Bounce Back from ENERGY STAR® Specification Changes in the Appliance Market in the Northeast US: A Regression Analysis

Seth E. Snell, Ph.D., Applied Proactive Technologies, Inc., Springfield, MA

Abstract

Periodically, ENERGY STAR® specifications for products are updated to reflect technological advances and to maintain the standard that all ENERGY STAR products are the most energy efficient products in the U.S. marketplace. Substantial drops in the availability of ENERGY STAR products following appliance specification changes have been common and may generate confusion in the marketplace especially in regions where rebates are offered for ENERGY STAR qualified products (Karney, 2006). The EPA, DOE, and its ENERGY STAR partners have undertaken various strategies to prevent the drop in available ENERGY STAR products following a specification change, with limited success. This paper addresses the extent of drop-off and the bounce back recovery time in ENERGY STAR availability associated with specification changes in the major appliances by analyzing sales floor inventory information from retailers throughout the Northeastern United States. Linear regression analyses of the fraction of models on sales floors that are ENERGY STAR qualified through time and across retailers throughout the region provide the analytical framework from which to estimate the bounce back time for each appliance and retailer type. The drop off is least and bounce back the quickest for clothes washers during this time period. The largest and most prolonged drop in the availability of ENERGY STAR models following a specification change is observed for room air conditioners. This research also generates estimates of the growth in the availability of ENERGY STAR models on northeastern sales floors by appliance and retailer type.

Introduction

It has been well established that the fraction of ENERGY STAR qualified appliances available on retail sales floors drops considerably following ENERGY STAR specification changes (Barnes, 2005; Rosenberg, 2003; Snell and DelNegro, 2005). This drop in ENERGY STAR qualified product may represent an inability on the part of retailers and manufacturers to fully anticipate and adequately adjust for the change in ENERGY STAR specifications, at least to some extent. Accordingly, the market requires a certain bounce back period for ENERGY STAR qualified fractions to return to pre-specification change trending levels. Although not statistically verified in the past, this bounce back period has been estimated as approximately one year in the Northeast U.S. appliance market (Snell and DelNegro, 2005).

Regional energy efficiency program efforts have focused on improving the dissemination of impending specification changes to both retailers and manufacturers with enough lead time to allow both sets of market actors to adjust production and stocking patterns. In spite of these efforts, the fraction of ENERGY STAR qualified refrigerators across retailers in the Northeast dropped substantially as a result of the January 2004 specification change (Snell and DelNegro, 2005).

To maintain positive relations with ENERGY STAR partners, the EPA and DOE have commonly provided and publicized a grace period following each specification change. For specification changes prior to January 2007, this grace period has been six months. During this grace period, partners could continue to promote products that qualified under the previous specification that had been labeled by manufacturers. For the January 2007 specification change affecting clothes washers and dishwashers, this grace period was reduced from six months to three months (Karney, 2006), reflecting an aim to reduce confusion in the

marketplace – especially where regional energy efficiency programs offer rebates on ENERGY STAR qualified products.

This paper adds a level of statistical rigor to the measurement of the bounce back period associated with ENERGY STAR specification changes. The extent to which market recovery differs by appliance and retailer type may shed some light on techniques that could be used to shorten this bounce back period, thus reducing market confusion for industry partners, and ultimately, consumers.

Data and Methodology

Over the past seven years, detailed sales floor data have been collected semi-annually from appliance retail locations in six northeastern states -- New Hampshire, Vermont, Massachusetts, Connecticut, and Rhode Island -- and New York (Long Island region only). [1] All sales floor information was collected on-site by trained field personnel and included model-level information about each of the four main appliances (Refrigerators (RF), Clothes Washers (CW), Dishwashers (DW), and Room Air Conditioners (AC)).

Product information such as size, type, Energy Guide rating, and ENERGY STAR qualification status are tracked for all appliance models on the sales floors of the retailers visited in each time period. Retailer-specific information such as price was also collected for retailers ranging from the largest national chains to the smallest independent appliance retailers. Data were collected twice annually (late spring and fall) from 1999 through spring 2006. In each round of data collection, every attempt was made to reach a census of stores that sell new appliances from a showroom sales floor. Previous work (Snell and DelNegro, 2005) presents the aggregated form of the data used in this analysis (through spring 2004).

To assess the extent and duration of the market impacts of ENERGY STAR specification changes, linear regression models are estimated with the fraction of models at each retailer that are ENERGY STAR qualified as the dependent variable. This fraction of ENERGY STAR qualified models is hypothesized to be a function of a host of variables associated with the availability of qualified products from manufacturers, retailer stocking decisions, and consumer preferences. The regression models are estimated using the following basic form for each of the four major appliance types:

$$\mathbf{ESQfraction} = \beta_0 + \beta_{1,i}\,(\mathbf{ST_i}) + \beta_2\,(\mathbf{Price\ Characteristics}) + \beta_3\,(\mathbf{Time}) + \beta_4\,(\mathbf{Stocking\ Practices}) + \beta_{5,j}\,(\mathbf{Spec\ Change_j}) + \varepsilon \qquad \textbf{(Eq.1)}$$

where:

ESQfraction = Fraction of models on the sales floor that are ENERGY STAR qualified

ST_i = Dummy variables for the state in which the retailer is located

Price Characteristics = Retailer level, appliance price characteristics

Time = Real value for year that data were collected to estimate trend over time (e.g. spring 2001 = 2001.3, fall 2002 = 2002.7)

Stocking Practices = Retailer level, stocking information

Spec Change$_j$ = Dummy variables to represent the time periods directly following an ENERGY STAR specification change.

The state level dummy variables included in the regression analysis proxy a variety of different effects that may vary by state (e.g. regional program support, effectiveness of energy efficiency program representatives, rebate levels, regulatory environment, and customer preferences). Given the perfect co-linearity of these variables if are all six (one for each state) were included in any single regression model,

[1] Data were not collected in each of these states in every time period.

a maximum of five ST_i dummy variables can be included. The coefficients of the ST_i dummy variables included in a given regression represent an average incremental difference in the fraction of models on the sales floors in that particular state that are ENERGY STAR qualified relative to the states represented by the ST_i dummy variable(s) not included in the regression analysis.

The models are estimated using Ordinary Least Squares (OLS) on a pooled cross-sectional dataset. To assess the differences between retailer types, I estimate separate models for each appliance type using data only from national chain stores (The Home Depot, Lowe's Home Improvement Warehouse, Best Buy, Sears, and Circuit City) and data from smaller regional and independent retailers. These two groups (national chains and regional/independent retailers) are chosen because stocking decisions and manufacturer-retailer agreements are similar within these two categories of retailers, but differ substantially between the two groups.

After estimating models that are fundamentally stable, the primary analytical technique to assess the length of the bounce back period is the number of statistically significant Spec $Change_j$ dummy variables that are included in each regression model. Simply considered, when evaluating the bounce back from a positively sloped trend line for the fraction of models that are ENERGY STAR qualified, we would expect to find negative impacts that are most severe in the time period directly following the specification change and then impacts reducing to zero as the market recovers (see Figure 1 for illustration). This positively sloped trend line is set as the standard here for two reasons: 1) efforts to promote ENERGY STAR among appliance manufacturers, retailers, and consumers should lead to greater availability of ENERGY STAR models through time, and 2) it tends to be the case that the fraction of models that are ENERGY STAR qualified has increased monotonically through time except following specification changes (see Figure 2). In statistical terms, the time period in which the Spec $Change_j$ dummy variable is statistically indistinguishable from zero is the time period in which the market has bounced back to its pre-specification change trending level.

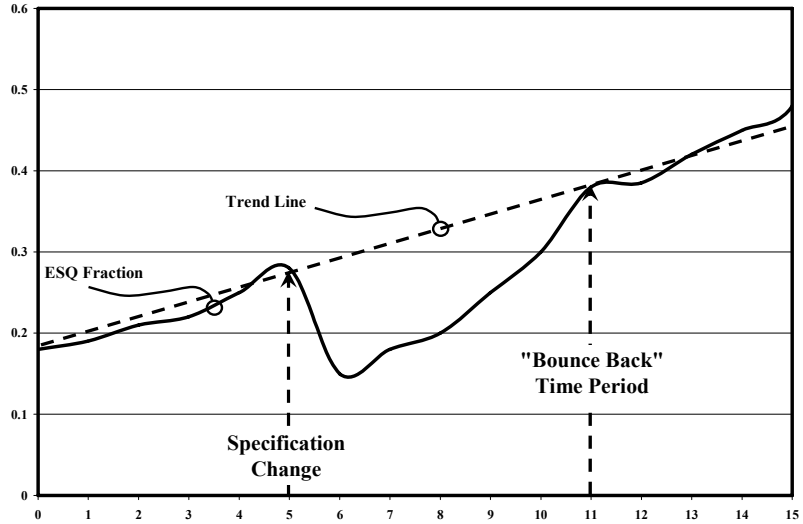

Figure 1: Diagram of Bounce Back from Specification Change

Results

There have been two specification changes for appliances in the past six years: January 2001, affecting all four major appliances, and January 2004, affecting Clothes Washers and Refrigerators. Table 1 details the number of product models that lost ENERGY STAR qualified status and the percentage of the total number of ENERGY STAR models that represents (number dropped/number of ENERGY STAR qualified models in previous October). The number of refrigerator models on the ENERGY STAR qualified products list before January 2001 is not available, but all models that had been on the list at that time were dropped as a result of the specification change.

Table 1. Magnitude of ENERGY STAR Specification Change Effects[a]

Specification Change	Clothes Washers	Dishwashers	Refrigerators	Room Air Conditioners
January 2001	14 models (25%)	89 models (39%)	?? models (100%)	75 models (75%)
January 2004	29 models (21%)		617 models (68%)	

[a] Number of models (and percentage) no longer qualifying.
Source: D & R International (2007)

Figure 2 illustrates the fraction of models on sales floors that is ENERGY STAR qualified, on average, in national chain retailers and independent/regional retailers throughout the Northeast region through time. The drop in the availability of ENERGY STAR models at each time of specification change is clearly evident in three of the four appliance types (RF, AC, and DW). The pattern of drop and bounce back is much less evident for clothes washers where smaller fractions of models (25% and 21%, respectively) dropped out of ENERGY STAR qualification as a result of the specification changes.

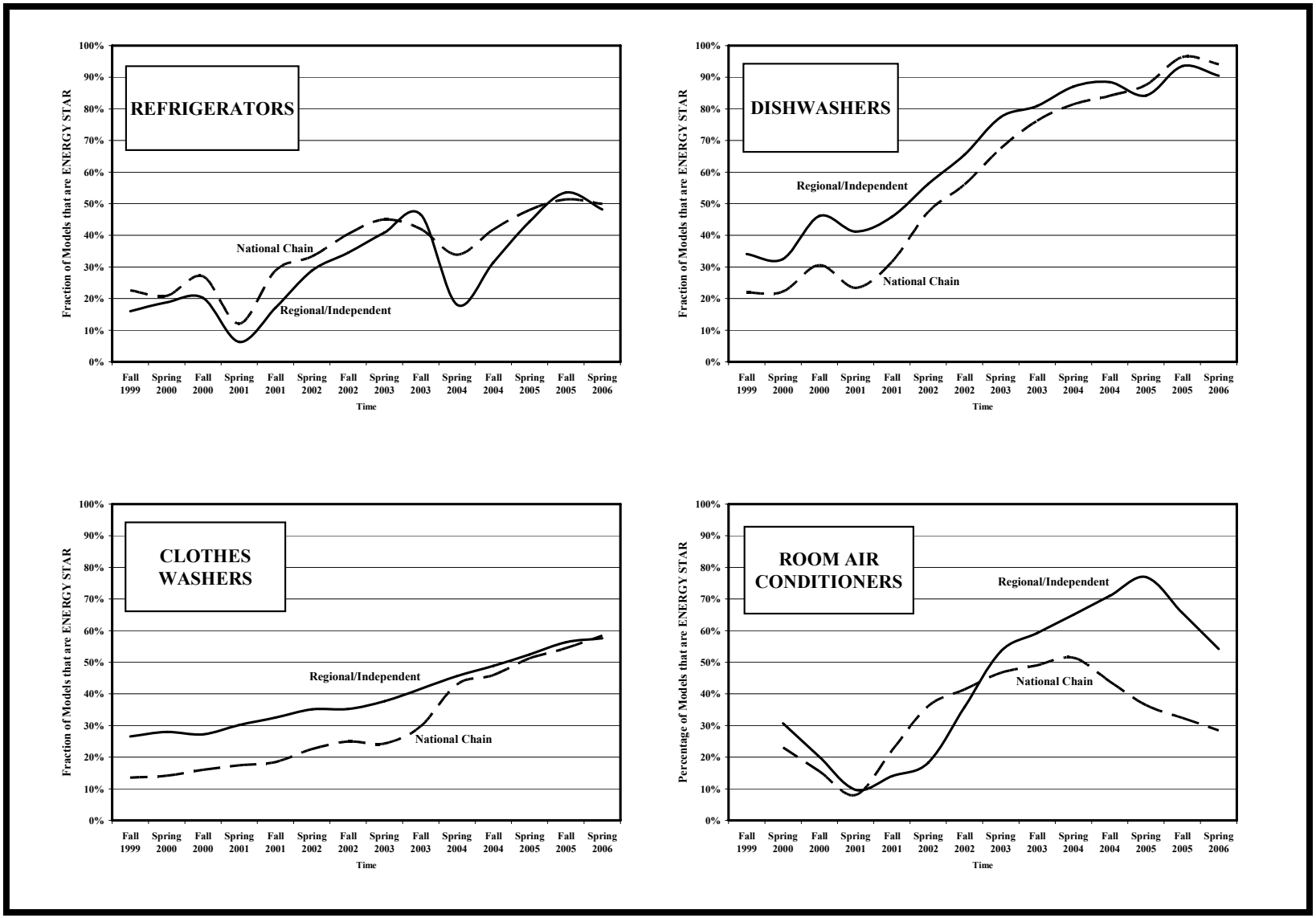

Figure 2. Average Fraction of Models That Are ENERGY STAR Qualified by Retailer Type

Refrigerators

The model specifications for the fraction of Refrigerators that are ENERGY STAR qualified at national chain retailers are presented in Table 2 below. The model specifications for comparable regional chains/independent retailers are presented in Table 3. For each regression model, the values shown are: 1) N = number of observations, 2) adjR^2 = Adjusted R-squared, 3) F = F statistic for overall significance of the model, 4) β = β-coefficient, 5) t-stat = t-statistic on significant difference from zero for β-coefficient, 6) signif. = significance level of t-stat – where a double asterisk (**) indicates $\alpha < 0.01$ level, a single asterisk (*) indicates $\alpha < 0.05$ level, and no marking indicates non-significance ($\alpha > 0.05$ level).

The regression models in Tables 2 and 3 account for around 50% of the variation in the fraction of refrigerators that are ENERGY STAR qualified across the retailers in the Northeast for this six-year period. All variables (except the most recent period dummy variables) are significant beyond the $\alpha < 0.05$ level. Furthermore, the signs of all of the β-coefficients in all four models are in the expected direction and have reasonable interpretations for their relationships with the dependent variable (the fraction of models that are ENERGY STAR qualified).

The dummy variables for the state in which the retailer is located are all positive indicating that the retailers in these states had higher fractions of refrigerators that were ENERGY STAR qualified than retailers in the state(s) not included in the regression model. As described earlier, these variables capture a combined effect of different characteristics (e.g. regional program support and customer preferences) for the states included in the model relative to those not included in the model.

The positive β-coefficients for the trend variable (YEAR) indicate that the fraction of refrigerators that are ENERGY STAR has grown at a rate of about 4.8% per year in national chain retailers and 6.1% in regional chains and independent retailers throughout the region.

The positive coefficients for the average price of refrigerators (AVG. PRICE; in $100s) reflect the marginally higher cost of ENERGY STAR refrigerators. For regional chains and independent retailers, there is a small negative effect associated with the highest priced refrigerator at the location (MAX PRICE; in $100s). This effect embodies the tendency of some independent retailers toward stocking higher end refrigerators. As a measure of stocking variety, the total number of refrigerator models on the sales floor at each location (NMODELS) has a positive relationship with the fraction of refrigerator models that are ENERGY STAR qualified in both national chains and regional chains and independent retailers alike.

Finally, and most important for this analysis, is the way in which the Spec Change$_j$ dummy variables for the time periods following the specification changes in January 2001 and 2004 are incorporated into these linear regression models. In Model 1 (Table 2), dummy variables from two time periods following the specification change in January 2001 and one time period following the change in January 2004 are included in the regression analysis (DUM2001-1 through DUM2001-2 and DUM2004-1). All of the coefficients associated with these variables have the expected sign, and are significant beyond the $\alpha < 0.05$ level. In terms of magnitude, the coefficient values also follow the pattern discussed in the Data and Methodology section above – largest negative effect in the early time periods, trailing off to zero. In Model 2 (Table 2), an additional Spec Change$_j$ dummy variable was added to the regression model following each specification change (DUM2002-1 and DUM2004-2). Consistent with the bounce back of the market following each specification change, neither of these Spec Change$_j$ dummy variables is statistically significant at the $\alpha <$ 0.05 level. This implies that the bounce back of the refrigerator market in national chain retailers was 1 to 1.5 years following the January 2001 specification change and 0.5 to 1 year following the January 2004 change.

For regional chains and independent retailers (Model 3 in Table 3), dummy variables from three time periods following each specification change are included in the regression analysis (DUM2001-1 through DUM2002-1 and DUM2004-1 through DUM2005-1). In Model 4 (Table 3), Spec Change$_j$ dummy variables

from four time periods following each specification change are included in the regression model. The fourth period variables following each specification change are not statistically significant ($\alpha > 0.20$). This analysis leads to the conclusion that the bounce back period for regional chains and independent retailers in the Northeast during this time period was between 1.5 and 2 years following each specification change.

Table 2. Refrigerator Linear Regression Results, National Chains

Variable	Model 1 N = 1,152; adjR^2= 0.56; F = 145			Model 2 N = 1,152; adjR^2= 0.56; F = 121		
	β	t-stat	signif.	β	t-stat	signif.
Constant	-95.786	-22.1	**	-96.269	-22.0	**
MA	0.041	4.4	**	0.042	4.5	**
NH	0.104	5.0	**	0.104	5.0	**
VT	0.084	6.4	**	0.086	6.5	**
RI	0.053	4.6	**	0.052	4.6	**
YEAR	0.048	22.1	**	0.048	22.1	**
AVG. PRICE	0.010	8.4	**	0.010	8.2	**
NMODELS	0.001	10.3	**	0.001	10.3	**
DUM2001-1	-0.186	-15.0	**	-0.188	-15.0	**
DUM2001-2	-0.033	-2.6	*	-0.036	-2.8	**
DUM2002-1				-0.016	-1.3	
DUM2004-1	-0.090	-10.0	**	-0.094	-10.3	**
DUM2004-2				-0.050	-1.8	

Table 3. Refrigerator Linear Regression Results, Regional Chains/Independents

Variable	Model 3 N = 2,571; adjR^2= 0.42; F = 127			Model 4 N = 2,571; adjR^2= 0.42; F = 112		
	β	t-stat	signif.	β	t-stat	signif.
Constant	-122.313	-25.3	**	-123.615	-24.2	**
MA	0.107	6.5	**	0.109	6.3	**
NH	0.132	5.3	**	0.133	5.2	**
CT	0.068	3.4	**	0.069	3.4	**
VT	0.074	4.2	**	0.076	4.1	**
RI	0.128	7.2	**	0.129	7.1	**
YEAR	0.061	25.3	**	0.062	24.2	**
AVG. PRICE	0.011	10.3	**	0.011	10.3	**
MAX PRICE	-0.001	-3.4	**	-0.001	-3.4	**
MODELS	0.001	4.8	**	0.001	4.8	**
DUM2001-1	-0.205	-18.1	**	-0.207	-18.1	**
DUM2001-2	-0.117	-10.3	**	-0.119	-10.3	**
DUM2002-1	-0.043	-3.8	**	-0.045	-3.9	**
DUM2002-2				-0.014	-1.2	
DUM2004-1	-0.264	-23.4	**	-0.268	-22.5	**
DUM2004-2	-0.155	-12.5	**	-0.159	-12.1	**
DUM2005-1	-0.060	-2.3	*	-0.064	-2.4	*
DUM2005-2				-0.005	-0.2	

Dishwashers

The model specifications for the fraction of dishwashers that are ENERGY STAR qualified among national chain retailers are presented in Table 4 below. The model specifications for regional chains and independent retailers are presented in Table 5.

The overall structure of the regression models for dishwashers is similar to those estimated for refrigerators, but the individual variables found to be statistically significant are different. The models for national chain retailers (Table 4) explain more than 87% of the variation in the fraction of ENERGY STAR dishwashers across retailers and time periods. The models for regional chains and independent retailers explain more than 57% of the variation.

Table 4. Dishwasher Linear Regression Results, National Chains

Variable	Model 1			Model 2		
	N = 1,157; adjR^2= 0.88; F = 907			N = 1,157; adjR^2= 0.88; F = 816		
	β	t-stat	signif.	β	t-stat	signif.
Constant	-262.930	-70.0	**	-262.898	-70.0	**
MA	0.064	8.8	**	0.064	8.5	**
CT	0.069	5.2	**	0.069	5.2	**
RI	0.024	2.4	*	0.024	2.4	*
YEAR	0.132	70.2	**	0.132	70.1	**
MODELS	0.002	5.3	**	0.002	5.3	**
DUM2001-1	-0.161	-14.2	**	-0.160	-14.0	**
DUM2001-2	-0.140	-11.5	**	-0.139	-11.3	**
DUM2002-1	-0.063	-5.5	**	-0.062	-5.3	**
DUM2002-2	-0.028	-2.6	**	-0.027	-2.5	*
DUM2003-1				0.007	0.6	

Table 5. Dishwasher Linear Regression Results, Regional and Independents

Variable	Model 3			Model 4		
	N = 2,575; adjR^2= 0.58; F = 349			N = 2,575; adjR^2= 0.58; F = 318		
	β	t-stat	signif.	β	t-stat	signif.
Constant	-208.456	-44.6	**	-208.475	-44.6	**
MA	0.105	7.0	**	0.107	7.1	**
CT	0.057	2.9	**	0.057	2.9	**
RI	0.099	5.5	**	0.100	5.6	**
VT	0.098	5.9	**	0.100	6.0	**
YEAR	0.104	44.7	**	0.104	44.7	**
AVGOFPRICE	0.039	14.9	**	0.039	14.9	**
MODELS	0.001	3.0	**	0.001	3.0	**
DUM2001-1	-0.088	-6.4	**	-0.090	-6.5	**
DUM2001-2	-0.096	-6.9	**	-0.099	-7.0	**
DUM2002-1	-0.065	-4.7	**	-0.067	-4.9	**
DUM2002-2				-0.019	-1.4	

The coefficients for the state dummy variables have a similar interpretation as for refrigerators. For example, in Model 1 (Table 4), MA, CT, and RI dummy variables have significantly positive β-coefficients. This implies that the fraction of dishwashers that are ENERGY STAR qualified in national chain retailers in

these states is significantly higher than the fraction of qualified models in the other areas of the study taken together as a group (NH, VT, and Long Island, NY).

The time trend variables indicate that the fraction of dishwashers that are ENERGY STAR qualified grew 13.2% per year in national chains and 10.4% per year in regional chains and independent retailers during this time period.

Dishwasher specifications were revised only in January 2001, when approximately 39% of ENERGY STAR qualified models dropped from qualification (see Table 1). Comparing the results of the Spec Change$_j$ dummy variables between Model 1 and 2 (Table 4) indicates that the bounce back period for national chain retailers was 2-2.5 years. The bounce back period for regional chains and independent retailers was shorter than for national retailers by six months (1.5-2 years).

Room Air Conditioners

The model specifications for the fraction of room air conditioners that are ENERGY STAR qualified among national chain retailers are presented in Table 6 below. The model specifications for regional chains and independent retailers are presented in Table 7.

Table 6. Room Air Conditioner Linear Regression Results, National Chains

Variable	Model 1 N = 652; adjR^2= 0.25; F = 38			Model 2 N = 652; adjR^2= 0.25; F = 33		
	β	t-stat	signif.	β	t-stat	signif.
Constant	-80.140	-6.0	**	-78.061	-5.7	**
MA	0.084	3.6	**	0.087	3.7	**
VT	0.219	5.8	**	0.221	5.9	**
NH	0.210	3.8	**	0.211	3.8	**
YEAR	0.040	6.0	**	0.039	5.7	**
MODELS	0.009	5.1	**	0.009	5.0	**
DUM2001-1	-0.278	-9.0	**	-0.285	-8.8	**
DUM2002-1				-0.022	-0.7	

Table 7. Room Air Conditioner Linear Regression Results, Regional and Independents

Variable	Model 3 N = 1,046; adjR^2= 0.40; F = 172			Model 4 N = 1,046; adjR^2= 0.40; F = 137		
	β	t-stat	signif.	β	t-stat	signif.
Constant	-138.455	-13.3	**	-138.203	-13.2	**
YEAR	0.069	13.3	**	0.069	13.3	**
MODELS	0.003	2.9	**	0.003	2.9	**
DUM2001-1	-0.295	-12.6	**	-0.293	-12.2	**
DUM2002-1	-0.277	-12.0	**	-0.275	-11.6	**
DUM2003-1				0.009	0.4	

The measurements of room air conditioner availability were made only during the spring rounds of the data collection throughout the six year period. This combined with the fact that not all retailers consistently carry room air conditioners leads to considerably fewer data points from which to estimate the regression models for this product. The models for the national chain retailers explain just over 25% of the variation across locations and time periods. The models for regional chains and independent retailers explain just over 39% of the variation.

The time trend variables indicate that the fraction of room air conditioners that are ENERGY STAR grew 4.0% per year in national chains and 6.9% per year in regional chains and independent retailers.

Room air conditioners underwent only one specification change during the six year period in this research (January 2001, when 75 of the approximately 100 earlier certified models dropped from qualified status). National retailers recovered from this specification change within 1-2 years. Regional chains and independent retailers, bounced back in 2-3 years. This finding is visually quite apparent when looking at the AC panel of Figure 2, but these results add statistical rigor to that visual inspection.

Clothes Washers

The model specifications for the fraction of clothes washers that are ENERGY STAR qualified among national chain retailers are presented in Table 8 below. The model specifications for regional chains and independent retailers are presented in Table 9.

Table 8. Clothes Washer Linear Regression Results, National Chains

Variable	Model 1			Model 2		
	N = 1,128; adjR^2= 0.84; F = 817			N = 1,128; adjR^2= 0.84; F = 716		
	β	t-stat	signif.	β	t-stat	signif.
Constant	-113.186	-37.6	**	-112.025	-36.1	**
CT	0.040	4.4	**	0.039	4.3	**
RI	0.027	4.1	**	0.026	4.1	**
NY	0.033	4.7	**	0.033	4.7	**
YEAR	0.056	37.6	**	0.056	36.1	**
AVGOFPRICE	0.077	25.1	**	0.076	25.1	**
MAXOFPRICE	-0.004	-4.2	**	-0.003	-4.0	**
MODELS	-0.002	-11.8	**	-0.002	-11.9	**
DUM2001_1				-0.011	-1.5	

Table 9. Clothes Washer Linear Regression Results, Regional and Independents

Variable	Model 3			Model 4		
	N = 2,549; adjR^2= 0.53; F = 418			N = 2,549; adjR^2= 0.54; F = 367		
	β	t-stat	signif.	β	t-stat	signif.
Constant	-77.104	-22.1	**	-76.045	-21.5	**
MA	0.020	2.3	*	0.021	2.4	*
VT	0.061	6.0	**	0.062	6.0	**
RI	0.057	4.9	**	0.057	5.0	**
YEAR	0.038	22.0	**	0.038	21.4	**
AVGOFPRICE	0.085	41.0	**	0.085	41.0	**
MAXOFPRICE	-0.005	-8.6	**	-0.005	-8.6	**
DUM2001_1	-0.028	-2.7	**	-0.030	-3.0	**
DUM2001_2				-0.018	-1.7	

The models for National retailers explain over 83% of the variation across locations and time. The models for regional chains and independent retailers explain over 53% of the variation.

The time trend variables indicate that the fraction of clothes washers that are ENERGY STAR qualified has grown 5.6% per year in national chain retailers and 3.8% in regional chains and independent retailers in the Northeastern US.

Clothes Washers are the only major appliance type where there is not a statistically measurable bounce back period for both retailer types and specification changes included in the study. Regional chains and independent retailers bounced back from the January 2001 change within one year but saw no measurable drop from the trend as a result of the January 2004 specification change. In both specification changes, approximately 20-25% of models were dropped from qualification, but only for the January 2001 change was there a statistically significant drop in the fraction of ENERGY STAR qualified models on sales floors. Among National retailers included in the study, no statistically significant drop was found following either specification change.

This result suggests that the efforts made by EPA, DOE, and its ENERGY STAR partners to get out early notification about upcoming specification changes have been effective in reducing market interruptions for this product type. It may also be the case that manufacturers of high efficiency clothes washers work more closely with ENERGY STAR and its other partners regarding product specification and the associated changes in specification. It could also be the case that energy-efficiency program partners generally push more strongly this product than the other appliances which leads manufacturers and retailers to provide a more constant supply of ENERGY STAR clothes washers. It should, however, also be noted that the specification changes in this product type have resulted in fewer models being dropped from ENERGY STAR qualification than the specification changes in the other product types (see Table 1). It is beyond the scope of this research to determine the correct explanation, but it is clear that the drop in the fraction of clothes washers that are ENERGY STAR qualified as a result of specification changes is smaller for this appliance type than the other three, and that the bounce back time is shorter for all retailer types.

Conclusions

This research uses regression analysis to statistically quantify the effect of ENERGY STAR specification changes on the appliance market in the Northeastern U.S., and the length of time required for the market to bounce back to its pre-specification trending level. The regression models explain a reasonable amount of the variation in a large pooled cross-sectional data set (nearly 13,000 observations combined) and are remarkably stable through the addition of time period dummy variables that allow the estimation of market effects.

During the six-year period included in this research (fall 1999 – spring 2006) ENERGY STAR specification changes have had the strongest impact on the availability of ENERGY STAR refrigerators. This was due, in part, to the fact that refrigerators have undergone two significant specification changes. This research found that national retailers recovered from those specification changes quicker than regional chains and independent retailers (by 6 months or more). However, the bounce back period for national retailers was still 1.0-1.5 years to pre-specification change trending levels (see Table 10).

Table 10. Summary Findings – Bounce Back Time Periods

Appliance	Specification Changes, January 2001			Specification Changes, January 2004		
	National Chains		Regional Chains and Independents	National Chains		Regional Chains and Independents
Refrigerators	1.0-1.5 yrs.	<	1.5-2.0 yrs.	1.0-1.5 yrs.	<	1.5-2.0 yrs.
Dishwashers	2.0-2.5 yrs.	>	1.5-2.0 yrs.	N/A		N/A
Room Air Conditioners	1.0-2.0 yrs.	<	2.0-3.0 yrs.	N/A		N/A
Clothes Washers	no drop	<	0.5-1.0 yrs.	no drop	=	no drop

For dishwashers, regional chains and independent retailers were quicker to recover (1.5-2.0 years) from the single specification change in January 2001 than national retailers (2.0-2.5 years). For room air conditioners, national retailers recovered more quickly (1-2 years) than regional chains and independent retailers (2-3 years). In terms of the impact of specification changes on ENERGY STAR clothes washers, the results of this research are mixed. Regional chains and independent retailers experienced a reduction in the fraction of clothes washers that are ENERGY STAR qualified during the January 2001 change, but not after the January 2004 change. The bounce back period following the January 2001 change was less than 1 year. National retailers did not experience a statistically significant drop following either specification change.

Generally speaking, national chains recovered from specification changes more quickly than regional chains and independent retailers (except in the case of dishwashers). This is likely the result of the significantly more centralized decisions about stocking practices within national retailers.

In addition to the findings regarding bounce back times, this research also generates estimates of the growth in the fraction of ENERGY STAR qualified models on sales floors in the Northeast (see Table 11). For all appliance and retailer types in this region, the availability of ENERGY STAR qualified models on sales floors has increased through time when the effects of specification changes are controlled. Dishwashers stand out with the quickest growth for both retailer types. The growth of ENERGY STAR qualified clothes washers has been slowest for clothes washers in regional chains and independent retailers (3.8%) and dishwashers among national chains (4.0%). When comparing time trends between national chains and regional chains and independent retailers, the results depend on appliance type.

Table 11. Summary Findings – ENERGY STAR Qualified Time Trends

Appliance	ENERGY STAR Qualified Time Trend		
	National Chains		Regional Chains and Independents
Refrigerators	+ 4.8%	<	+ 6.1%
Dishwashers	+ 13.2%	>	+ 10.4%
Room Air Conditioners	+ 4.0%	<	+ 6.9%
Clothes Washers	+ 5.6%	>	+ 3.8%

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