

Risk Preferences and Demand Drivers of Extended Warranties

Online Appendix

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A Calibration Exercise Details

We use sales data for 13 different product categories of home appliances from a large mid-western retailer. We have data on product and warranty sales and prices at the individual level, and product repair costs at an aggregate level (across categories). The average price of a standard 4 year warranty across all product categories is \$118 while the average costs of repair are \$125. The maximum average failure rate (across different categories) from the Consumer Reports is around 40% over the first 3-4 years of service.¹ Using this failure rate, and the warranty price and repair costs calculated above, we find that the retailer has a contribution margin of around 55% from the sales of warranties as compared to an average contribution margin of 15%-20% from product sales.

Given the small number of purchases for each model and the lack of price variation, we use the aggregate warranty prices, repair costs and failure probabilities to calibrate the degree of risk aversion required to explain the warranty attachment rate commonly observed for such products. Assume that the consumer has already purchased the product and is deciding between buying a warranty or not. Let the warranty price be ω , repair costs be c and the failure probability be π . Assuming a constant relative risk aversion utility specification mirrored around the origin, the utility the consumer gets is given by

$$u = \begin{cases} -\frac{\exp(\gamma\omega)}{\gamma} + \epsilon_w & ; \mathbb{I}(\text{warranty}) = 1 \\ -\pi \frac{\exp(\gamma c)}{\gamma} + \epsilon_{nw} & ; \mathbb{I}(\text{warranty}) = 0 \end{cases}$$

¹<http://www.warrantyweek.com/archive/ww20061121.html>

Assuming that the random taste shocks (ϵ) are type 1 extreme value distributed, the probability a consumer purchases warranty is given by

$$\Pr(\mathbb{I}(warranty) = 1) = \frac{\exp\left(-\frac{\exp(\gamma\omega)}{\gamma}\right)}{\exp\left(-\frac{\exp(\gamma\omega)}{\gamma}\right) + \exp\left(-\pi\frac{\exp(\gamma c)}{\gamma}\right)} \quad (1)$$

We use the average attachment rate, warranty price and repair cost to calibrate the risk aversion coefficient (γ) which satisfies equation 1. To interpret γ , we report the dollar value (x) corresponding to the γ such that the consumer is indifferent between accepting and rejecting a gamble in which she has an equal chance of winning \$100 and losing \$ x .

We implicitly normalize the variance of the error shocks to $\pi^2/6$. For any plausible changes in the variance of the error shocks, the qualitative findings stay the same. This exercise does not account for product preferences and heterogeneity in risk preferences. It is highly unlikely that accounting for these will change the substantive findings herein.

B Snapshots from the Surveys

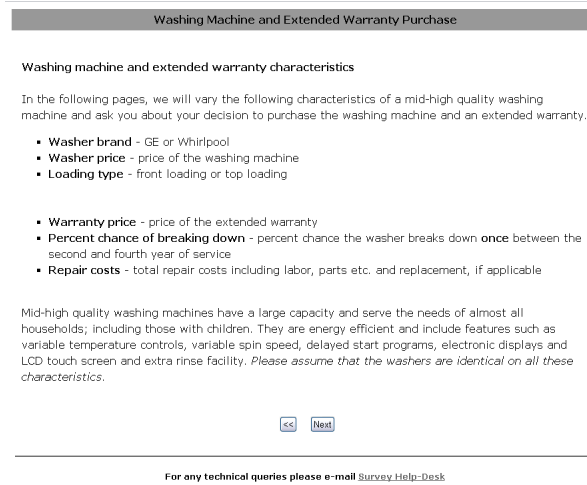


Figure 1: Survey Snapshot - Washer and Warranties characteristics presented

Note. The figure shows the characteristics presented to the subjects at the beginning of the simultaneous choice survey. A similar screen was shown to the subjects at the beginning of the sequential choice survey.

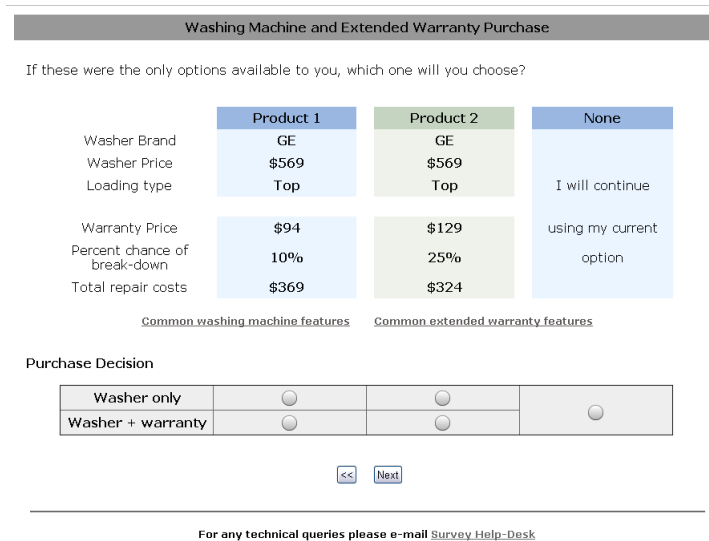


Figure 2: Simultaneous Survey - Sample choice task

Note. The figure shows a sample base choice task from the simultaneous survey. The screen lists the brand, loading type and price of two different washers. Additionally, the screen lists the warranty price, repair cost and failure probability for both the washers, and allows subjects to choose between the washers, with or without warranty, and the outside option of no purchase.

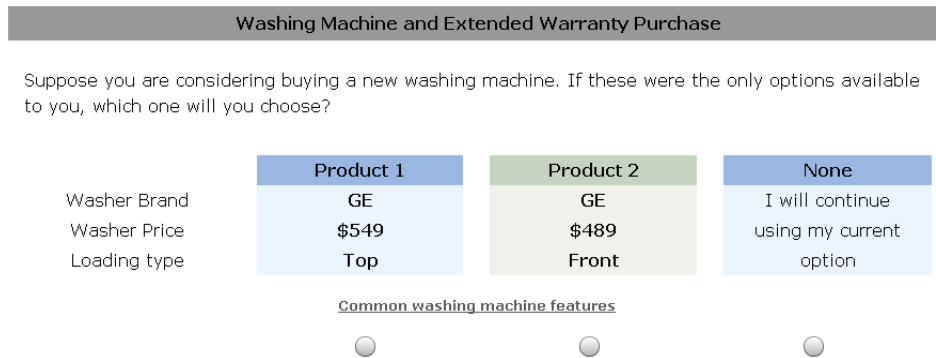


Figure 3: Sequential Survey - Stage 1 choice task

Note. The figure shows a sample base choice task from the sequential survey. The screen lists the brand, loading type and price of two different washers, and allows subjects to choose between the washers, and the outside option of no purchase.

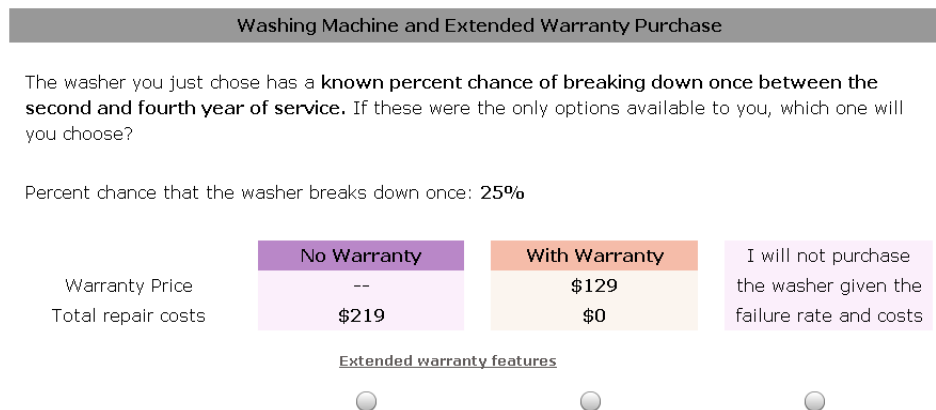


Figure 4: Sequential Survey - Stage 2 choice task

Note. The figure shows a sample base choice task from the sequential survey. The screen lists the warranty price, repair cost and failure probability for the previously chosen washer, and allows subjects to choose between buying a warranty or not, and the outside option of no washer purchase.

C Robustness Analysis

We now report several robustness analysis around the survey design and parametric assumptions we make in the paper. For robustness to parametric assumptions, we focus on data from the simultaneous choice survey for simplicity.

Choice Based Design versus Willingness to Pay Design

First, we test the robustness of our findings based on choice based designs to an alternate design where subjects provide willingness to pay for warranties. Specifically, we design a new conjoint study where the first stage is identical to the sequential survey (subjects choose between different washers and the no purchase option). In the second stage, instead of choosing between buying a warranty or not, subjects report their willingness to pay for the warranty given the failure probability and repair costs.² This is similar to the approach outlined in Becker, DeGroot, and Marschak (1964), where subjects provide the amount they are willing to accept to avoid taking a gamble between two potential gains. The approach differs from Becker, DeGroot, and Marschak (1964) in that (1) in the context of warranties, it is difficult to design chained experiments (as is possible with money) since a prospect cannot be *a priori* classified as a gain or a loss, and (2) we deal with gambles in both gains and losses domain.

Data for this study was collected from 210 subjects drawn from an online sample representative of the population. Figure 5 shows the decision weighting function for the average consumer and the pointwise posterior mean and 90% credibility region of the marginal density of curvature and loss aversion. Consistent with our findings from the sequential model, we find on average, an inverse S-shaped decision weighting function, slightly concave value function and a loss aversion parameter of 2.31.

Accounting for Warranty Choice in Sequential Survey

The sequential choice model assumes that subjects are myopic in that they do not anticipate the warranty choice when making washer purchase decision. To the extent that subjects can go back and forth between survey pages, this assumption may not be valid. To test this, we treat decision making as a “dynamic” problem where we allow subjects to account for the expected maximum utility from warranty choice in the first stage washer decision. We assume that in the first stage, subjects have information about the warranty price, failure probability and repair costs (in addition to brand, loading type and washer price). Synonymous with dynamic discrete choice models, we include a “continuation value” in the first stage, which captures the expected utility from the second stage decision, and test for the importance of the continuation value through an accounting factor. The value subjects get from different choices in the second (warranty choice) stage are the same as given in the paper. In contrast to the myopic model, the value from adopting washer j in stage 1

²Screen shots of the survey and model details can be requested from the authors.

can be written as

$$u_{ij} = v(y_{ij}) + \zeta_i \mathbb{E}[\max\{u_{ij,w}, u_{ij,nw}, u_{i0}\}] + \epsilon_{ij} \quad (2)$$

where ζ_i is the individual specific accounting factor. If $\zeta_i = 0$, then the subject does not account for warranty decision while making washer purchases. If, however, $\zeta_i = 1$, then the subject perfectly accounts for the warranty choice. If the subject decides to not buy in the first stage, then there is no continuation value since the subject doesn't get an option to purchase the warranty.

Table 1 reports estimates from this model. While this specification fits the data better as compared to the Full sequential model, we do not find substantial qualitative differences in the parameter estimates. Importantly, the distribution of the accounting factor is centered at 0. Thus, substantive behavioral predictions from this model are similar to those from the myopic model. If information related to warranty price and repair costs are provided to subjects upfront, then the results could be different. However, we stress that in most buying conditions, retailers only reveal the warranty price once the consumer has decided to buy the product.

Effect of Observable Characteristics - Simultaneous Survey

Table 6 reports the mean effect (and the 95% credibility region) of observable characteristics on preference estimates. While we do not find any significant effect of characteristics on risk preferences; in general, we see that women tend to be more loss averse, older subjects are more loss averse, and subjects with higher education are more likely to have less pronounced inverse S-shaped weighting function. Also, subjects with higher income tend to be more loss averse and have a less concave value function.

Reference Point and Mental Accounting

In the simultaneous model, we allow consumers to have different mental accounts for product purchase and repair costs. This leads to two different reference points which enables non-parametric identification of intrinsic preference for warranties. This is similar to Jarnebrant, Toubia, and Johnson (2009) where gains and losses involved in a single stage decision are segregated. The top panel of Table 2 reports estimates from a model where the reference point is fixed at the status quo; thus, gains and losses from product purchase and repair costs are integrated (as opposed to segregated). Consistent with the predictions of Tversky and Kahneman (1991), holding the distribution of choices fixed, such a change in reference point should lead to an increase in the degree of loss aversion, as we find (average loss aversion increases from 3.09 in the base case to 3.69). We also find slightly lower sensitivity to product prices as compared to the *Full* model. While this specification fits the data better as compared to the Full model, we do not find substantial qualitative differences in the parameter estimates and the out of sample predictions.

Next, we do robustness check around the value function specification. In the simultaneous survey, the reference point assumption implies that utility from product purchase and warranty purchase is integrated, while that from product purchase and repair costs is segregated. In contrast

in the sequential survey, owing to the two stage process, the utility from product purchase is segregated from both, warranty purchase and repair costs. We estimate a model where value from buying the product and the warranty is segregated in the simultaneous study. Tversky and Kahneman (1991) predict that holding preferences fixed, such a change in reference point should result in increased choices in favor of warranties. Conversely, for the same distribution of choices, we should find lower degree of loss aversion among subjects. As compared to the base model, we find slightly less loss aversion on average (lower panel of Table 2), but most of the qualitative findings stay the same. Also, this model has an inferior fit as compared to the base model.

Figure 6 compares the optimal washer prices under different reference point assumptions with the price implied by the rational *Expected Utility* model. While we do see some differences in optimal washer prices under different reference point assumptions; the prices are similar, and more importantly, higher than the price implied by a rational *Expected Utility* model which ignores loss aversion and reference dependence.

Probability Weighting Function

Failure probabilities are given to subjects in the survey. Subjects may, however, have reasons to believe that the probabilities shown are for the population, and that they have higher (or lower) failure probability. Note that we estimate individual level probability weights; thus, measuring the total effect of failure probability and probability weights. To see this, let's assume that a subject is shown a failure probability π but believes that she has a failure probability of π_i (and a probability weighting function given by $\delta_i(\cdot)$). It is straightforward to show that we can find an alternate probability weighting function $\delta'_i(\cdot)$ such that $\delta'_i(\pi) = \delta_i(\pi_i)$ provided, $\delta'(\cdot)$ allows for both, over-weighting and under-weighting, along the entire support of probabilities. The one-parameter weighting function is restrictive in this sense, and thus, we check the sensitivity of our risk preference estimates to alternate, more flexible, weighting function specifications.

Prelec (1998) proposes a two parameter weighting function $\delta(\pi) = \exp(-\psi(-\ln(\pi))^\mu)$. Similarly, Gonzalez and Wu (1999) propose a weighting function, $\delta(\pi) = \frac{\mu\pi^\psi}{\mu\pi^\psi + (1-\pi)^\psi}$, where ψ measures the extent to which individuals differentiate between probabilities (curvature), and μ measures the attractiveness of risk (elevation). Table 3 reports the estimates from both these specifications run using data from the simultaneous survey. While these specifications with more flexible weighting functions fit the data better (as measured by the trimmed log marginal density), we do not find any qualitative differences in the estimates of risk aversion (curvature), loss aversion and price and product preferences, as compared to the Full model.

Separate Curvature for Gains and Losses

In our estimation, we assume that the value function has the same curvature in gains and losses. This is merely a convenience assumption to restrict the number of model parameters. To test whether this provides biased estimates of other risk preferences, we allow the value function to

have different curvature in gains and losses. Specifically, we re-estimate the Full model subject to the value function

$$v(y_{ij,k}) = \begin{cases} (y_{ij,k})^{\gamma_i} & ; y_{ij,k} \geq 0 \\ -\lambda_i (-y_{ij,k})^{\phi_i} & ; y_{ij,k} < 0 \end{cases} \quad (3)$$

and restrict $\phi_i > 0$ by using the transformation $\phi_i = \exp(\Phi_i)$, where Φ_i is another parameter we estimate. Understandably, a model allowing for different curvature in gains and losses fits the data better than the base model which restricts the curvature to be same. Qualitatively, our findings about risk preferences are consistent with the base model which restricts curvature in gains and losses domain. We find on average, an inverse S-shaped weighting function and an average loss aversion parameter of 3.65. Figure 7 shows the distribution of risk aversion (curvature) from the base model and from this model (for both gains and losses). Allowing for different degree of curvature in gains and losses, we find that on average, the value function is convex in losses, which is consistent with the findings in the behavioral literature. In contrast to the literature, we find that the average degree of curvature is higher in losses domain than in gains domain. Further, subjects are substantially more heterogeneous in the degree of curvature in the losses domain, than they are in the gains domain.

Nature of Risk Preferences

We estimate the Full model with constant absolute risk aversion (CARA) utility specification. Unlike power function, the exponential function is defined for negative values, and hence, we do not assume that the value function is mirrored around the origin. Table 4 reports the demand estimates from the Full model with a CARA utility specification. As compared to the base model, we find a higher degree of loss aversion (5.62 as opposed to 3.09). Increase in the loss aversion estimate can partly be attributed to the value function specification which implies convexity in the losses domain. On average, we find a concave value function in gains and an inverse S-shaped decision weighting function. Consistent with the Full model, there exists substantial heterogeneity in product, price and risk preferences.

Endogenous Reference Point

We now outline a model of endogenous reference point (Kőszegi and Rabin (2006, 2007)) and discuss the non-identification. The consumption utility from c given a reference point r is given by $u(c | r) = u(c) + \mu(u(c) - u(r))$ where $\mu(x)$ is the gain loss utility ($\mu(x) = \eta x$ for $x \geq 0$ and $\mu(x) = \lambda \eta x$ for $x < 0$), and has a weight η associated with it relative to the consumption utility. Let a lottery Y over N possible outcomes be defined as $(y_n, p_n)_{n=1}^N$ where y_n is the pay-off with probability p_n . As per Kőszegi and Rabin (2007), the utility from choosing a lottery $Y \equiv (y_n, p_n)_{n=1}^N$ given a reference point $\tilde{Y} \equiv (\tilde{y}_m, \tilde{p}_m)_{m=1}^M$ is given by $U(Y | \tilde{Y}) = \sum_{n=1}^N \left[\sum_{m=1}^M (p_n \tilde{p}_m u(y_n | \tilde{y}_m)) \right]$. Unlike the exogenous reference point case where value from an outcome is independent of the failure probability; with

endogenous reference points, value from an outcome depends on the failure probability. Thus, any variation in the failure probability changes both, decision weights and outcome specific value; hence, decision weights and value functions are not identified non-parametrically.

Consistent with ?, we use a *choice-acclimating personal equilibrium (CPE)* and write out the deterministic part of the primitive utility indices as follows:

$$\begin{aligned}
y_{ij1} &= \alpha_{ij,w} - \beta_i (p_j + \omega_j) - \text{warranty purchased} \\
y_{ij2} &= \alpha_{ij,nw} - \beta_i p_j - \text{warranty not purchased (no failure)} \\
y_{ij3} &= \alpha_{ij,nw} - \beta_i (p_j + c_j) - \text{warranty not purchased (failure)}
\end{aligned}$$

The value a subject gets from the different alternatives can then be written as³

$$u_{ij,w} = v(y_{ij1}) + \epsilon_{ij,w} \tag{4}$$

$$\begin{aligned}
u_{ij,nw} &= \delta_i(\pi_j) v(y_{ij3}) + (1 - \delta_i(\pi_j)) v(y_{ij2}) \\
&\quad - \delta_i(\pi_j) (1 - \delta_i(\pi_j)) \eta_i (\lambda_i - 1) (v(y_{ij2}) - v(y_{ij3})) + \epsilon_{ij,nw}
\end{aligned} \tag{5}$$

$$u_{i0} = \epsilon_{i0} \tag{6}$$

The model reduces to the expected utility model if $\eta = 0$ or $\lambda = 1$. The gain loss utility and loss aversion parameter are not separately identified; only the term $\Lambda_i = \eta_i (\lambda_i - 1)$ is identified. Based on log marginal density (Table 5), this model fits the data better than the Full model and the ‘‘EU’’ model. In contrast to our findings in the base model, on average, subjects have a less pronounced inverse S-shaped decision weighting function, a slightly more convex utility function, and are more loss averse.

The average effective loss aversion is 3.68, which is in line with Crawford and Meng (2011). We plot the density of loss aversion (Figure 8) assuming that the gain-loss utility η ($= 0.5, 1, 2$) i.e. we fix η to either of these values and back out the distribution of λ_i from the distribution of Λ_i . If subjects weigh the gain-loss utility twice as much as the utility from consumption, then the average degree of loss aversion in the sample is similar to the base specification.

³Please refer to Köszegi and Rabin (2006, 2007); ? for derivation of this specification.

Table 1: Sequential choice model with continuation value

	Homogeneous Tastes			Heterogeneous Tastes					
				Pop. mean			Pop. SD		
	2.5%	50%	97.5%	2.5%	50%	97.5%	2.5%	50%	97.5%
α_{GE}	1.60	2.07	2.51	3.71	4.47	5.43	2.40	3.18	4.02
α_{GE}^w	1.08	1.25	1.41	2.50	3.20	4.58	2.39	3.22	4.65
α_{Wh}	1.86	2.36	2.84	4.03	4.78	5.81	2.25	2.94	3.75
α_{Wh}^w	1.09	1.26	1.42	2.29	2.97	4.28	2.45	3.21	4.50
Price(β)	0.26	0.34	0.42	0.53	0.65	0.81	0.49	0.58	0.74
Front loading (κ)	-0.33	-0.24	-0.15	-0.72	-0.33	0.04	1.89	2.36	2.84
Probability weight (μ)	1.09	1.90	4.74	1.23	1.78	2.55	1.36	2.33	4.61
Curvature/risk (γ)	0.74	0.99	1.28	1.37	1.84	2.43	1.19	1.85	3.01
Loss aversion (λ)	0.50	0.77	1.25	3.35	4.03	4.81	1.96	2.42	3.29
Accounting Factor (ζ)	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01
Log marginal density		-8033.30					-3538.30		
Trimmed log m.d.		-8029.49					-3489.24		

Note. The table summarizes the parameter estimates from the “dynamic” model which accounts for warranty choice in the first stage washer decision, estimated using the sequential survey data. We report estimates from both, the homogeneous and the heterogeneous models. For the homogeneous model, we report estimates corresponding to the 95% confidence region along with the median estimate. For the heterogeneous model, we report the same statistics for both, the mean and the standard deviation of the distribution of population heterogeneity.

Table 2: Robustness to varying reference point assumptions

	Homogeneous Tastes			Heterogeneous Tastes					
				Pop. mean			Pop. SD		
	2.5%	50%	97.5%	2.5%	50%	97.5%	2.5%	50%	97.5%
Reference Point fixed to Status Quo									
α_{GE}	0.22	0.27	0.33	2.16	2.92	3.53	3.22	4.08	4.71
α_{GE}^w	0.20	0.22	0.24	1.21	1.61	2.01	2.44	2.89	3.40
α_{Wh}	0.24	0.30	0.35	2.34	3.10	3.74	3.29	4.16	4.75
α_{Wh}^w	0.19	0.21	0.23	1.11	1.51	1.90	2.39	2.83	3.30
Price(β)	0.04	0.05	0.06	0.28	0.38	0.45	0.36	0.43	0.48
Front loading (κ)	-0.03	-0.02	0.00	-0.16	-0.03	0.11	0.73	0.85	1.00
Probability weight (μ)	0.92	1.05	1.22	1.13	1.42	1.75	0.76	1.04	1.52
Curvature/risk (γ)	0.81	0.89	0.99	0.78	0.86	0.95	0.43	0.52	0.65
Loss aversion (λ)	4.08	4.34	4.63	3.31	3.69	4.21	1.67	1.93	2.19
Log marginal density		-11879.97					-6924.92		
Trimmed log m.d.		-11877.16					-6854.10		
Value function specification consistent with Sequential survey									
α_{GE}	2.70	3.72	4.33	2.92	3.85	4.84	5.60	6.63	7.50
α_{GE}^w	0.48	0.55	0.63	1.54	2.18	2.73	2.63	3.35	3.87
α_{Wh}	3.04	4.02	4.63	3.09	4.03	5.05	5.79	6.81	7.69
α_{Wh}^w	0.48	0.55	0.62	1.48	2.05	2.58	2.58	3.22	3.71
Price(β)	0.86	1.12	1.29	0.51	0.63	0.76	0.60	0.71	0.82
Front loading (κ)	-0.46	-0.21	0.05	-0.30	-0.12	0.06	0.87	1.01	1.18
Probability weight (μ)	1.10	1.27	1.51	1.05	1.28	1.54	0.57	0.74	1.01
Curvature/risk (γ)	0.48	0.54	0.59	0.85	0.93	1.07	0.40	0.48	0.60
Loss aversion (λ)	0.30	0.34	0.40	1.73	2.11	2.46	1.67	2.10	2.39
Log marginal density		-11984.25					-7055.62		
Trimmed log m.d.		-11983.51					-7016.18		

Note. The table summarizes the parameter estimates from models estimated using the simultaneous survey data where (a) reference point is assumed to be status quo (and does not shift to utility from working product conditional on purchase), and (b) utility from product purchase and warranty purchase is segregated (for consistency with the sequential study). We report estimates from both, the homogeneous and the heterogeneous models. For the homogeneous model, we report estimates corresponding to the 95% confidence region along with the median estimate. For the heterogeneous model, we report the same statistics for both, the mean and the standard deviation of the distribution of population heterogeneity.

Table 3: Full model with alternate two-parameter probability weighting function specifications

	Homogeneous Tastes			Heterogeneous Tastes					
				Pop. mean			Pop. SD		
	2.5%	50%	97.5%	2.5%	50%	97.5%	2.5%	50%	97.5%
Prelec (1998)									
α_{GE}	0.45	0.61	0.74	3.49	4.24	5.07	3.99	5.04	5.88
α_{GE}^w	0.29	0.33	0.42	0.89	1.36	1.87	2.84	3.38	3.91
α_{Wh}	0.50	0.64	0.80	3.74	4.52	5.36	4.00	5.13	5.97
α_{Wh}^w	0.29	0.33	0.41	0.70	1.14	1.57	2.68	3.27	3.81
Price(β)	0.09	0.11	0.14	0.44	0.52	0.61	0.45	0.56	0.65
Front loading (κ)	-0.05	-0.03	-0.01	-0.18	-0.02	0.15	0.94	1.10	1.27
Probability weight (μ)	0.11	0.23	0.30	0.25	0.41	0.74	0.50	1.34	5.41
Curvature/risk (γ)	0.69	0.74	0.94	0.68	0.78	0.88	0.40	0.50	0.63
Loss aversion (λ)	2.12	2.53	2.88	2.48	2.73	2.99	1.02	1.25	1.49
Probability weight (ψ)	3.35	4.12	5.29	2.85	5.08	8.96	2.82	6.25	17.36
Log marginal density		-11934.33				-6958.63			
Trimmed log m.d.		-11931.30				-6884.83			
Gonzalez and Wu (1999)									
α_{GE}	0.60	0.73	0.83	3.35	4.25	5.18	4.50	5.23	6.09
$\alpha_{GE,w}$	0.36	0.44	0.49	0.77	1.26	1.73	3.01	3.53	4.16
α_{Wh}	0.62	0.78	0.90	3.64	4.53	5.46	4.46	5.33	6.20
$\alpha_{Wh,w}$	0.35	0.42	0.44	0.62	1.06	1.51	2.86	3.38	4.02
Price(β)	0.11	0.13	0.15	0.42	0.52	0.62	0.44	0.51	0.59
Front loading (κ)	-0.06	-0.03	0.00	-0.17	0.01	0.19	0.93	1.08	1.26
Probability weight (μ)	8.83	9.57	10.00	8.25	9.16	9.95	0.07	1.68	2.87
Curvature/risk (γ)	0.71	0.80	0.89	0.72	0.80	0.90	0.40	0.50	0.63
Loss aversion (λ)	2.32	2.86	3.05	2.44	2.73	3.03	1.23	1.42	1.66
Probability weight (ψ)	2.02	2.39	2.83	1.67	2.10	2.64	1.28	1.63	2.06
Log marginal density		-11935.95				-6952.83			
Trimmed log m.d.		-11933.22				-6908.35			

Note. The table summarizes the parameter estimates from alternate models with two-parameter probability weighting function, estimated using the simultaneous survey data. We report estimates from both, the homogeneous and the heterogeneous models. For the homogeneous model, we report estimates corresponding to the 95% confidence region along with the median estimate. For the heterogeneous model, we report the same statistics for both, the mean and the standard deviation of the distribution of population heterogeneity.

Table 4: Full baseline model with CARA utility function

	Homogeneous Tastes			Heterogeneous Tastes					
				Pop. mean			Pop. SD		
	2.5%	50%	97.5%	2.5%	50%	97.5%	2.5%	50%	97.5%
α_{GE}	0.48	0.60	0.76	2.04	2.53	3.17	2.08	2.70	3.34
α_{GE}^w	0.58	0.60	0.63	1.56	1.87	2.20	1.54	2.02	2.53
α_{Wh}	0.53	0.65	0.82	2.20	2.69	3.35	2.15	2.69	3.45
α_{Wh}^w	0.57	0.58	0.60	1.48	1.75	2.04	1.49	1.84	2.34
Price(β)	0.09	0.11	0.14	0.28	0.33	0.41	0.31	0.35	0.41
Front loading (κ)	-0.06	-0.03	-0.01	-0.12	-0.02	0.08	0.54	0.64	0.77
Probability weight (μ)	1.13	1.30	1.49	1.05	1.25	1.46	0.65	0.84	1.12
Curvature/risk (γ)	-4.79	-3.69	-2.71	-0.89	-0.52	-0.24	1.61	1.87	2.24
Loss aversion (λ)	3.71	4.64	5.33	4.83	5.62	6.28	2.39	2.80	3.28
Log marginal density	-11914.91			-6995.08					
Trimmed log m.d.	-11913.00			-6944.13					

Note. The table summarizes the parameter estimates from the model allowing for value function to be consistent with Constant Absolute Risk Aversion. We report estimates from both, the homogeneous and the heterogeneous models. For the homogeneous model, we report estimates corresponding to the 95% confidence region along with the median estimate. For the heterogeneous model, we report the same statistics for both, the mean and the standard deviation of the distribution of population heterogeneity.

Table 5: Endogenous reference point model based on rational expectations

	Homogeneous Tastes			Heterogeneous Tastes					
				Pop. mean			Pop. SD		
	2.5%	50%	97.5%	2.5%	50%	97.5%	2.5%	50%	97.5%
α_{GE}	1.34	1.57	1.79	2.88	3.84	4.66	3.54	4.23	5.12
α_{GE}^w	0.32	0.35	0.37	1.28	1.85	2.40	2.63	3.36	4.01
α_{Wh}	1.47	1.70	1.91	3.17	4.20	5.01	3.62	4.24	5.10
α_{Wh}^w	0.28	0.30	0.31	1.09	1.58	2.14	2.49	3.17	3.79
Price(β)	0.28	0.31	0.34	0.40	0.51	0.60	0.42	0.49	0.58
Front loading (κ)	-0.11	-0.04	0.02	-0.17	-0.02	0.15	0.77	0.93	1.12
Probability weight (μ)	1.64	1.86	2.11	1.75	2.30	3.31	1.98	3.02	5.42
Curvature/risk (γ)	0.80	0.89	0.99	1.12	1.32	1.62	0.79	1.10	1.55
Effective loss aversion (Λ)	4.45	5.58	6.75	3.18	3.68	4.22	1.75	2.07	2.41
Log marginal density	-11940.95			-6815.10					
Trimmed log m.d.	-11938.85			-6765.21					

Note. The table summarizes the parameter estimates from the model where reference point is endogenous and is consistent with Köszegi and Rabin (2006). We report estimates from both, the homogeneous and the heterogeneous models. For the homogeneous model, we report estimates corresponding to the 95% confidence region along with the median estimate. For the heterogeneous model, we report the same statistics for both, the mean and the standard deviation of the distribution of population heterogeneity.

Table 6: Effect of Observable Characteristics on Preference Estimates (Simultaneous Survey)

	α_{GE}	α_{GE}^w	α_{Wh}	α_{Wh}^w	Price(β)	Front loading (κ)	Probability weight (μ)	Curvature/risk (γ)	Loss aversion (λ)
Familiarity	0.304 (-0.384,0.98)	0.56 (-0.166,1.276)	0.514 (-0.198,1.22)	0.61 (-0.109,1.319)	0.045 (-0.032,0.118)	0.063 (-0.098,0.228)	0.033 (-0.087,0.15)	-0.093 (-0.188,0)	0.298 (0.032,0.568)
Warranty	-1.482 (-3.492,0.413)	-0.063 (-2.017,1.923)	-1.795 (-3.862,0.152)	-0.622 (-2.685,1.403)	-0.222 (-0.461,0.01)	0.514 (0.078,0.953)	-0.136 (-0.427,0.148)	-0.014 (-0.251,0.233)	-0.146 (-0.885,0.584)
Washer	-0.877 (-3.332,1.669)	-0.835 (-3.471,1.67)	-1.471 (-4.006,1.033)	-0.879 (-3.512,1.619)	-0.155 (-0.413,0.095)	-0.455 (-1.054,0.115)	-0.12 (-0.551,0.306)	0.219 (-0.083,0.533)	-0.302 (-1.197,0.603)
Purchased / Considered	1.496 (0.001,3.235)	0.236 (-1.224,1.787)	1.362 (-0.173,3.144)	0.384 (-1.09,1.942)	-0.102 (-0.255,0.062)	0.08 (-0.275,0.433)	0.085 (-0.183,0.343)	0.096 (-0.097,0.306)	-0.15 (-0.764,0.473)
Male	0.354 (-0.488,1.171)	0.141 (-0.772,0.982)	0.598 (-0.298,1.454)	0.174 (-0.717,0.999)	0.093 (-0.003,0.183)	-0.136 (-0.334,0.057)	0.012 (-0.144,0.167)	0.017 (-0.102,0.132)	0.333 (0.007,0.671)
Age	0.046 (-0.219,0.311)	-0.019 (-0.3,0.242)	0.033 (-0.244,0.31)	-0.014 (-0.289,0.239)	0 (-0.027,0.027)	-0.052 (-0.112,0.012)	0.018 (-0.03,0.07)	-0.024 (-0.059,0.01)	-0.028 (-0.138,0.075)
Education (yrs)	0.135 (-0.019,0.307)	0.018 (-0.139,0.183)	0.122 (-0.038,0.298)	0.025 (-0.136,0.191)	-0.002 (-0.018,0.014)	0.024 (-0.011,0.058)	-0.002 (-0.03,0.024)	0.012 (-0.007,0.031)	0.027 (-0.045,0.103)

Note. The table summarizes the effect of observable characteristics on preference estimates from the simultaneous survey. In addition to the point estimates, we report 95% credibility region in parenthesis.

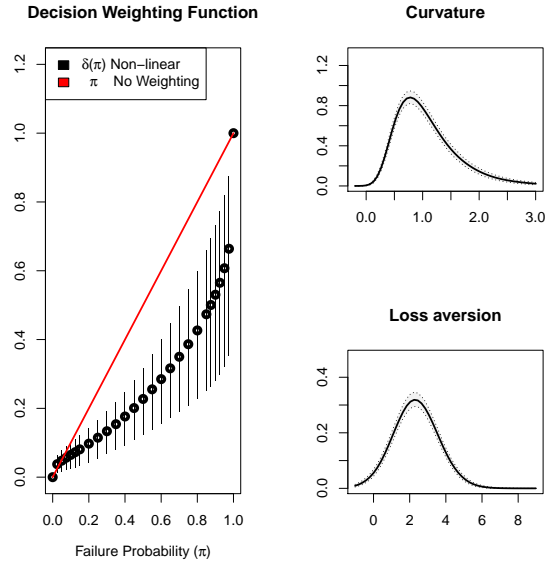


Figure 5: Distribution of risk preferences for the survey eliciting WTP for warranty

Note. The graph on the left displays the weighting function (and the 95% credibility region) for the average consumer. The top (bottom) right graph displays the pointwise posterior mean and 90% credibility region of the marginal density of the curvature coefficient γ (loss aversion coefficient λ).

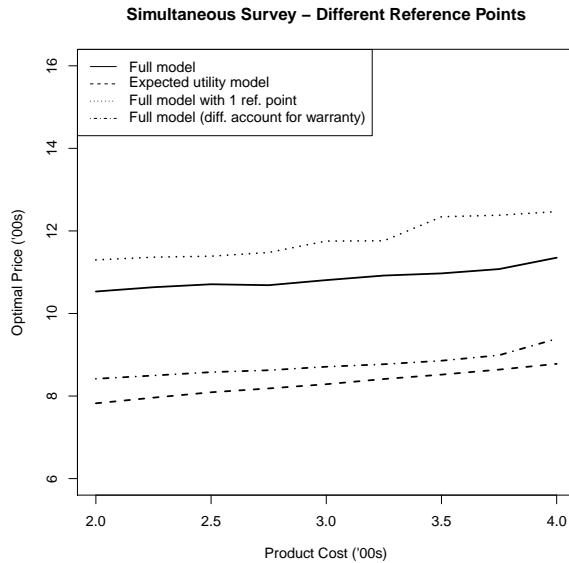


Figure 6: Optimal washer prices (GE) under different reference point assumptions

Note. The figure shows the optimal washer prices (\$'00s) for a monopolist retailer. These prices have been calculated assuming the retailer sells both washers and warranties, but makes profit only from washers. The figure shows the optimal prices using estimates from the Full model, the Expected utility model, and two models with different assumptions about the reference point.

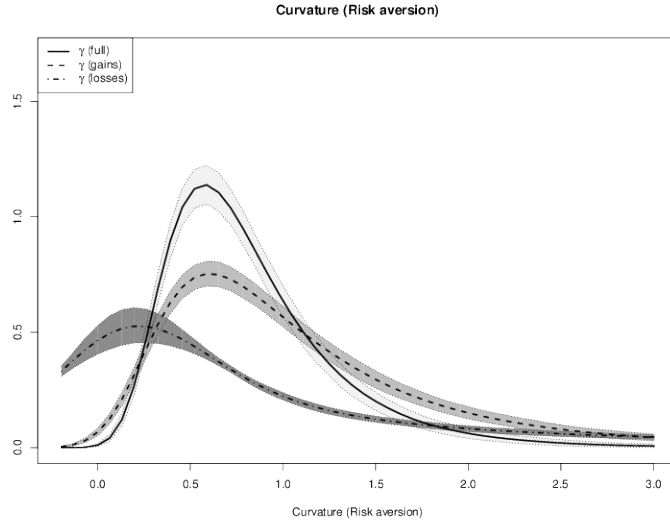


Figure 7: Distribution of curvature under Full model and model with unrestricted curvature

Note. The graph displays the pointwise posterior mean and 90% credibility region of the marginal density of the risk aversion (curvature) coefficient γ from the Full model, and the model which allows for separate curvature in gains and losses. We estimate γ subject to only the restriction $\gamma > 0$.

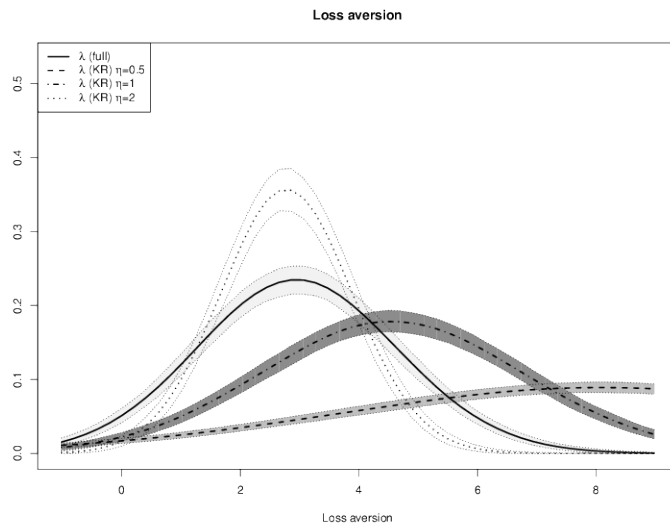


Figure 8: Distribution of loss aversion under Full and rational expectations KR models

Note. The graph displays the pointwise posterior mean and 90% credibility region of the marginal density of the loss aversion coefficient λ from the Full model, and the model based on Kőszegi and Rabin (2006). For the model based on Kőszegi and Rabin (2006), we estimate the effective loss aversion parameter and then plot the density of loss aversion coefficient for different assumed values of the gain loss utility parameter.

D Summary of Demographics

Table 7: Survey Demographics

Gender	Simultaneous Survey		Sequential Survey	
	N	Percent	N	Percent
Male	167	51%	103	44%
Female	155	48%	132	56%
Prefer not to answer	4	1%	1	0%
Age	N	Percent	N	Percent
20 - 25	5	2%	4	2%
26 - 30	60	18%	29	12%
31 - 35	79	24%	47	20%
36 - 40	36	11%	23	10%
41 - 45	49	15%	36	15%
More than 45	95	29%	96	41%
Prefer not to answer	2	1%	1	0%
Ethnicity	N	Percent	N	Percent
White/Caucasian	165	51%	165	70%
African American	47	14%	20	8%
Hispanic	50	15%	30	13%
Asian	46	14%	16	7%
Other	16	5%	3	1%
Prefer not to answer	2	1%	2	1%
Education	N	Percent	N	Percent
Less than high school	3	1%	4	2%
High school	65	20%	63	27%
College	154	47%	107	45%
Graduate degree	100	31%	56	24%
Other	2	1%	5	2%
Prefer not to answer	2	1%	1	0%
Income	N	Percent	N	Percent
Less than \$25,000	40	12%	25	11%
\$25,000 - \$50,000	92	28%	68	29%
\$50,000 - \$75,000	58	18%	58	25%
\$75,000 - \$100,000	40	12%	21	9%
\$100,000 - \$150,000	57	17%	32	14%
More than \$150,000	26	8%	17	7%
Prefer not to answer	13	4%	15	6%

Note. The table summarizes the subjects familiarity with warranties and their usage and purchase behavior for washing machines, for both the simultaneous and sequential choice surveys.

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