

CAN WE DISTINGUISH THE EFFECTS OF SPECIFIC PROGRAM SUPPORT ACTIVITIES ON MARKET PENETRATION?

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Many residential energy-efficiency programs across the country have adopted a common model for promoting the sale of ENERGY STAR[®] qualified appliances. This model entails collaboration with other utilities and regional/state market transformation organizations, coordinated through the Consortium for Energy Efficiency (CEE), to work with the federal ENERGY STAR program and with participating manufacturers and national retailers at several levels. First, program sponsors strive to ensure that increasingly efficient qualifying appliances (e.g., clothes washers) are in the supply chain and receive broad promotional support from national manufacturers and retailers. Second, they work with retailers in their service territories to provide relevant sales training, labeling assistance, and advertising support. Third, they promote the products to end-use customers, using a variety of methods that include—where deemed appropriate—offers of financial incentives.

Program designers and implementers recognize the value of a multifaceted effort. Leveraging the self-interests of manufacturers and retailers in developing, distributing, and selling energy-efficient products is clearly beneficial to the overall program. Helping retailers train sales staff regarding the benefits of qualifying appliances and cooperating in advertising and in-store promotions is a proven method of increasing public awareness of qualifying products and customer choice of those options. And offering financial incentives is an established method of attracting customer interest and consideration.

Nonetheless, it is necessary and appropriate to ask whether it is possible to isolate the contributions of individual promotional activities and to use that information to optimize the investments of program sponsors. Furthermore, broader economic trends and demands to address other opportunities for energy-efficiency program investments place strains on budgets and require regular re-examination of the mix of promotional activities. Can some activities be ramped down or eliminated? Are others indispensable? For example, is it necessary to continue providing field support to retailers? Does direct mail help?

This paper results from just such an inquiry, about the effects of different promotional activities, and draws on research conducted for the Massachusetts ENERGY STAR Appliance Program. The study involved development of a statistical model that estimates the incremental effect of such programs on the market penetration of qualifying appliances at the state level.^{1,2} An additional objective was to determine which program-related influences (e.g., customer incentives, training of sales staff, mass media advertising) are strongly associated with market penetration of qualifying appliances and which are not.

¹ For the overall model, see Hoefgen, Wilson-Wright & Feldman (2004). It was designed to expand on an earlier model (Rosenberg 2003), in which market penetration had been shown to be affected by the simple presence of a program in a state (as indexed by whether rebates were available).

² The sponsors were Massachusetts Electric Company, Nantucket Electric Company, NSTAR Electric, Western Massachusetts Electric Company, and Fitchburg Gas and Electric Light Company.

The research identified regression models for each of four appliances (clothes washers, dishwashers, refrigerators, and room air conditioners) for each of two years (2001 and 2002), of the form,

$$\mathbf{MP} = \mathbf{c} + \mathbf{b1PV} + \mathbf{b2NPV} \tag{1}$$

where

MP denotes market penetration for a specific appliance in a given year, over states

c is a constant, **b1** and **b2** are regression coefficients,

PV denotes program-related variables (e.g., incentives, sales training) and

NPV denotes non-program related variables (e.g., residential electricity rate, percent of college graduates)

and

the incremental effects of the program are estimated by comparing the power of models that include **b1PV** for the particular appliance and year against those that do not.

To develop these models, therefore, it was necessary to identify and define measures of market penetration, of program-related influences, and of other influences. However, before attempting to estimate the specific influence of each of the program activities, it was necessary to determine the degree to which these activities were independent of one another.

It may be helpful to portray this question graphically. Figure 1 shows a (hypothetical) case in which each variable is an independent predictor of market penetration.

Figure 1. Program variables as independent influences on market penetration

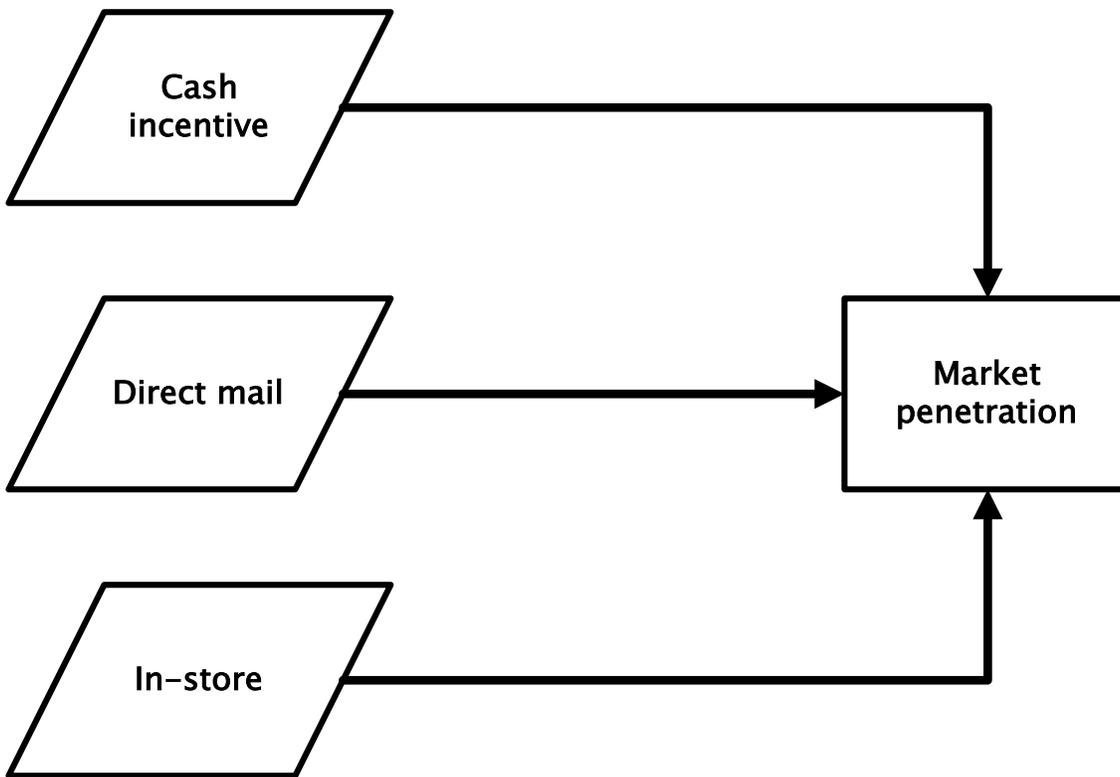
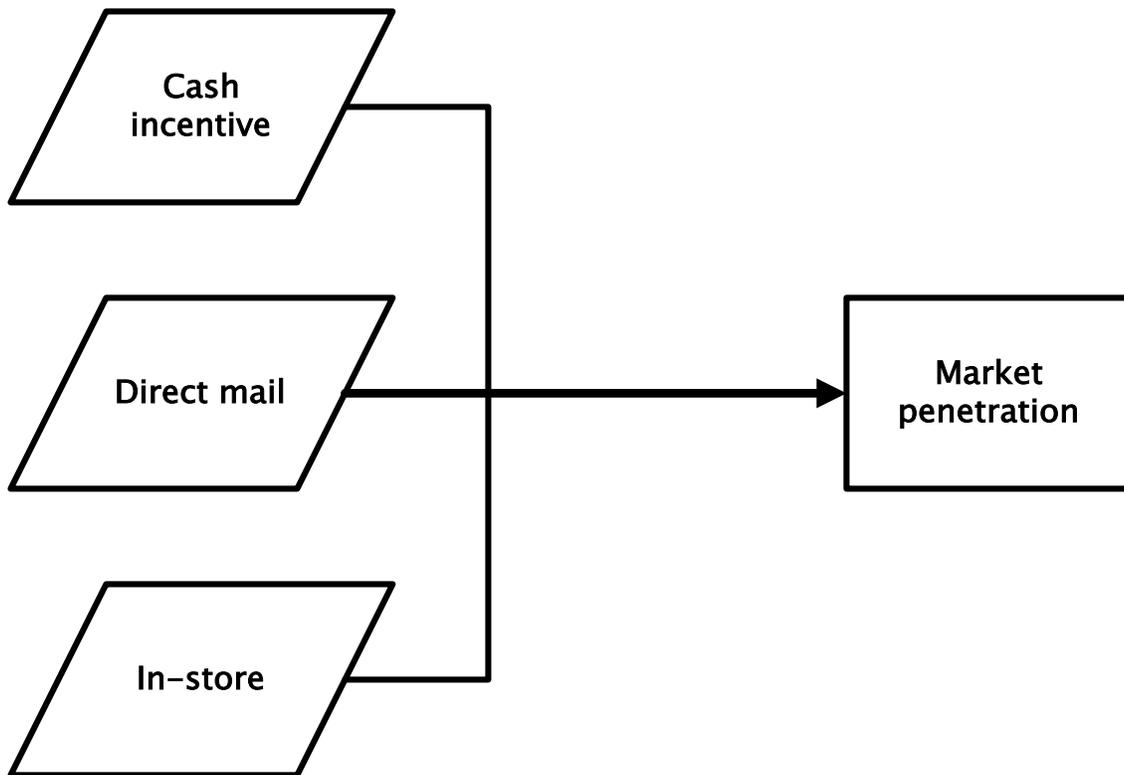


Figure 2 shows a contrasting case (at the extreme) in which all of the variables are so highly interrelated that they cannot be disentangled with respect to their effects on market penetration.³

Figure 2. Program variables as composite influence on market penetration



If Figure 1, independent influences, is a reasonable portrayal of the situation, we can develop useful guidance regarding the optimal mix of program activities to support ENERGY STAR appliance programs, based on statistical models of what has offered and what has worked best in different states. If Figure 2, the composite influence model, is a more accurate portrayal of what has been offered, however, we cannot separate out the effects of different activities based on experience to date, and cannot recommend any specific mix of program activities.

³ Statistically, it would not be possible to develop a regression model with all the variables because the parameters would be “collinear”—so correlated with one another that it would not be possible to create stable estimates of their effects.

Methods

This paper is based on statistical analysis of reported appliance program-related activities in the forty-eight contiguous states. This section first describes the activities considered and the data collection effort, and then summarizes the analytic approach.

Relevant activities and data collection

We initially examined descriptions of ENERGY STAR appliance programs across the U.S., as provided to CEE and on the web sites of program sponsors. We found that each of the programs included some subset of the following activities:⁴

- Direct mail promotions (e.g., bill inserts, newsletters)
- Mass media advertising (newspapers, television, radio)
- In-store displays (point-of purchase materials, labeling of qualifying products)
- Field support (retailer visits, training of sales staff)
- Cash incentives to end-users
- Other financial incentives
 - ❖ Tax credits
 - ❖ Tax exemptions
 - ❖ Bill credits
 - ❖ Appliance turn-in bounties
 - ❖ Recycling rebates
 - ❖ Low interest loans
 - ❖ Incentives to retailers or sales staff

Once we had compiled this list, we reviewed the descriptions provided to CEE and the web sites to develop a consistent data base of the presence and intensity of each activity in each state. (Intensity was defined as the percentage of households in the state served by programs in that state or the average incentive available to eligible households.) For those programs for which the data were not readily available, we conducted follow-up interviews with staff members of the program sponsors.

These efforts provided systematic information for all variables in the list other than field support. We were also unable to obtain consistent records of the number of years each program had been in operation, without which we could not attempt to estimate the cumulative effect of program activities. To address these deficiencies, we obtained ratings of field support and program length from two experts familiar with appliance programs across the country.⁵

⁴ We hoped to include the effect of brand advertising for ENERGY STAR, as indexed by awareness of the label. However, most programs do not collect this information on their own, and the national survey conducted by CEE is not large enough to provide reliable estimates at the state level. Although it was possible to use data at the Census district level for the overall statistical model, it was not possible to use those data effectively in the analysis reported here.

⁵ We subjected their ratings to Kappa tests that confirmed high inter-rater reliability ($t=2.83$, $p<.01$ for field support; $t=3.26$, $p<.01$ for cumulative effects) and then averaged their scores. All states lacking a program were scored as zero; those with programs were rated from 1 (low) to 5 (high).

Table 1 shows each of the variables we considered, the way in which we operationalized that variable, and the source of the data used to create a score for each state. To overcome the problem of different scales of measurement (percentages, dollars, and ratings), all data were eventually transformed into standard scores.

Table 1. Program variables considered as influences on market penetration of ENERGY STAR®-qualifying appliances

| Variable | Operationalization ^a | Data source |
|---|---|---|
| Cash incentive | Average dollar amount available to each household | CEE, NEEA, NEEP adjusted to households, per U.S. Census Bureau data |
| Direct mail (e.g. bill inserts, newsletters) | Scored zero if not offered; otherwise, adjusted to percentage of households served by utility or program | CEE, adjusted per data from U.S. Census Bureau |
| In-store (POP displays, labeling of products) | Scored zero if not offered; otherwise, adjusted to percentage of households served by utility or program | CEE, adjusted per data from U.S. Census Bureau |
| Mass media (e.g. newspapers and television) | Scored zero if not offered; otherwise, adjusted to percentage of households served by utility or program | CEE, adjusted per data from U.S. Census Bureau |
| Field support | Average rating by two independent experts | Expert rating |
| Cumulative effects | Average rating by two independent experts | Expert rating |
| Tax credits | Average dollar amount available to each household | CEE, NEEA |
| Bill credits | Average dollar amount available to each household | CEE, NEEA |
| Tax exemptions | Percentage of households served by utility or program | CEE, NEEA |
| Appliance turn-in bounties | Require a customer both to turn-in an older, less efficient model and buy a newer, more efficient model; based on average dollar amount available to each household | CEE, NEEA |
| Recycling rebates | Require a customer only to turn-in an older model; based on average dollar amount available to each household | CEE, NEEA |
| Low interest loans | Percentage of households served by utility or program | CEE, NEEA |
| Incentives to retailers or sales staff | Amount offered by program or utility | CEE, NEEA |

^a All variables computed at the state level.

Analysis

Once the data set was completed, we examined each of the distributions. We then eliminated all of the “other financial incentives” (tax credits and exemptions, bill credits, etc.) since so few programs used any one of these. We then focused on the six remaining variables and applied a statistical test designed to determine whether they were in fact independent of one another, based on what has been done in different programs, or had to be collapsed into a smaller number of predictors of market penetration, given the lack of variation across programs.

The statistical test was Cronbach’s alpha, originally developed for reliability analysis—for assessing the degree to which various questionnaire items hold together to form a single measurement scale, for example the degree to which a set of questions is homogeneous. The resulting statistic, the alpha coefficient, normally ranges between 0.00 and 1.00, similar to a positive correlation.⁶ Standard texts suggest that a result of 0.70 or more is an acceptable demonstration of homogeneity and indicates that the variables should be considered as a composite rather than as individual predictors. Additional statistics developed through this analysis include the correlations between each of the individual items and the composite variable (item-total correlations) and estimates of the alpha coefficient if a particular variable is omitted from the composite.

Findings

The analysis indicates that the measures considered are better characterized as contributing to a composite program variable than as independent influences on market penetration. Table 2 shows the degree to which each set of components defines a single coherent program variable for each appliance in each of the years studied. The alpha coefficients are all 0.89 or more, indicating that the program support variables are *not* independent of one another. Rather, they define an overall program support variable that is extremely coherent for each appliance program, and in each year studied. (It should not be too surprising that internal reliability is highest for CW, the appliance targeted most frequently by programs throughout the nation. In contrast, coefficient alpha is lowest—though still impressively high—for refrigerators.) The program composite variables, then, are statistically coherent and thus best contribute to explaining the market penetration of ENERGY STAR appliances in the overall modeling effort.

Table 2. Alpha coefficients for program variables, by appliance and year

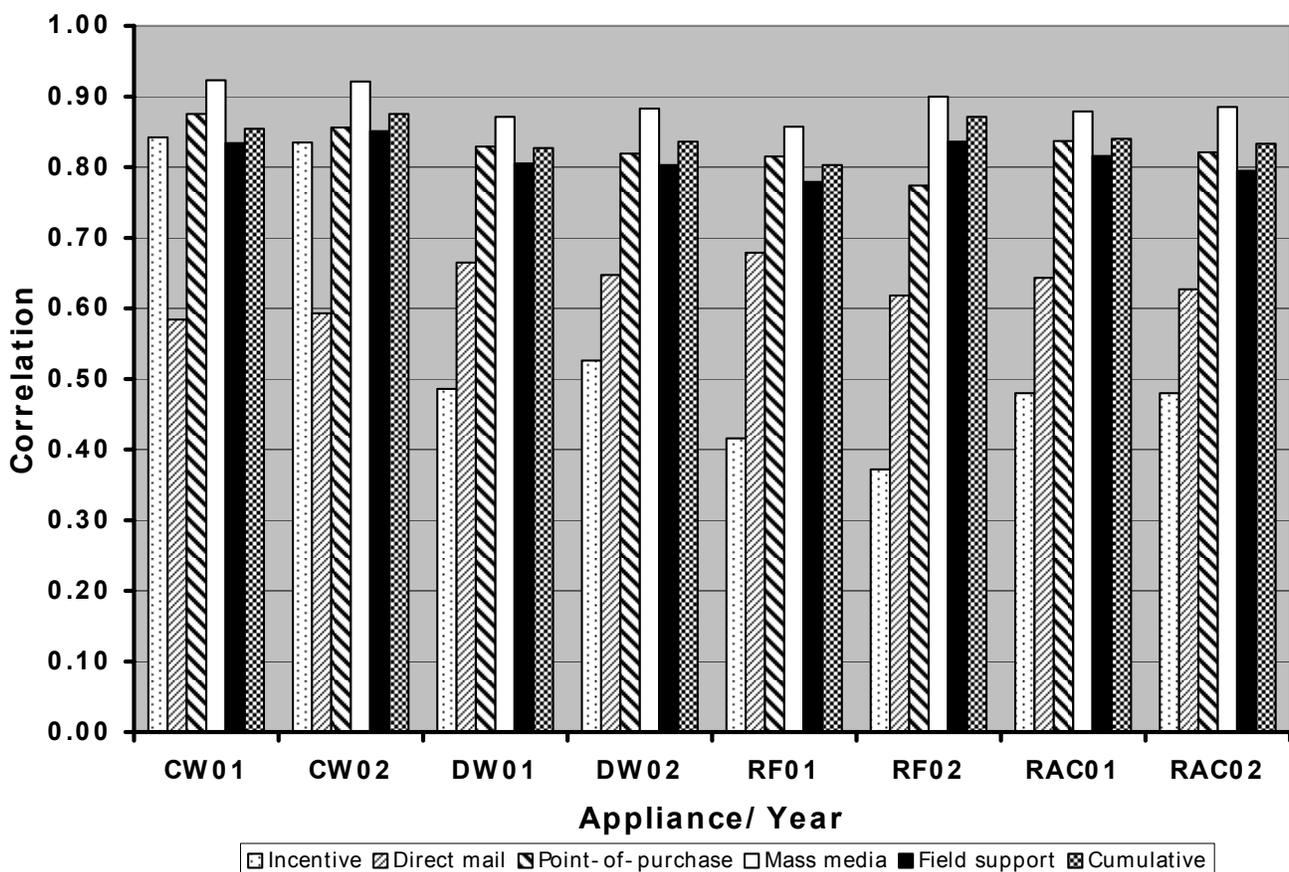
| Appliance | 2001 | 2002 |
|-----------------------------|-------------|-------------|
| Clothes washer | .938 | .940 |
| Dishwasher | .905 | .912 |
| Refrigerator | .898 | .895 |
| Room air conditioner | .905 | .909 |

The analysis also allows addressing several corollary questions. First, can any single variable be identified as the quintessential indicator of the underlying concept? Conversely, can one or more variables be eliminated without reducing the measurement power of the composite? As noted earlier these questions can be addressed by examining changes in the alpha coefficient when individual variables are omitted and the item-total correlations.

⁶ In certain anomalous cases, the statistic can become negative—essentially, if one or more items are negatively correlated with the underlying concept.

The item-total correlations provide an index of which individual variables are most central to each of the composites. Figure 3 shows those correlations for each appliance, for each of the years studied. As can be seen, mass media advertising is the component most closely related to the index formed by the other components in each and every case. However, the high item-total correlations between the other variables and the composite suggest that it may not be useful to focus further investment purely on this one support activity. In contrast, program support through direct mail correlates consistently lower than other components across appliances and years. Moreover, financial incentives are strongly correlated with the overall index for clothes washers, but less so for other appliances. This most likely reflects the fact that such incentives have been regularly associated with programs for clothes washers, but not for other energy-efficient appliances.

Figure 3. Corrected item-total correlations between individual measures and the composite program variable, by appliance and year



The degree to which any individual measure could be eliminated from the composite variable—thus, treated as something separate and apart from the core set of program activities—was also studied. The results indicate only marginal opportunities to increase coefficient alpha by eliminating a component.⁷ Thus, although it is theoretically possible to improve the measure of program support by pruning it somewhat, no practical opportunities present themselves. We conclude that it is appropriate to use a single index of program support encompassing all of the components described and that all contribute

⁷ The greatest single difference may be found in the program support variable for refrigerator programs in 2002. In this instance, eliminating the financial incentive measure would allow alpha to rise only from 0.898 to 0.927, an increase of just 3 percent from an already high level of coherence.

highly to the success of those programs that have promoted market penetration of energy-efficient appliances in the active states and regions.

Conclusions and Discussion

Ideally, this analysis would provide policymakers and program designers with guidance as to the best mix of support activities. This would include the optimal level of financial incentives—the level that would stimulate the greatest increase in market penetration over baseline at the least cost. Moreover, in this ideal analytic world, we would also be able to specify the most advantageous level of other marketing support, such as field services (labeling, dealer training, etc.) and promotional efforts (point-of-sale materials, direct mail, mass media, etc.).

However, the results show that the activities conducted by sponsors of ENERGY STAR appliance programs are not only complementary in concept, but that their effects cannot be separated out through statistical analysis based on programs that have been conducted across the nation. Too few programs have experimented with “other financial incentives” to support statistical analysis, and too many programs have taken what is essentially a standard approach to integrating the other support activities considered to allow any differentiation of their effects. In other words, the “inputs” of the various programs across the country are so similar as to preclude any effort to match any specific mix of activities to specific levels of market penetration as program outputs.⁸

It can be argued that these findings are not unexpected. Many marketers and program designers would suggest that the program support considered cannot and should not be separated. It would not be sensible, for example, to offer financial incentives without providing field support and without making some effort to alert customers to the opportunities available.

Still, the findings raise the question as to how financial incentives should be treated, relative to other components of overall program support. Given the strong item-total correlations when incentives have been a consistent part of the marketing mix, we believe it is appropriate to retain them as part of the overall index. This recommendation also reflects the belief of many program implementers that retailer support for energy-efficient appliances is conditioned in part by the incentives that have been available for clothes washers—that some financial commitment by program sponsors is required, even if not for each and every appliance in the program. Thus, while it is certainly possible to provide program support without any financial incentives, such a program may be less likely to appeal to and obtain the allegiance of a broad array of retailers.⁹

⁸ We are currently completing a replication of this research that includes market penetration results for 2003 and greater attention to programs conducted by water utilities. Preliminary analysis suggests that the new data may support more detailed examination of individual program variables.

⁹ Other issues also complicate the problem of achieving the ideal, such as the likelihood that incentive effects are not linear.

References

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