

Effect of Weatherization Programs on Low-Income Customer Arrearages

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Weatherization programs targeting low-income customers in Oregon and Washington were analyzed to determine what effect participation in utility-sponsored programs had on reducing customer billing arrearages.

A higher proportion of participating customers in the Oregon study were able to change their billing status from "problematic" to "normal" than did non-participating low income customers.

Prior to the program, participants had significantly higher median annual arrearages than did the control group. After the program, the two groups were statistically similar. The decrease in median arrearage indicated that the group as a whole reduced arrearages. The median amount of arrearage decreased for program participants from an annual total of \$11.84 to \$3.14. The median arrearage for the control group rose from \$3.06 to \$3.88, which was not a significant change.

In the Washington study, program participants had worse bill paying habits than non-participants, but improved their situation following weatherization. Many participating low-income customers were able to considerably reduce the amount of annual arrearage and the frequency of monthly arrearages. Customers with the most serious problems appeared to be the ones who benefitted the most. On average, participating customers cut their arrears in half, while the non-participating customers experienced a slight increase between the pre- and post-treatment periods.

Introduction

Traditionally, impact evaluations have focused on measuring energy savings, and have neglected quantification of other potential benefits. An important aspect of conservation programs is the financial impact of reducing energy consumption. This is especially true in the case of low-income programs. Significant benefits can be accrued by both the utilities and the rate payers by reducing write-offs and the costs of bad debt collection (late notices, collection agencies, disconnect costs, etc). It was estimated that in the State of Washington alone, the total cost of bad debt in UTC-regulated utilities has exceeded \$9.5 million in 1985. Added to the rate base, these costs caused a 0.1-0.4 mills increase per kilowatt-hour.¹

Pacific Power began offering residential weatherization programs in the late 1970's. In 1982-83 Pacific participated in the Bonneville Power Administration's (BPA) Weatherization Buyback Program which offered rebates to customers who installed cost-effective weatherization measures. Participant income data collected in this program showed that only ten percent were low-income households. Regulatory concerns about the disproportionately lower number of participants with incomes below the

poverty guidelines led to the development and offering of low-income residential weatherization programs throughout Pacific's service territory in the mid-1980's.

The goals of Pacific's Low-Income Programs are to assist economically disadvantaged customers in reducing their electric energy usage, resulting in a lower electric bill while providing the utility with reduced demand for electricity, and to reduce customer billing arrearages. The purpose of this paper is to analyze the effect Pacific's Oregon and Washington Low-Income Residential Weatherization Programs have had on participant billing arrearages.

Program Descriptions

The Low-Income Programs offer funding to offset the cost of installing energy efficiency measures which include insulation (wall, ceiling, floor, duct, and pipe), water heater wrap, energy efficient shower head, infiltration measures, window replacement (or storm windows), and temperature setback controls. To qualify for the programs,

participants must use electricity as their primary fuel source and have a household income which does not exceed 125 percent of the Poverty Income Guidelines established by the U.S. Department of Health and Human Services. The programs are available to renters and owners of single family homes, apartments, and mobile homes.

Community Action Program (CAP) agencies in both states handle the administration of the low-income weatherization programs. They are responsible for identifying, qualifying, auditing, and arranging installation of weatherization measures for program participants. In return, Pacific currently allocates \$1,000 and \$1,350 per participant for measure installation in Oregon and Washington respectively. Program administration cost per resident are limited to \$150.² In Oregon, prior to August 1989, funding was limited to \$350 per program participant. In Washington, prior to March 1988, funding was limited to \$500 per program participant. These funding limits were increased in an attempt to significantly increase program participation.³ In addition to funding for weatherization by Pacific, Community Development agencies in Oregon and Washington provided matching funds.

In conjunction with the weatherization, energy conservation education programs have been piloted recently in Oregon and Washington. The energy education programs provide training to low-income program participants on energy usage and conservation practices. In Washington, the Yakima Valley Energy Savings Partnership Program (YVESP) was piloted during the 1988/89 heating season. In Oregon, two programs have been piloted by CAP agencies. The North Coast Energy Counseling Pilot Project was offered in the fall of 1989 to establish a "full services low-income program" which in addition to weatherization would provide: (1) energy education, (2) budget counseling, (3) equal payment plan, and (4) energy assistance payments. In East Central Oregon the Responsible Energy Awareness Learning & Living (REALL) Program was piloted in 1990. One of the goals of weatherization/energy education programs is to reduce the number and frequency of customers who are behind on paying their electric bills.

Methodology

This evaluation of low-income customer arrearages employs a quasi-experimental design--comparison between a treatment group and a similar, but untreated, control group(s)--to net out the background effects not attributable to program efforts.

If data are not normally distributed, i.e., if the median and mean are far apart, analyses of variance and covariance are not appropriate. In these cases, non-parametric tests must be used to determine whether distributions and/or medians are statistically similar. In the analysis of arrearages, median values were compared using the Median Test for Two Samples⁴, means were compared using simple difference of means t-tests, and distribution similarities were evaluated using the Wilcoxon rank sum test.⁵ The Wilcoxon test does not require assumptions about the shape of the underlying distributions. It tests the null hypothesis that the two sample populations have the same distribution. However, the form of the distribution need not be specified.⁶

Data Sources

The data sources for the arrearage analysis included: (1) a Program Participant Database which included participant data, measures installed, and measure costs, (2) Company Customer Accounting Records which included kWh usage, housing characteristics, and bill payment history, (3) a Company Customer Survey Database (Energy Decisions Survey)⁷ which included household income, end-use appliance information, housing characteristics for program non-participants (Oregon Study), and (4) a Demographics Database⁸ which contained census tract data which provided average household income and number of people (Washington Study).

Pacific's records on bill payment history contain two variables COLLECT(yr) and WRTOFF(yr). COLLECT(yr) gives a brief history of the account's payment behavior during year "yr", i.e., it shows whether the account has a history of bad debt and if the account is on any special payment program. WRTOFF(yr) gives the cumulative number of write-offs up to year "yr".

Treatment Groups

Oregon: The treatment group was identified from customers participating in the program between August 1989 through April 1990. The CAP agencies began receiving the higher funding limit per weatherized home at the start of this period (from \$350 to \$1,000 plus \$150 administrative fee). Data for post-installation energy savings for customers participating after April 1990 was not available at the time of this impact evaluation.

Washington: The treatment group included participants who received weatherization through the low-income

program between March 1988 and June 1990. Data for post-installation energy savings for customers participating after June 1990 was not available at the time of impact evaluation.

Control Groups

Oregon: The control homes were selected randomly from the respondents of various Energy Decisions Surveys to ensure income-level consistency with the treatment group. The homes selected had never participated in a weatherization program offered by Pacific and household income did not exceed 125 percent of the Poverty Income Guidelines.

Washington: Two control groups were selected, an "internal" control group which consisted of low-income customers who participated in Pacific's program prior to March 1988 and an "external" control group which consisted of a randomly selected group of low-income customers who had never been weatherized through Pacific programs. The internal control group was included in the program impact evaluation to investigate changes in energy savings between "old program" participants (internal control) who received only a \$500 rebate and the participants in the revised program who could have received up to \$2,300. For the analysis of arrears, these two groups were combined into one control group.

Table 1 presents the treatment and control groups sample sizes used for the arrearage analysis.

State	Treatment	Control
Oregon Program	59	162
Washington Program	295	808

Results

Conducting an impact evaluation of payment behavior is not a straightforward process. This is mainly due to the lack of a reliable measure of the change. As discussed in the data sources, two "measures" of bill payment are available in Company records, neither of which is reliable. In the Oregon study, the original sample size selected for the treatment group was 169, and as Table 1 shows only 59 were in the final sample after accounting for missing/

incomplete data. The other groups also had high drop rates due to missing arrearage data.

The analysis was mainly conducted based on actual amounts in arrears before and after the program period, setting the initial arrearage to zero for all customers in the program and control groups in order to examine payment behavior for only the year in question.

Oregon Study Results

Table 2 illustrates the change in payment behavior for the two groups between the pre- (August 1988 through July 1989) and post-program (May 1990 through April 1991) periods. Payment behavior was clustered into four categories: "N to N" (normal in both periods), "N to P" (normal in pre-, problematic in post-program), "P to N" (problematic in pre-, normal in post-program), and "P to P" (problematic in both periods).⁹ The chi-squared test of independence showed the two groups portrayed statistically different behavior across the created categories (chi-squared = 7.37 and P = 0.06).¹⁰ While eight percent of the control homes switched from problematic to normal behavior, 13 percent of the treatment homes were able to make the same transition. Overall, participants increased from 63 percent of homes with good payment records in the pre-period to 65 percent in the post-period. Customers in the control group decreased from 74 percent of homes with good payment records to 71 percent.

Category	Treatment		Control	
	Number	Percent	Number	Percent
N to N	88	52%	280	63%
N to P	19	11%	47	11%
P to N	21	13%	36	8%
P to P	41	24%	80	18%

Prior to the program, participants had significantly higher median annual arrearages than did the control group. After the program, the two groups were statistically similar. The decrease in median arrearage indicates that the group as a whole reduced arrearages. As Table 3 indicates, the median amount of arrearage decreased for program participants from an annual total of \$11.84 to \$3.14 (P=0.15). The median arrearage for the control group rose from \$3.06 to \$3.88, which was not a significant change (P=0.78). The Wilcoxon test of

Table 3. Oregon Program Arrearage Analysis - Mean, Median, and Distribution Tests

Statistic	Treatment Group			Control Group		
	Pre	Post	P-Value	Pre	Post	P-Value
Mean	29.56	27.06	0.69	4.95	7.53	0.31
Median	11.84	3.14	0.15	3.06	3.88	0.78
Distribution			0.17			0.78

population distribution indicates that there is an 83 percent ($P=0.17$) chance that the participants pre and post distributions of arrearages are different (post distribution had shifted to the left). The control group, on the other hand, did not experience a significant shift in arrearage distribution ($P=0.78$).

Figures 1 and 2 show the distribution of annual balances for the treatment and the control groups before and after the program period. While there is almost no change in the pattern exhibited by the control group, the treatment group shows a noticeable shift to the left while retaining the same overall shape as before the program.

Washington Study Results

Overall, participants with good payment records increased from 62 percent of homes in the pre-period to 72 percent in the post-period. Increases for the internal control group were from 77 to 78 percent with good payment records for the year, and from 78 to 84 percent for the external

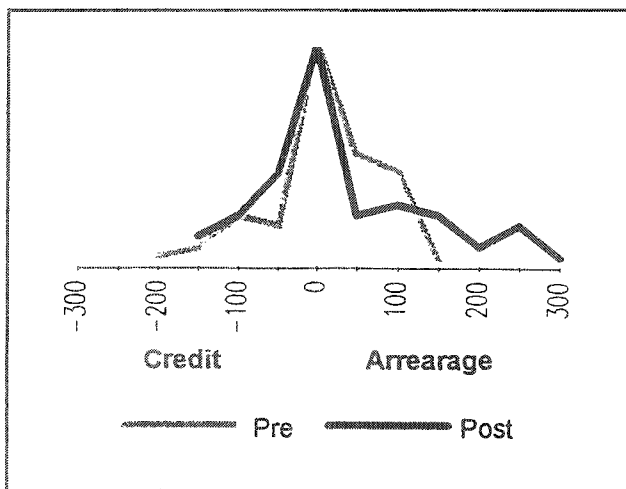


Figure 1. Distribution of Annual Bill Balance Pre and Post Program - Treatment Group in Oregon

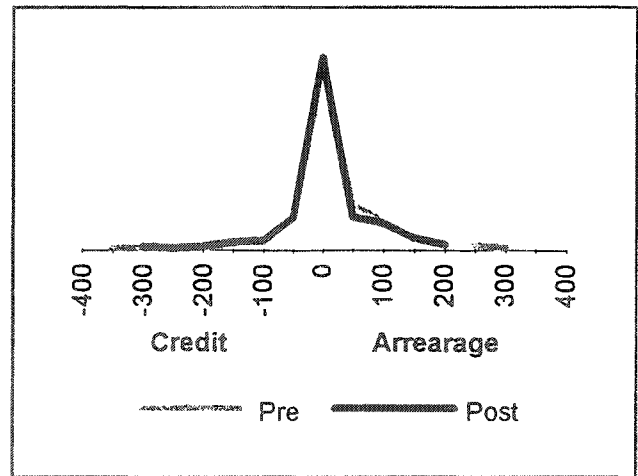


Figure 2. Distribution of Bill Balance Pre and Post Program - Control Group in Oregon

control group. The percent improvement in good payment records is statistically higher for participants than for either control group ($P=0.01$) using a difference of proportions test. The changes in the two control groups were not statistically different from each other.

Significant improvements in paying their bills were made by program participants. In January 1988, 38 percent of program participants were classified as having some kind of problem in paying their bills. At the end of 1989 this had been reduced to 28 percent. Both of the control groups remained relatively constant in their bill paying habits.

Program participants had also made efforts towards getting a better handle on their personal budgets. Fifteen percent of program participants had at some time during the period 1988-89, participated in the Company's Budget Balancer program. The Budget Balancer program is a program allowing customers to pay equal amounts during the year and defer payment of the seasonal increase in

their electric bill during the winter months. This contrasts with the control groups, where only six percent of customers participated.

Table 4 displays the changes in actual arrearages experienced by the treatment and the combined (internal and external) control group. The treatment group showed a significant reduction in average arrearage (from \$48.99 to \$21.85, $P=0.00$). In addition, the treatment group arrearage distribution shifted significantly to the left (as indicated by the Wilcoxon test $P=0.06$) lowering the median from \$16.30 to \$10.38. The control group did not show any significant changes in their payment behavior.

Figure 3 shows the shift in the distribution of annual arrearages for participant homes.

Figure 4 illustrates that the distribution of annual arrearages did not change between the pre- and post-periods for the control group.

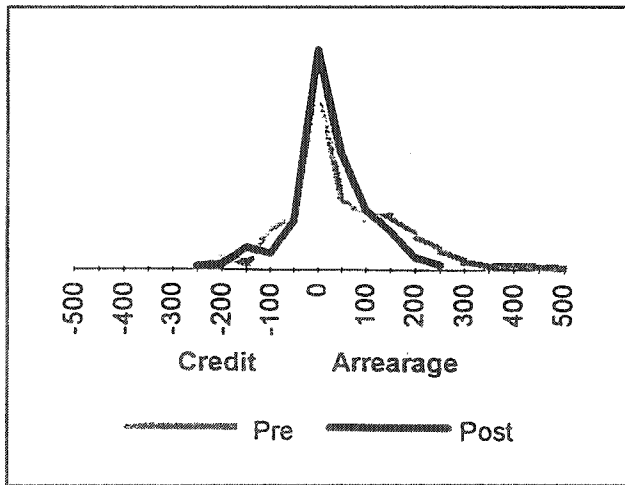


Figure 3. Distribution of Annual Bill Balance Pre and Post Program - Treatment Group in Washington

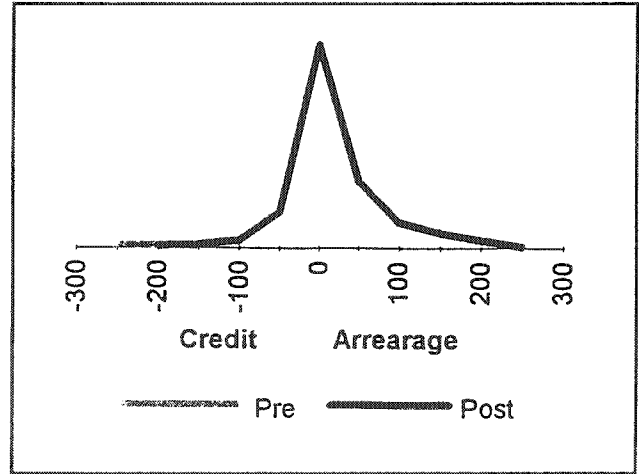


Figure 4. Distribution of Annual Bill Balance Pre and Post Program - Control Group in Washington

Conclusion

The Oregon and Washington Programs have successfully assisted low-income customers through reduction in electricity bills and increased home comfort. Many participating low-income customers were able to reduce the amount of annual arrearage and the frequency of monthly arrearages.

In the Oregon study, arrearages and participants' payment records improved from the pre period. The median annual arrearage decreased from \$11.84 to \$3.14 for participants (at $P=0.15$) while remaining virtually unchanged among the control group customers.

A small number of participants improved their payment status between the pre-program and post-program periods, while payment status degraded for an equal number of

Table 4. Washington Program Arrearage Analysis - Mean, Median, Distribution Tests

Statistic	Treatment Group			Control Group		
	Pre	Post	P-Value	Pre	Post	P-Value
Mean	48.99	21.85	0.00	14.07	16.70	0.59
Median	16.30	10.38	0.08	2.23	2.53	0.69
Distribution			0.06			0.72

non-participants over the same time frame. Though these changes were small, they are statistically significant at $P=0.06$.

In the Washington study, customers with the most serious problems appear to be the ones who benefitted the most. Participants were able to reduce both average and median arrears after receiving the program treatment.

Finally, this study's findings may be greatly solidified when the following issues are assessed in future research¹¹:

- While this study did show that participation in energy efficiency programs do in fact have an effect on payment behavior, due to lack of time, no attempt was made to isolate the effect of weatherization from that of energy education or energy assistance programs.
- The appropriateness of the experimental design is in question. Examination of the pre-treatment arrearage levels seemed to indicate that some self selection bias may be present. Two solutions are possible: (1) a statistical regression-based adjustment for the pre-program differences in the two groups, and (2) a control group selection procedure based on a similar distribution of arrearages to the treatment group.
- This study made the assumption that participating and non-participating customers are as likely to participate in other utility and non-utility programs. If this assumption is accurate, the employed quasi-experimental design should be sufficient to isolate the effect of the treatment. However, if the treated group is more likely to be aware of other low-income offerings, then the estimated programmatic effects are overstated.

Endnotes

1. Quaid, Maureen, and Scott Pigg. "Measuring the Effects of Low-Income Energy Services on Utility Customer Payments."
2. Multi-family units receive \$150 plus \$25 for each building and \$5 for each unit (e.g., a project with three buildings of four units each would receive a total of \$285 for administration costs).
3. Oregon Low-Income Impact Evaluation, November 1991. Average savings per home were estimated at 950 kWh. Washington Low-Income Impact Evaluation, April 1992. Average savings per home were estimated at 1,848 kWh.

4. The two samples are combined and a median computed. Each observation is assigned a 0 or 1 depending on its location relative to the combined median. The distributions of the 1's and 0's are compared between the two original samples.
5. Also known as the Mann-Whitney U test. The difference between "sum of the ranks" is tested in an analogous manner to the difference of means tests. (See Hubert Blalock, *Social Statistics*, 2nd Edition, McGraw Hill, New York, 1979.)
6. Non-parametric (distribution free) tests are generally less powerful than their parametric counterparts. However, departure from the required distribution assumptions of parametric tests (e.g., non-normal distribution of the tested data) mandates the application of such tools.
7. Pacific Power/Utah Power residential appliance saturation mail survey - *Energy Decisions '90*.
8. Pacific Power's database combines customer records with census and other demographic data sources to allow identification and targeting of specific customers.
9. These definitions were created using customer accounting data-base terms. The "normal" definition was based on: 1) no arrearage history, 2) arrangements made, 3) budget balance plan, 4) equal payment plan, and 5) no balance. The "problem" category was defined based on whether the customer had received a notice, had service disconnected, or had "overage writeoff."
10. These are the probabilities of what is referred to as a "type I" error. This is the probability of rejecting a true null hypothesis. In this case, the hypothesis being tested is that two groups' means, medians, or parent distributions are equal. If the desired level of significance is five percent, then any probability value less than .05 would lead to the rejection of the null hypothesis, i.e., the means are not equal.
11. A comprehensive evaluation of all low-income programs throughout PacificCorp service territory (Oregon, Washington, Utah, Idaho, Montana, Wyoming, California) is scheduled for the end of 1992. Interested readers may contact one of the authors for results of the study.

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