Market Penetration of ENERGY STAR Qualified Appliances: An Analysis of Various Predictor Variables

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ABSTRACT

For the past nine years, D&R International has collected ENERGY STAR market penetration data from national retailers who are partners in the ENERGY STAR program. This is the only national data available on ENERGY STAR market penetration for appliances. The data collected consists of ENERGY STAR sales and total sales by store. D&R aggregates the data and releases the penetration percentages nationally and by region and state.

A thorough analysis of the data has never before been undertaken. Other organizations have completed local analysis using portions of the data, but they have not had access to the full dataset.

Using the disaggregated data, D&R has completed a regression analysis using several available predictor variables. The results show which factors influence the penetration of ENERGY STAR appliances. The effects analyzed were retailer, state, season, and the existence of ENERGY STAR promotions in the area.

The research shows whether or not ENERGY STAR market penetration is a product of local consumer preferences, is determined almost entirely based on retailer stocking practices, or is affected by local utility and other efficiency group promotions. The results will give organizations justification for choosing whether to expend promotional dollars for ENERGY STAR qualified appliances and help them predict the effects of any promotions. The results also have broader implications for any organization seeking to promote efficient products at the retail level.

Introduction

Through the ENERGY STAR program, the U.S. Department of Energy (DOE) and the U.S. Environmental Protection Agency (EPA) recognize a wide range of energy-efficient products and encourage consumers to purchase them. The ENERGY STAR label appears on the most efficient residential appliance products and many other products that consume electricity. The ENERGY STAR program is a private/public partnership, with the approximately $50 million annual federal budget supplemented by hundreds of millions of dollars in investment by state and local efficiency groups, utilities, manufacturers and retailers. As part of the partnership agreement, retailers are expected to provide quarterly sales data including the number of ENERGY STAR qualified products and the total number of products sold by store. Since 1997, national retailers have submitted this data to D&R International for room air conditioners, clothes washers, dishwashers, and refrigerators. Currently this data is the only point of sale data available on the appliance market. D&R aggregates the data and releases the market penetration percentages nationally and by region and state. DOE combines the market penetration data with the average savings of each ENERGY STAR qualified appliance to show Congress and the Office of Management and Budget that the ENERGY STAR budget amounts are responsible for a substantial amount of electricity and consumer utility bill savings. Utilities and other regional

groups also use the data to prove to rate commissions and local governments that local promotions also justify the amount of money spent on them.

Beyond a simple combination of the data, no organization has ever attempted to isolate the variables that contribute to a higher or lower market penetration for ENERGY STAR qualified appliances. Other organizations have completed local analyses using portions of the data, but they have not had access to the full dataset or any information by individual retailer.

This project used multiple regression analyses to test several predictor variables in order to determine which factors influence the market penetration of ENERGY STAR appliances. Effects analyzed were retailer source, the existence of other ENERGY STAR promotions in the area, and the time of year of the sales by quarter. This analysis sought to determine whether ENERGY STAR market penetration is determined almost entirely based on retailer stocking practices or whether it is affected by regional activities such as local consumer preferences and utility and other efficiency group promotions.

The hypothesis was that the retail chain is a significant determinant of ENERGY STAR market share for appliances, especially for dishwashers, refrigerators, and room air conditioners since there are fewer specific utility and local promotions on these products. If this is the case, efficiency programs have a great opportunity to increase ENERGY STAR market share by working with retailers.

The results of the analysis showed that for the four appliance types in aggregate, the retail store was the only significant predictor variable, but for all three retailers, the result was very significant. If clothes washers are considered separately from the other three appliance types, the retail store was once again a highly significant predictor but the level of other efficiency activity in the state was also a significant predictor.

Additional analysis could be undertaken to define the variable of specific local efficiency program activity, but regardless, the main predictor of the market share of ENERGY STAR qualified appliances is which retailer sells them. Therefore, there are strong opportunities for efficiency programs to affect ENERGY STAR market share by targeting specific retailer promotions or stocking practices.

Methodology

The dataset was compiled from submissions from three major national appliance retailers who are partners in the ENERGY STAR program. D&R does not have access to the databases of the individual retailers. Therefore D&R sends a list of qualified product model numbers to retailers. The retailers use this product list to separate out the ENERGY STAR qualified products from the non-qualified products and send the data to D&R. Most retailers already have ENERGY STAR qualification as a variable in their databases since they conduct retailer-based promotions and need to know which products to label.

For this analysis, three national retailers were selected in order to collect sales by each individual storefront. These three national retailers sell approximately 50% of all clothes washers, 35% of all dishwashers, 65% of all refrigerators, and 25% of all room air conditioners. Since these are all national retailers, they each have at least 800 storefronts nationwide with data from every state.

To protect the confidentiality of the data, D&R labeled three national retailers as A, B, and C. The data included total sales for each of the appliance types and ENERGY STAR qualified sales and was submitted by quarter for calendar year 2005 for each individual retail

storefront. Based primarily on D&R's direct knowledge of utilities and regional groups promoting ENERGY STAR and previous communication with Shel Feldman on his work for the State of Wisconsin, an activity level of High, Medium, Low, or None was assigned to each state. The categories represent the estimated amount of ENERGY STAR or other active energy efficiency programs in the state in order to develop one overall variable for activity level. The category rankings were based on such variables as energy efficiency program size and expenditures, energy efficiency activity levels of both state agencies and utilities, and variety of ENERGY STAR promotional activities. Trying to include a separate variable for each appliance type or promotion type would have resulted in a cluttered and unmanageable dataset. Factors considered were whether the state had an active state organization that promoted ENERGY STAR, the number of utilities in the state that ran ENERGY STAR promotions, and the historical visibility of the ENERGY STAR label. A listing of the state activity levels is shown in Table 1.

Table 1. Ranking of States by Activity Level

None	Low	Medium	High
Alabama	Colorado	Arizona	California
Alaska	Florida	Idaho	Connecticut
Arkansas	Georgia	Illinois	Massachusetts
Delaware	Iowa	Kentucky	New York
Hawaii	Maryland	Maine	Oregon
Indiana	Michigan	Minnesota	Rhode Island
Kansas	New Mexico	Montana	Vermont
Louisiana	Pennsylvania	Nevada	Washington
Mississippi	Texas	New Hampshire	Wisconsin
Missouri	Utah	New Jersey	
Nebraska		Ohio	
North Carolina			
North Dakota			
Oklahoma			
South Carolina			
South Dakota			
Tennessee			
Virginia			
West Virginia			
Wyoming			

Table 2 shows a sample of the dataset.

Table 2. Sample Data from Initial Import (First 15 Observations)

Obs	estar	total	atype	state	quarter	retailr	Actlevel
1	18	61	CW	IL	3	A	Medium
2	47	170	CW	WI	1	A	High
3	51	59	DW	WI	1	A	High
4	29	118	RF	WI	1	A	High
5	24	88	CW	WI	1	A	High
6	38	41	DW	WI	1	A	High
7	18	90	RF	WI	1	A	High
8	30	169	CW	WI	1	A	High
9	42	50	DW	WI	1	A	High
10	21	120	RF	WI	1	A	High
11	28	91	CW	WI	1	A	High
12	39	49	DW	WI	1	A	High
13	9	57	RF	WI	1	A	High
14	59	126	CW	WI	1	A	High
15	63	71	DW	WI	1	A	High

Table 2 only shows the first 15 observations of the dataset out of a total of 48,700 observations. Each individual retailer is represented by a separate observation for each of the four appliance types for each of the four quarters for 2006 so there are 16 observations per storefront. A total of 3045 storefronts from three retailers were represented in the dataset.

Looking at Table 2, the first column just shows the observation number. The second column shows the number of ENERGY STAR products sold at that storefront of the listed appliance type and quarter. The third column shows the total number of products sold at that storefront of the listed appliance type and quarter. The fourth column shows the appliance type where CW is clothes washer, DW is dishwasher, RF is refrigerator, and AC is room air conditioner. The fifth and sixth columns show the state and quarter respectively. The seventh column shows which retailer the data are submitted from. The final column shows the activity level of the state as listed in Table 1. So the first row shows that at an Illinois storefront from Retailer A, there are 18 ENERGY STAR qualified clothes washers sold in the third quarter out of 61 total clothes washers sold in the third quarter.

An initial procedure was run to create the new variable for market share (mktshare) for each store which is simply the sum of the qualified sales by store divided by the total sales for each store.

Dummy variables were created for each of the three retailers with a value of either 1 or 0. An additional variable for activity level (levact) was created in order to translate the qualitative description of state efficiency activity level into one quantitative continuous variable for analysis. Attempting to maintain separate variables for each activity level would have resulted in an inconsistent picture of activity level that was not linear. The values were assigned such that High = 100, Medium = 50, Low = 25, and None = 0.

For the analysis of the final dataset, a final dataset was created that just included the data for clothes washers. The reason for this is that the purchase of an ENERGY STAR qualified clothes washer is hypothesized as a consumer choice that is very dependent on and influenced by the activity level of the state. As opposed to the other three appliance types which have very low price premiums, ENERGY STAR qualified clothes washers retail for a minimum of $300 more

than a non-qualified model. Consumers will normally only purchase a qualified washer if they have at least a familiarity with the ENERGY STAR label and understand the utility savings and other benefits that justify the higher sticker price. Therefore, it is expected that the market share of clothes washers will have the greatest variance and also the greatest dependence on state activity level.

Results

Full Model Analysis

A univariate procedure was run to determine the market share and general characteristics for each of the four appliance types which are listed in Table 3. The table shows the mean, standard deviation, minimum, and maximum of each variable as well as the kurtosis (where higher variance is due to isolated extreme deviations as opposed to consistently smaller deviations) and skewness (where a positive value indicates more of the data to the right of the normal distribution and where a negative value indicates more of the data to the left of the normal distribution). Both of these last two measures show how close to normal the distribution of the variable is.

Table 3. General Characteristics of each Appliance Type

Appliance Type	Mean Market Share	Standard Deviation	Maximum Market Share	Minimum Market Share	Kurtosis	Skewness
Room AC	56%	24%	>100%	<0%	0.04	-0.59
Clothes Washers	36%	7%	58%	16%	0.48	0.40
Dishwashers	85%	15%	100%	43%	0.92	0.86
Refrigerators	36%	17%	69%	8%	-1.42	0.17

Each appliance type was represented by approximately 12,000 observations. Table 3 shows the general characteristics of each appliance type. For room air conditioners, the mean market share for ENERGY STAR qualified units is 56% with a standard deviation of 24%. For room air conditioners there were significant outliers both above 100% and below 0%. This is explicable since the low volumes of room air conditioners in some states for some quarter's results in returns or exchanges on a very limited number of units. It should be mentioned that room air conditioner data for quarters one and four were not included at all due to the lack of sales in most regions of the country. The standard deviation is much higher for dishwashers due to the large range between the minimum and maximum values. The small kurtosis value shows that the standard deviation is due to many smaller deviations as opposed to a few isolated outliers. The large negative skewness shows that more of the data is to the left of the mean market share.

For clothes washers, the mean market share is 36% with a standard deviation of only 7%. The maximum market share is 58% and the minimum market is 16% so the range of values is much smaller. The higher value for kurtosis shows that the standard deviation is more due to isolated outliers as compared to consistent smaller deviations. The moderate positive skew shows that more of the data is to the right of the mean market share.

For dishwashers, the mean market share is 85% with a standard deviation of 15%. The maximum market share is 100% and the minimum market share is 43%. The large kurtosis value shows that the standard deviation is due to several significant outliers and the high positive skewness shows that much more of the data is to the right of the mean. The dishwasher market share is therefore centered at 85% but with any values more than 85% very close to the mean value, but any values less than 85% to tail off further to the left.

The mean market share for refrigerators is 36% with a standard deviation of 17%, the second highest standard deviation after room air conditioners. The maximum value is 69% and the minimum value is only 85. the large kurtosis value (sign is not relevant) shows that more than any other product, the standard deviation is due to the extreme values, not a combination of small deviations at more observations. The low value of skewness shows that the data is pretty evenly centered so the extreme values occur on both sides with values well over the mean value and well under the mean value.

The ENERGY STAR criteria for dishwashers changed in 2007; in the meantime, almost all currently available dishwasher models are qualified which undermines any potential product-specific analysis on dishwashers. Dishwashers were still included since, even with the high market share, differences can still be determined between states based on activity level.

The next step was to create dummy variables for each of the three retail chains. The new variables dretA, dretB, and dretC were set as dummies for retailers A, B, and C respectively with a value of 1 if the condition is true and 0 if the condition is false. The new variable for the state level of activity, levact, was created to translate the values of High, Medium, Low and None into a 0 to 100 quantitative scale as explained in the previous section.

A means procedure was run to once again evaluate the diagnostics of the final model. The information gathered here was duplicative of the univariate procedure above except for the finding that the mean level of activity was 33.1, so just above low on the quantitative scale.

An initial regression was run on all variables grouping appliance type together. Using a dummy variable for all three retail chains included in the dataset leads to every single observation having a sum of the dummy variables of one (1+0+0). Therefore the regression coefficients were not estimable due to the collinear predictors brought on by the use of an intercept and the three dummy variables. Since one of the main goals of the analysis was to check the differentiation among the three retailers, it did not make any sense to drop any of the dummy variables so two scenarios were performed, the first the dropping of the intercept and the second, using a restrict statement to set the sum of the three dummy variable coefficients equal to zero. The dropping of the intercept resulted in the following equation:

$$\text{Market Share} = \underset{(0.0054)}{-0.0033}*\text{Quarter} + \underset{(0.17)}{0.56}*\text{DretA} + \underset{(0.17)}{0.41}*\text{DretB} + \underset{(0.17)}{0.60}*\text{DretC} + \underset{(0.00016)}{0.00033}*\text{levact} \qquad \sigma^2 = \underset{(0.0020)}{0.0650}$$

With the following Analysis of Variance (ANOVA) table:

Source	Degrees of Freedom	Sum of Squares	Mean Square	F Value
Model	5	581.04	116.21	1789.09
Error	2025	131.53	0.065	
Corrected Total	2030	712.57		

Parameter Estimates:

Parameter	Estimate	Standard Error	T Value	Prob > |t|
Quarter	-0.0033	0.0054	-0.61	0.5439
DretA	0.56	0.17	32.07	<0.0001
DretB	0.41	0.17	23.45	<0.0001
DretC	0.60	0.17	34.49	<0.0001
levact	0.00033	0.00016	2.08	0.0372

The F-test shows the probability that the difference in means between the sample dataset and a normal distribution is due to chance and not the effects of the independent variables. For this dataset, the F-test value of 1789 is highly significant meaning that the measured affect of each predictor variable on the dependent value of market share cannot be explained by random chance. The t-test is a test of the statistical chance that the difference in means is also due to chance and gives values for each of the three dummy variables. These values are also highly significant. The t-test value for quarter is not significant. The t-test value for the level of activity is not significant at the 95% confidence interval although it would be significant at the 90% confidence interval.

The restrict statement led to the following equation:

$$\text{Market Share} = \underset{(0.015)}{0.523} - \underset{(0.0054)}{0.0033}*\text{Quarter} + \underset{(0.0080)}{0.0372}*\text{DretA} - \underset{(0.0081)}{0.1138}*\text{DretB} + \underset{(0.0079)}{0.0765}*\text{DretC} + \underset{(0.00016)}{0.00033}*\text{levact} \quad \sigma^2 = \underset{(0.0020)}{0.0650}$$

With the following Analysis of Variance table:

Source	Degrees of Freedom	Sum of Squares	Mean Square	F Value
Model	4	13.86	3.47	53.35
Error	2025	131.53	0.065	
Corrected Total	2029	145.39		

Parameter Estimates:

Parameter	Estimate	Standard Error	T Value	Prob > |t|
Intercept	0.523	0.015	33.77	<0.0001
Quarter	-0.0033	0.0054	-0.61	0.5439
DretA	0.0372	0.0080	4.67	<0.0001
DretB	-0.1138	0.0081	-14.02	<0.0001
DretC	.0765	0.0079	9.64	<0.0001
levact	0.00033	0.00016	2.08	0.0372

Once again, the values for the three retailer dummies and now the intercept are all highly significant as is the overall f-value of the model. The quarter is not significant and the level of activity is only significant at the 90% confidence interval.

Clothes Washer Specific Analysis

In order to isolate the effects of one appliance type, a version of the data was created that just included clothes washer sales. As explained in the methodology section, clothes washers were chosen because of their perceived susceptibility to energy efficient marketing and activity. Looking at just the clothes washer data allows a comparison between the effects of regional activity on clothes washers as opposed to the other appliance types.

A means procedure was run on the clothes washer data, which showed the same mean, minimum, maximum, and standard deviation as reported above. Based on the results of this procedure, a correlation was run between market share and activity level. The correlation was 35.4% with less than a 0.01% chance of getting a higher correlation. This shows that market share and activity level are not that related since the partial correlation coefficient is closer to zero than it is to one. The variables for market share and activity level were plotted and no major signs of overlap were detected. A regression analysis was conducted to find the equation and the additional step was added to test the hypothesis that there was no difference between the three retailers since the coefficients were similar. Additionally, the collinearity diagnostics and variance inflation factors were checked. The resulting model for clothes washers was:

Market Share = -0.0002*Quarter + 0.3088*DretA + 0.3368*DretB + 0.3604*DretC + 0.000718*levact $\sigma^2 = 0.00416$
(0.0024) (0.0080) (0.0080) (0.0079) (0.000075) (0.00025)

With the following Analysis of Variance table:

Source	Degrees of Freedom	Sum of Squares	Mean Square	F Value
Model	5	75.69	15.14	3 642.41
Error	575	2.39	0.0042	
Corrected Total	580	78.08		

Parameter Estimates:

Parameter	Estimate	Standard Error	T Value	Prob > |t|
Quarter	-0.0002	0.0024	0.07	0.9430
DretA	0.3088	0.0080	38.69	<0.0001
DretB	0.3368	0.0080	42.25	<0.0001
DretC	0.3604	0.0079	45.40	<0.0001
levact	0.000718	0.000075	9.63	<0.0001

The results of the ANOVA table show that the f-statistic of the model and the t-tests of the coefficients of the three dummy variables for the retailers and the level of activity are all highly significant. The variable for quarter was not significant at all which is to be expected since there is no evidence of any seasonal shifts in either the purchase of clothes washers or the purchase of ENERGY STAR qualified clothes washers. Unlike room air conditioners, most consumers purchase a new clothes washer either when the old one breaks or when they move into a new house. Neither of these variables is significantly seasonally dependent.

The f-statistic was 31.75 with a p-value <.0001 so we reject the hypotheses that there is no significant difference between the variables for each of the three retailers. Therefore the retail chain does have an effect on the market share and quite a large one since everything is in terms of percentage.

Just to confirm that the variables selected for the initial regression model were the most accurate predictors, a regression analysis was then run to find the best model using each of the methodologies: forward selection, backward reduction, and stepwise selection. The forward selection method added each of the variables and concluded that the best model contained all five variables (quarter, the level of activity, and the dummy variable for each of the three retailers). The backward elimination method eliminated only the variable for quarter. The

stepwise selection method initially added in quarter, but then removed it as the last step, leaving the same model as the backward elimination method.

Additionally, the best twenty models were calculated using Mallows' C_p statistic. Mallows' C_p is a test that can be used to help determine which independent variables should be used in a regression analysis. It should not be overused to determine the variables, but for an analysis like this, it is a nice check on the final chosen model to make sure that it is the best of all options. The lower the value of Mallows' C_p, the better the model is as compared to the other available options. Both the model containing all five variables and the model containing all variables except for quarter fared very well with Mallows' C_p statistics of 5.00 or less, but the model without the variable for quarter was preferred with a Mallows' C_p statistic of 3.0051. This is consistent with the results of the initial regression analysis that showed that the variable for quarter was not significant.

Upon determination of the ideal model being one with each of the dummy variables for each retailer, the variable for the level of energy efficiency activity, no intercept, and no quarter variable, a final regression analysis was run to calculate the final equation of:

$$\text{Market Share} = \underset{(0.0053)}{0.3093}*\text{DretA} + \underset{(0.0053)}{0.3372}*\text{DretB} + \underset{(0.0052)}{0.3608}*\text{DretC} + \underset{(0.000075)}{0.000718}*\text{levact} \qquad \sigma^2 = \underset{(0.00024)}{0.00415}$$

With the following Analysis of Variance table:

Source	Degrees of Freedom	Sum of Squares	Mean Square	F Value
Model	4	75.69	18.92	4560.89
Error	576	2.39	0.0042	
Corrected Total	580	78.08		

Parameter Estimates:

Parameter	Estimate	Standard Error	T Value	Prob > |t|
DretA	0.3093	0.0053	58.60	<0.0001
DretB	0.3372	0.0053	64.09	<0.0001
DretC	0.3608	0.0052	69.24	<0.0001
levact	0.000718	0.000075	9.64	<0.0001

The model and all variables were highly significant with a probability of <.0001 of the coefficient values being outside of the confidence interval.

Finally a check was made for outliers using the Cook's D technique and none were found. Cook's D measures the effect on the parameter values from deleting outliers. If the outliers are large enough such that deleting them changes the parameters, then this is an indication that the model is not an accurate explanation of the dependent variable since it is determined by outliers. The lack of significant outliers for this model was not surprising since, especially for clothes washers, the market share is fairly close to normal with fewer extreme outliers than any of the other appliance types. The predicted values were plotted against the residuals. As expected, the results indicated a homoscedastic model or one having the same variance for each statistical distribution. The variance is spread evenly across all predicted values and although the mean of the residual has a slight tilt above zero, it does not appear to be very significant.

Since the model was homoscedastic, no transformation was needed on the variables. The variance was reasonable across all observations and the graph of the predicted values against the residuals indicated that the model was already linear.

Discussion

The results of the analysis were in line with what was anticipated. For both the model examining all appliance types and the specific model examining clothes washers, the predictor variables for each retailer were significant. For the clothes washer model, the variable for level of state activity level was also significant. This was not surprising since with the high initial price premium for an ENERGY STAR qualified clothes washer, it requires more consumer education or financial incentive to convince the consumer that the long-term energy savings will more than offset the initial price. States with a high ranking of activity level for efficiency programs have active efficiency programs run by either the state or by prominent utilities. These programs have served to not only publicize the benefits of an ENERGY STAR qualified clothes washer, but in many cases have also provided significant rebates to drive consumers to qualified washers. Based on this, the data supports the hypothesis that efficiency program efforts have led to increased market penetration of clothes washers.

The assignment of state efficiency levels was not an exact science. An estimate was made for each state based on known efficiency programs. No effort was made to actually rank the states or to quantify the overall effects of current or past efficiency programs. A much more complicated analysis could try to refine this scale by assigning more categories to differentiate between the states since, although California and Rhode Island both have very high levels of activity, it cannot be said that Rhode Island's level of activity is anywhere near as high as California's level of activity. A better metric could also be created to measure the actual effect of the efficiency programs. One possibility is to measure the total amount of efficiency program dollars that go to appliance promotions, but this is difficult to determine and most states also have promotions that encourage consumers to buy ENERGY STAR qualified products in general. These general promotions should have substantial spillover effects onto specific product purchasing decisions. A final option would be to use a metric such as awareness and understanding of the ENERGY STAR label to determine state activity effects. It seems logical that a high level of consumer understanding on the benefits of ENERGY STAR qualified appliances would result in higher market shares for each product category.

The results show very significant effects on market share between each of the three retailers. Examining the final regression model for all appliances, the difference between the retailers was four percentage points between Retailer C (0.60, *SE*=0.17) and Retailer A (0.56, *SE*=0.17) and a full nineteen percentage points between Retailer C and Retailer B (0.41, *SE*=0.17). For all efficient products, the market share is dependent on availability of efficient products as determined by the manufacturer, the stocking practices and point-of-purchase promotional activities of the retailers, and the final consumer buying decision, which is influenced by promotions and information from all channels including state and utility efficiency programs. The results of this analysis show that retailer promotions and stocking practices significantly affect the market share of ENERGY STAR qualified appliances. There is little variation among manufacturer product availability across retail channels; the vast majority of appliances available at the national retailers are produced by one of four manufacturers.

For this large effect between retailers to exist, one of three scenarios must be true. First, the retailers are making conscientious decisions on what to stock based on whether or not the products are ENERGY STAR qualified. Second, some retailers are much more active with the promotion of ENERGY STAR qualified appliances, either in circulars or other advertisements, or with in-store signage. Finally, consumers at one retailer are more likely to purchase an

ENERGY STAR qualified appliance. The final option does not seem likely since the three retailers are fairly similar. The truth probably involves a combination of the first two scenarios. Retailers do heavily promote the efficiency of many products, but for products where energy consumption is not as diverse, such as refrigerators and room air conditioners; a large effect is probably due to stocking decisions and overall promotion of the ENERGY STAR brand across all product categories. For example, a consumer may have purchased an ENERGY STAR qualified clothes washer in the past and as a result, looked for the label on another appliance type.

The gap between retailers was not as great for clothes washers with Retailer C again the most significant with a coefficient of 0.36 (*SE*=0.0052), followed by Retailer B at 0.34 (*SE*=0.0053) and Retailer A at 0.31 (*SE*=0.0053). The lack of difference in the coefficients probably is due to the smaller overall variance in the market penetration of clothes washers. Additionally, specifying one product removes any effects across appliance types, for example, if one retailer sells many more ENERGY STAR qualified dishwashers than any of the other qualified products. The coefficient on activity level seems small, but since activity level was ranked on a 100-point scale and the market penetration is only a percentage, the effects are large. For example, a state with high activity as opposed to low activity would see a change in the clothes washer market share of more than five percentage points. This is consistent with the only other data on this subject, which examined the effect of a sales tax holiday or waiver on ENERGY STAR qualified clothes washers in the state of Maryland on market share and concluded that the holiday resulted in a jump in market share of three percentage points.

The lesson for any group interested in promoting ENERGY STAR qualified appliances is that working with retailers is vital in order to promote qualified products. Consumers may eventually find ENERGY STAR qualified products if they are very persistent on finding specific products, but most consumers will not go out of their way to find a product if it is not available at the retailer. As this analysis shows, even seemingly similar retail chains have a significant difference and effect on the market share and this is probably due to either chain-specific promotions or chain-specific stocking decisions.

This analysis may be only the starting point for any group interested in pursuing a more in-depth analysis of ENERGY STAR qualified appliance sales. The basic predictor variables and model is provided and it confirms the expected results. The most potential lies in regional specific analysis that follows the general national pattern. Regional groups are more knowledgeable about local promotions and could more accurately assign both a quantifiable metric for the level of activity and specify the exact time that the activity took place. One shortcoming of this analysis is that if a local utility in a state without much overall activity had a very visible short-range promotion; it was not captured in the data. In fact, if such a promotion did lead to a temporary jump in ENERGY STAR qualified sales or even a long-term localized change in purchasing habits, this may offset the rest of the data from the state. But any additional analyses would need to be very tailored and very specific. For the time being, it is safe to assume that this analysis does definitively show a quantifiable relation between the retail chain where an appliance is purchased and whether or not that purchase will tend to be ENERGY STAR qualified. This model also shows that for at least one appliance type, the level of state activity has a very significant effect on sales.