High Efficiency Clothes Washers: Whiter Whites with Less Energy?

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Abstract

Objective: The Department of Energy's Office of Codes and Standards is considering mandating an energy efficiency standard for clothes washers. As part of the analysis to determine the possible effects of such a standard, focus groups and conjoint analysis sessions were used to determine those attributes that are most influential in the decision to purchase a clothes washer. The data collected from these sessions is used to estimate the likelihood of purchasing a clothes washer and to determine how the demand for clothes washers will change with equipment modifications resulting from an efficiency standard.

Research Design and Methodology: Focus groups are used to determine the most important clothes washer features from a broad range of respondents. These washer attributes are then used in the conjoint analysis sessions. Conjoint analysis is a stated preference technique where respondents rank cards representing different clothes washer options. Each card shows a different clothes washer described by equipment characteristics such as price, electricity and water savings, and front or top loading design. By examining how card rankings change with changes in the equipment features given on the cards, the value placed on the various equipment characteristics relative to each other is determined. The advantage of the conjoint analysis is that equipment characteristics are presented together, forcing respondents to make tradeoffs between attributes as they would if they were actually purchasing a clothes washer.

Using the conjoint analysis results, the probability of purchasing a clothes washer is estimated using a logit model. These purchase probabilities are used to estimate the effect of equipment changes resulting from the standard. Changes in purchase probabilities are estimated by changing equipment features that are likely to be affected by an efficiency standard. In this manner, the effect of the standard is evaluated by examining different energy efficient clothes washer design options. This analysis allows for the price effects to be evaluated as well as other equipment features such as top versus front loading washing machine design. By examining these non-price attributes, the analysis shows which equipment features can be modified to meet the efficiency standard while minimizing the effect on the likelihood of purchase due to a price increase.

Why this is Important: This analysis represents the first time DOE has ever conducted a nationwide study to determine the effect of a proposed standard. The success of this analysis will affect whether other nationwide studies will be conducted in support of future standards. In addition to contributing to the formulation of the standard, this analysis illustrates the willingness of customers to trade off other equipment features for an energy efficient clothes washer design. The conjoint analysis techniques and the purchase probability estimation described in this paper are easily transferable to other appliances and will be of interest to any researcher evaluating the demand for energy efficient appliances.

Introduction

The Department of Energy (DOE) is considering a new clothes washer energy efficiency standard. As part of the energy efficiency standard rulemaking process, DOE must determine "if any lessening of the utility or performance of the product is likely to result from the imposition of a standard" (42 USE Sec. 6295 (o)(2)(B)(I)(3)). Quantum Consulting was hired to collect consumer data to determine the value consumers' place on clothes washer attributes, such as door placement, cycle options, and temperature settings. DOE and the National Renewable Energy Laboratory then analyzed Quantum's findings to assess if the new efficiency standard would negatively impact any of the clothes washer attributes highly valued by consumers.

The consumer analysis involved a two-step process. First, we conducted focus groups to develop a list of clothes washer attributes valued by consumers. Second, we collected data from roughly 400 respondents using a conjoint analysis survey to estimate which clothes washer attributes are valued most by consumers. The six attributes that were cited most often by the focus groups and were likely to be affected by an efficiency standard were included in the conjoint analysis survey. Conjoint analysis is a stated preference technique that requires respondents to trade off different attributes against each other. By examining how respondents make these tradeoffs, we were able to estimate the relative values placed on the clothes washer features included in the conjoint survey.

The consumer analysis completed for the proposed clothes washer standard was the first time DOE's Office of Codes and Standards (OCS) has used conjoint analysis to assess if the utility of the appliance would be lessened due to the standard. In this paper, we discuss the two step methodology used in this effort, and highlight our key findings.

Focus Groups

The primary purpose of the focus groups was to identify the most important clothes washer features. Once identified, these key washer characteristics were included in the conjoint analysis. The focus groups enabled Quantum Consulting to develop an extensive list of clothes washer features that influence a consumer's purchase decision. This was accomplished by the moderator encouraging an open dialogue among focus group members to obtain an unsolicited list of clothes washer attributes. Once the unaided list of attributes is obtained, the moderator suggested other attributes that were not volunteered initially for the group to discuss.[1] When the clothes washer attributes discussion was completed, the moderator asked the focus group participants to identify which ten attributes would most significantly influence their selection of a new clothes washer, assuming they had made the decision to purchase a new clothes washer. These responses were then totaled across all ten focus groups to arrive at a list of the six most important clothes washer features to consumers.

Focus groups were conducted in five cities; Washington, DC, San Francisco Bay Area, CA, Madison, WI, Miami, FL, Dallas, TX. These cities were selected so that five different regions are represented in the focus groups. Ten focus groups were conducted, two in each city, with a total of 90 focus group participants divided almost evenly across the ten sessions. Focus group participants were

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[1] The moderator relied upon on a list of attributes provided by clothes washer manufacturers to the Department of Energy.

recruited randomly by phone to ensure a mix of demographic types and each respondent was paid a $50 incentive for participating in the focus group.

Table 1. Focus Group Results: Most Important Clothes Washer Attributes

Feature	Frequency in Top 10	Percentage out of 90
Price	75	83%
Capacity	73	81%
Energy & Water Costs	65	72%
Load Size Options	61	68%
Durability	54	60%
Water Temperature Options	54	60%
Door Placement	38	42%
Quiet Operation	36	40%
Wash Time	34	38%
Warranty	33	37%
Multiple Wash Cycle Options	30	33%
Horizontal/Vertical Axis	25	28%

Table 1 shows the top 12 characteristics mentioned from all of the focus groups as well as the percentage of respondents who listed that attribute. Price was mentioned most often as an important attribute for selecting a clothes washer, with 75 of 90 respondents mentioning price. This was followed by capacity, mentioned by 73 percent of respondents, and by energy and water costs, which was listed by 65 percent of the respondents. The ability to adjust the water to fit different wash load sizes, durability, and water temperature options were all mentioned by more than half of the respondents.

Based on the focus group results, clothes washer price, energy and water savings, capacity, water temperature, door placement, and load size adjustment were selected as attributes to use in the conjoint analysis. This group of attributes contains the five characteristics that will be potentially affected by an efficiency standard. In addition, these attributes were ranked among the very most important attributes among consumers.

The inclusion of price posed a research issue for DOE to consider because, according to the appliance energy efficiency standard legislation, the impact of appliance price increases is considered in the context of the expected energy cost savings from the appliance efficiency gains being imposed by the standard. *(42 USC Sec. 6295 (o) (2) (B) (i))* This is determined by DOE conducting a life-cycle cost analysis.

Conjoint Analysis

Conjoint analysis is a stated preference survey technique that involves having respondents sort through and rank cards that reflect different clothes washer equipment options. Each card describes a separate clothes washer based on the six washer attributes determined from the focus groups. Respondents rank the cards from most to least preferred. As discussed below, this ranking information is used to estimate the probability of purchasing different clothes washer options based on the equipment characteristics.

Conjoint analysis has the advantage of presenting washer characteristics simultaneously, which forces the respondent to make tradeoffs between attributes. By presenting washer attributes simultaneously, respondents must decide which features are most important, much as they would if they were actually shopping for a new clothes washer. Past experience as well as existing literature indicate that the most successful conjoint designs limit each exercise to ranking 16 cards at a time with 4 to 6 features on each card. Including more cards or additional attributes tends to overwhelm respondents and results in less reliable data. For these reasons, the clothes washer conjoint is designed with 16 cards with 6 different attributes.

This conjoint application utilizes an orthogonal card design, which means that there is zero correlation between each of the card attributes. This is critical to the analysis, as correlation across attributes results in a loss of precision and makes it difficult to estimate the importance that respondents place on each attribute. For example, consider the situation where purchase price and energy cost savings are two of the characteristics being evaluated, and on each card the purchase price is high and the energy savings is also high and expressed as a fixed proportion of price. Since purchase price and energy cost savings are perfectly correlated, there is no way to determine from the data if a respondent is ranking the cards based on price or savings. For this reason, having an orthogonally designed study is essential.

In addition to empirically determining the value consumers placed on each clothes washer attribute included on the cards, the conjoint method enabled DOE to estimate the likelihood of making a clothes washer purchase. Upon completing the rankings the respondents were asked to determine which clothes washers they would actually purchase given their situation today. This was done by inserting a 'Purchase Card' in the deck after each respondent completed the ranking process. The cards ranked above the Purchase Card were recorded as the clothes washers the respondent would consider purchasing today while those below the Purchase Card were recorded as clothes washers they would not consider purchasing today. The likelihood of purchasing a clothes washer findings are discussed below.

Given the scope and budget of the clothes washer study, the conjoint sample size was set at 400 points. Respondents were phoned randomly from a database of phone numbers in zip codes located near each the conjoint session location. The sample was stratified across income level and age group so that purchase probabilities could be estimated with confidence for these groups. Income level and age group were selected because DOE was particularly concerned about how the clothes washer rule might affect low income groups and the elderly, so we stratified these groups to ensure we had a large enough sample of each group to do a statistical analysis. Finally, respondents that attended the conjoint sessions were paid a $50 incentive for their time.

As with the focus groups, one of the goals of the conjoint analysis was to utilize a national sample with several different geographic regions represented. As a result, the conjoint sessions were conducted in four different regions: Washington, DC, Dallas, TX, Madison, WI, and San Francisco Bay Area, CA. The sample was divided so that approximately 100 respondents were recruited from each of these regions for a total sample of about 400.

Table 2. Variable Definitions

Variable	Description
Price	Dollar value of retail price of machine
Savings	Dollar value of annual water and energy bill savings
Capacity	Binary variable: zero for standard capacity machine, one for extra large capacity.
Door Placement	Binary variable: zero for front loader, one for top loader.
Wash Temp	Binary variable: zero for 'cold/warm', one for 'cold/warm/hot' washing temperature options
Load Size	Binary variable: zero if there is no load size adjustment option, one if there is

Table 2 shows the six clothes washer features used in the conjoint analysis. The values used for each variables were chosen to correspond to a standard efficiency clothes washer, a medium efficiency machine (23 percent efficiency improvement) and a high efficiency machine (46 percent efficiency improvement). The order in which the attributes were presented on each card was varied across the groups. This was done to avoid any potential bias due to the card presentation.

Once respondents completed ranking the 16 cards, the data were used to estimate two different models. The first model is referred to as the *Equipment Choice model* and the second model is referred to as the *Purchase Probability model* throughout this paper. Both of these models provide different means for examining the value that consumers place on the different clothes washer attributes. The results of both of these models are described below.

Equipment Choice Model

The equipment choice model analyzes the choice of a specific equipment option, given that the decision to purchase a washer has already been made. In the conjoint analysis session the respondents ranked 16 clothes washer cards, from the most preferred to the least preferred. When all the conjoint data were collected, Quantum Consulting regressed the rankings of the cards against the attribute levels on the cards.[2]

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[2] A more complete description of how ranked conjoint data can be analyzed using this logit specification is contained in "Logit Models for Sets of Ranked Items", Nicholos Christakis and Paul Allison, *Sociological Methodology*, Volume 24, 1994, pp. 199-228.

$$Rank = \beta'Price_i + \beta'Savings_i + \beta'Top_i + \beta'Capacity_i + \beta'Hot_i + \beta'LoadSize_i + \varepsilon_I$$

Where Rank = Rank value between 1 and 16, based upon the respondents' relative assessment of each card

$Price_i$ = Dollar value for price on card I

$Savings_i$ = Dollar value for energy and water savings on card i

Door $Placement_i$ = 1 for top loading, 0 for front loading on card i

$Capacity_i$ = 0 for standard capacity, 1 for large capacity on card i

Wash $Temperature_i$ = 1 for hot water available, 0 if no hot water on card i

Load $Size_i$ = 1 if adjustable, 0 if nonadjustable on card i

β = Coefficients to be estimated

α = Constant to be estimated

ε_i = random error term assumed to be logistically distributed.

The results of the equipment choice model are used to infer the relative importance of each feature to the consumer's total utility. Specifically, the coefficient estimates from the equipment choice model can be used to calculate an "importance statistic." This statistic measures the importance of one design feature, relative to that of all other design features in determining a card's total utility.

The total utility of each card can be calculated by inserting attribute values into the estimated regression equation.

$$Total\ Utility_i = \beta,Price_i + \beta'Savings_i + \beta'Top_i + \beta'Capacity_i + \beta'Hot_i + \beta'LoadSize_i$$

Using the coefficient estimates and the values for the variables used in the conjoint analysis, the importance statistic is defined as:

$$IMP_i = \frac{\Delta Yi}{\Delta y} = \frac{\text{The\_maximum\_utility\_change\_due\_to\_feature\_i}}{\text{The\_maximum\_utility\_change\_due\_to\_all\_features}}$$

The importance statistic measures the percentage of the total maximum change in utility across all card choices that is attributable to a single feature. Stated another way, the importance statistic measures each feature's contribution to the total utility based on the six attributes included in the conjoint analysis.

Equipment Choice Model Estimation Results

Table 3. Regression Coefficients and Relative Importance

	Coefficient	Standard Error	Significance Level	Relative Importance
Price	-0.004	0.000	1%	26%
Savings	0.010	0.001	1%	14%
Capacity	0.248	0.024	1%	7%
Door Placement	0.383	0.024	1%	11%
Wash Temp.	0.614	0.024	1%	18%
Load Size	0.852	0.024	1%	25%

The results of the equipment choice model estimation are shown in Table 3. As expected, the coefficient estimates for price is negative and significant and the estimate for savings is positive and significant. The four other variables are statistically significant with positive coefficient estimates. Regarding door placement, respondents indicated a preference for top-loaders over front-loaders. A positive coefficient for "Large" indicates consumers prefer extra-capacity machines to standard capacity. Having a hot water wash option was attractive, as was the ability to adjust the water level to match the size of the load. All of these coefficients are significant at the 1 percent level of significance.

While coefficients estimates do provide some information on the influence of the variable on total utility, it is misleading to look only at the coefficient to gauge the influence of that variable. For example, the savings coefficient is ten times the magnitude of the price coefficient since savings is measured in tens of dollars and price in hundreds of dollars. Only looking at the magnitude of the coefficients would give the misleading impression that savings is considered much more important than price. To address this issue, relative importance statistics are calculated that combine both the coefficient and attribute value to get an overall measure of the influence on total utility. The relative importance statistic can be interpreted as each attribute's contribution to total utility.

Table 4 provides a comparison of the relative importance statistics across demographic and regional subgroups. Information for demographic groups was obtained from a survey respondents filled out during the conjoint sessions. Recent purchasers are defined as those that purchased a new clothes washer within the last two years and low income households are those with annual incomes of $25,000 or less.

Table 4. Relative Importance Statistics for Demographic Subgroups

	Full Sample	Low Income	65 & older	18-24 yrs old	Recent Purchasers	Have Tried Horizontal Axis	Would Consider Purchasing H-Axis Machine	Would Not Consider Purchasing H-Axis Machine
Price	26%	30%	22%	31%	22%	26%	26%	25%
Savings	14%	16%	11%	19%	9%	13%	15%	9%
Capacity	7%	8%	5%	9%	6%	8%	8%	5%
Door Placement	11%	10%	13%	11%	11%	9%	8%	20%
Wash Temp	18%	16%	19%	13%	19%	19%	19%	15%
Load Size	25%	20%	30%	16%	32%	26%	24%	26%

As shown in Table 4, the relative importance statistics show that while price is the most important feature to consumers, it just barely surpasses adjustable load size in terms of importance in total utility based on the six washer attributes. Together, these two attributes contribute about half of the total utility. Having a hot water wash option was the third most important attribute, contributing about 18 percent of total utility. Interestingly, door placement finished second-to-last in importance, with 11 percent of total utility. Capacity ranked last in terms of impact on total consumer utility, at 7 percent.

Table 5. Relative Importance Statistics for Regional Subgroups

	Full Sample	Madison	Washington DC	Dallas	San Francisco Bay Area
Price	26%	25%	26%	27%	25%
Savings	14%	16%	16%	8%	15%
Capacity	7%	10%	6%	5%	7%
Door Placement	11%	12%	6%	17%	10%
Wash Temp	18%	16%	20%	17%	18%
Load Size	25%	21%	25%	27%	26%

Table 5 presents relative importance statistics for regional subgroups. For most of the subgroups, price contributed a little over 25 percent to total utility, and was the most important single feature, albeit by a slim margin. Low income people and young people (who are likely also to have lower incomes) placed the highest relative value on price, 30 percent and 31 percent, respectively. On the other side, recent purchasers and people over 65 responded more strongly to adjustable load size than to price. For both groups, price comprised 22 percent of total utility.

For most groups, savings contributed between 9 percent and 16 percent to total utility, and was not in the top three important features. Those from Dallas placed the lowest value on energy cost savings, at 8 percent of total utility, and young people placed a very high value on savings, 19 percent.

A large capacity clothes washer was not very important to most subgroups, with relative importance ratings varying from a low of 5 percent for elderly people and people from Dallas, to a high of 10 percent for people from Madison. Young people also placed a higher than average value on capacity, 9 percent. There appears to be a correlation between age and the relative importance of clothes washer capacity.

Door placement ranked fifth out of six features for the full sample. For most of the subgroups the relative importance was similar. Not surprisingly, those who would not consider purchasing a horizontal axis machine placed the highest relative importance on door placement. Door placement was the third most important feature for this subgroup. People from Dallas also placed a relatively high importance on door placement, at 17 percent of total utility. Older people placed a somewhat higher than average importance on door placement, 13 percent.

For most subgroups, as well as the full sample, a hot water wash option was the third most important feature. Relative importance statistics vary from a low of 13 percent for young people to a high of 20 percent for the Washington DC group. Most subgroups found hot water to contribute between 16 percent and 19 percent to total utility.

Purchase Probability Model

After the respondents had completed ranking their cards during the conjoint analysis,-they were asked to place the Purchase Card in the card set to indicate which of the 16 clothes washers indicated on the cards they would actually considering purchasing. Based on this information, the probability of making a purchase was estimated based on the attributes on the cards above and below the Purchase Card. In equation form

$$\text{Purchase}(0,1) = \alpha + \beta'\text{Price}_i + \beta'\text{Savings}_i + \beta'\text{Top}_i + \beta'\text{Capacity}_i + \beta'\text{Hot}_i + \beta'\text{LoadSize}_i + \varepsilon_i$$

Where Purchase = 1 if card is ranked above the Purchase Card, 0 if ranked below. The other variables are defined as before in the equipment choice model.

Table 6. Purchase Model Coefficient Estimates

	Coefficient	Standard Error	Significance Level
Intercept	-0.949	0.224	1%
Price	-0.007	0.000	1%
Savings	0.029	0.002	1%
Capacity	0.452	0.072	1%
Door Placement	0.698	0.075	1%
Wash Temp.	1.438	0.071	1%
Load Size	1.809	0.071	1%

Table 6 shows the coefficient estimates for the purchase model using the entire sample. As these results indicate, the coefficient estimates are very similar to those found in the equipment choice model used to estimate relative importance of attributes. All of the coefficient estimates are statistically significant at the 1 percent level.

Once this model is estimated, the probability of making a purchase is calculated by combining the coefficient estimates with the six washer attributes and plugging into the logit probability function

$$\text{Prob(Purchase)} = \exp(\beta'X) / (1 + \beta'X)$$

Where β'X reflects the sum of the coefficient estimates and variable values used in the conjoint analysis as shown in Table 6. By using different values for price, savings, and the equipment features to simulate different efficiency levels, this equation can be used to determine the coverall effect on utility, and therefore purchases, of an efficiency standard.

Table 7. Purchase Scenarios

Sample Group	Standard Efficiency	Medium Efficiency	High Efficiency Front Load	High Efficiency No Hot Water	High Efficiency Front Load, Constant Price
Full sample	0.59	0.58	0.36	0.21	0.75
Low Income	0.65	0.63	0.41	0.26	0.78
Elderly	0.59	0.59	0.39	0.26	0.66
Young	0.64	0.61	0.29	0.28	0.76
Recent Purchasers	0.55	0.54	0.33	0.17	0.67
Would Consider H-Axis	0.56	0.55	0.42	0.21	0.78
Have Tried H-Axis	0.57	0.56	0.39	0.19	0.78

Table 7 shows purchase scenarios probability estimates for different sample subgroups. These purchase scenarios are calculated by estimating the purchase probability using different values for the model variables. The values for the clothes washer variables are modified to reflect standard efficiency, medium efficiency, and several high efficiency equipment options. The standard efficiency option assumes a price of $400, no energy and water savings, and a top loading machine. The medium efficiency washer has a price of $450 and energy and water savings of $10 annually, and is a top loading machine. This is consistent with a 23 percent improvement in efficiency. The high efficiency equipment options have a price of $650, annual savings of $50, and are either front loading or have no hot water. These high efficiency options are designed to coincide with a 46 percent improvement in efficiency. To judge the effect of price in these scenarios, the high efficiency option is also calculated with holding price constant at $400, while having a front loading machine with $50 annual savings.

The first row of Table 7 shows the purchase probability estimates for the full sample for a variety of washer efficiency levels. For the full sample, the initial likelihood of purchase estimate is 59 percent, meaning that 59 percent of those surveyed would be willing to purchase the standard efficiency clothes washer. This provides a starting point from which to compare changes in attributes and the effect these will have on the likelihood of purchase. In this sense, examining the changes in purchase probability reflects the change in utility, since lower utility washer configurations will have a lower likelihood of being purchased.

The high efficiency equipment options tend to have much greater affect on the likelihood of purchase. This results from the greater change in price as well as changing the design of the machine to be either a front loader or to have the machine clean without using hot water. As shown in Table 7, a high efficiency front loading washer at a price of $650 and annual savings of $50 will decrease the likelihood of purchase from .59 to .36, a decrease of 39 percent. If the machine is designed to run without hot water instead of being a front loader, the decrease is even greater. In this case, the purchase probability falls 64 percent to 21 percent.

For these high efficiency options, the changing likelihood of purchase is the combined result of changes in price, savings, and either door placement or water temperature options. As discussed in the analysis of the importance statistics, for the overall sample price plays the greatest role in influencing utility, followed by water temperature and door placement. This also can be seen when changes in equipment options are changed but price is held constant. When price is held constant and compared with the other estimated probabilities, the importance of price is apparent.

The far right columns of Table 7 show the likelihood of purchase for high efficiency machines that have the standard efficiency ($400) price. In the case where savings is $50 annually and the machine is a top loader, then the purchase probability is estimated to increase from 0.59 to 0.75. This shows that the increase in savings more than offsets the decrease in utility due to switching from a front loader to a top loader.

A similar analysis was conducted to find the break even price for high efficiency machines. This is the price at which price increase and door placement would just offset the benefit of the $50 annual savings. For a front loading high efficiency machine, the breakeven price is $510, so that the likelihood of purchase remains at 0.59 with the $50 and front loading design. The breakeven price is lower when hot water is removed, since this has a greater negative impact on utility. For a top loading machine with a $50 savings but with no hot water, the break even price is $400. Stated another way, this suggests that consumers would be willing to pay $50 a year to be able to have hot water as an option for washing clothes.

Those respondents that would at least consider purchasing a front loading washer have the most sensitivity to price. For this group, the change from standard efficiency to a front loader high efficiency machine results in a 25 percent decrease in purchase probability, the lowest change of all the sample subgroups. In addition, when price is held constant for the same machine, the likelihood of purchase jumps 39 percent relative to standard efficiency, which is the highest increase for any demographic group. This result is consistent with expectations. For this group, door placement is less of an issue than for other respondents, which is evidenced by the importance statistics. As a result, changes in a price have more of an influence than door placement relative to other groups, a result that is confirmed by both the importance statistics and the changes in the purchase probabilities.

Conclusions

Several key conclusions can be drawn from the clothes washer consumer analysis regarding which attributes are most valued by consumers. First, four attributes (hot water, load size adjustment, savings, and price) significantly influence which type of clothes washer consumers will purchase when they have decided to buy a new clothes washer, accounting for 83 percent of the value of the six attributes included in the conjoint survey. The ideal clothes washer, according to our conjoint data, is a low-priced energy efficient clothes washer that has the capability to wash clothes in cold, warm, and hot water, as well as a load size adjustment feature. Changing any of these four attributes within the range of the conjoint analysis will affect the estimated likelihood of purchase by 40 percent or more. In contrast, changing either capacity or door placement will affect estimated likelihood of purchase by 17 percent and 29 percent, respectively.

Second, all of the analysis results show price as the most important feature when consumers are purchasing a new clothes washer. Price was cited most often in the focus groups when the respondents identified their top ten lists of important washer features. In addition, the conjoint analysis results show price as the primary feature respondents focused on when ranking their cards. This resulted in the highest importance statistic of all the washer features used in the conjoint.

In the purchase scenarios, the purchase probabilities were more sensitive to price than any of the other washer attributes. While the shift from a standard to a high efficiency machine resulted in a significant drop in the estimated purchase probability, this was due to the change in price rather than to changes in the other features. When price is held constant at the standard efficiency level while the other features are allowed to change to reflect a high efficiency machine, the likelihood of purchase actually increases. This is due to the benefit of additional savings from the high efficiency machine outweighing the disutility associated with a front loading machine.

Third, another option for reducing clothes washer energy consumption without eliminating the hot water wash option is to replace vertical axis machines with horizontal axis models. This option reduces energy consumption by using less water to clean the laundry because the water is sprayed through fins as the clothes circulate are circulated in a drum rotating on a horizontal axis, much as clothes do in residential clothes dryers. While both top-load and front-load horizontal axis residential clothes washers are available today at retail stores, DOE is concerned that a standard encouraging the development of horizontal axis machines would result in front-loading washers becoming the norm over time. As such, one of the major objectives of this consumer analysis was to determine if a switch to front-load washers would reduce the utility of clothes washers to consumers.

In our consumer analysis both the focus groups findings and the conjoint survey findings indicate that door placement has less utility to consumers than other clothes washer attributes. In the focus group sessions, less than half of the participants (i.e., 42 percent) included door placement as one of the 10 most important attributes they would consider when purchasing a new clothes washer. Of the six attributes included in the conjoint analysis, the focus group participants scored door placement the lowest.

In the conjoint analysis, door placement was second from last in importance among the six attributes included in the conjoint survey. In addition to scoring below four other attributes included in the conjoint analysis, door placement scored lower than the constant term that is calculated in the likelihood of purchase model. The constant term coefficient represents the combined effect of attributes other than the six included in the conjoint analysis survey that would impact the consumers' decision to purchase a clothes washers. In our analysis, the constant term estimate was –0.949 while the door placement coefficient equaled 0.698. The negative estimate for the constant term indicates that there are a number of factors not accounted for in the conjoint survey that discourage consumers from purchasing clothes washers.

Additional evidence indicating door placement is not highly valued by consumers is found in the conjoint session follow-up survey in which 70 percent of the respondents said that they would consider purchasing a front-loading machine if they were going to buy a new clothes washer. For these people, door placement was tied for last in terms of importance, comprising only 8 percent of total utility. The lower value placed on door placement was also evident in the purchase scenarios. When price is held constant in the analysis, the purchase probability statistics indicate that consumers are more likely to purchase a front load washer that saves them $50 annually than a top load washer that provides no annual efficiency savings.

References

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