Programs: A Review of Customer Surveys, ORNL/CON-102, Oak Ridge National Laboratory, December.

Berry, L. and B. Tonn, 1984, Loan Impacts in Northern States Power Home Energy Audit Programs, ORNL/CON-145, Oak Ridge National Laboratory, February.

Hirst, E., 1984, "Household Energy Conservation: A Reivew of the Federal Residential Conservation Service," Public Administrative Review 44(5) (September/October).

Hirst, E., and R. Goeltz, 1985, Energy Savings One and Two Years After Participation in Minnesota Home Energy Audit and Retrofit Loan Programs, ORNL/CON-168, Oak Ridge National Laboratory, January.

Hirst, E., R. Goeltz, and H. Manning, 1982, Household Retrofit Expenditures and the Federal Residential Energy Conservation Tax Credit, ORNL/CON-95, Oak Ridge National Laboratory, July.

Hirst, E., et al., 1983, Evaluation of Home Energy Audit and Retrofit Loan Programs in Minnesota: The Northern States Power Experience, ORNL/CON-136, Oak Ridge National Laboratory, December.

Stern, P. C. and E. Aronson (eds.), 1984, Energy Use: The Human Dimension. Committee on Behavioral and Social Aspects of Energy Consumption and Production, National Research Council. New York: W. M. Freeman.

Stern, P. C., L. G. Berry and E. Hirst, 1985, "Residential Conservation Incentives," Energy Policy, April.

Tennessee Valley Authority, 1985, Conservation Report, 1984, Division of Conservation and Energy Management.