Gender Differences in Extended Warranty Purchases:
The Case of Electronic Products

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Are women more likely to purchase an extended warranty? In this paper, we study in-store sales of extended warranties for electronic products, and find that gender *and* income matter: female consumers from low-income households are more likely to purchase an extended warranty, although few gender differences exist for middle- and high-income households. It is also found that the gender gap in extended warranty purchases is more apparent in the case of personal computers than in the case of cathode ray tube televisions. This finding suggests that gender may matter more in extended warranty purchases for more mechanical products. We also argue that our empirical results may suggest that advantageous selection prevails in the extended warranty market for personal computers.

Ⅰ. Introduction

Extended warranties (EWs) (or extended service contracts) are sold by retailers as an option during the purchase of a durable good, such as an electronic product and an automobile. Although a base warranty－provided (mandatorily) by man ufacturers－is usually valid for the first year, an EW provides an additional period (usually two to three years) for repairs without further charges. It is well known that electronics retail chains earn considerable revenues from selling EWs,[1] and, as such, they are often criticized by the popular media. Some opponents even argue that consumers should avoid purchasing an EW at all.[2]

This paper studies gender differences in EW purchases in two major electronic products categories: personal computers (PCs) and cathode ray tube (CRT) televisions (TVs). In particular, our empirical analysis focuses on the gender gap in EW purchases considering income status. We find that, in the case of EWs for PC purchases, female consumers in low-income households are 16 percentage points more likely to purchase an EW than male counterparts. Yet, this number for female consumers in middle- or high-income households is only 6 and 4 percentage points more, respectively, relative to men from low-income households. However, the gender gap is less apparent in the TV category: although female consumers in a low-income household are 7 percentage points more likely to purchase an EW than average males in the same category are, female consumers from middle- and high-income households are 5.5 and 7.6 percentage points *less* likely to purchase one than males from low-income households are. In both categories, poorer women tend to purchase an EW. Although this finding may indicate that men are more risk averse than women from middle- and high-income households, it may also imply that an EW purchase results from unthoughtful decision making. In addition, the contrast between the PC and the TV categories suggests that the gender gap may matter more in EW purchases for more mechanical products.

Furthermore, a comparison of women and men in the PC sample shows that women are

more likely to purchase an EW for each income category. There are two possible interpretations. The first one is that (i) if women are more likely to break a computer than men, then our empirical finding suggests *adverse* selection. However, (ii) if women are less likely than men to break a computer, then it suggests *advantageous* selection: those who have less of a need for EW are more likely to purchase one, and vice versa (see, e.g., Einav and Finkelstein (2011) and Mahoney and Weyl (2017)). However, the relationship is less apparent in the TV sample. We argue that our empirical results may suggest that advantageous selection prevails in the EW market for PCs.

The remainder of this paper is organized as follows. The next section briefly surveys the related literature. Section 3 explains the data that we use for this study. We then present empirical results and robustness checks in Section 4. Section 5 concludes.

Ⅱ．Related Literature

This paper studies the gender gap in EW purchases, and is related to the following three areas: (i) empirical and experimental studies of gender differences in risk attitude, (ii) empirical studies of EWs, and (iii) empirical studies of insurance purchases.

1. Gender Differences in Risk Attitude

This paper empirically finds the gender gap in EW purchases. Our empirical findings are in line with existing experimental studies on gender differences in risk preferences (see, e.g., excellent surveys by Croson and Gneezy (2009) and Meyers-Levy and Loken (2015)). Controlling for demographics such as education, age, race, and country of origin, existing studies on experimental economics have repeatedly found strong evidence that females are more risk averse than males, in both the laboratory (usually in the context of lottery choices) and the field (usually in the context of investment

decisions).[3,4] However, our empirical results imply that *women's risk attitude varies across their income status*. This finding is also consistent with the finding by Johnson and Powell (1994) that gender differences in risk attitude are quite small in the managerial subsample. In the nonmanagerial subsample, women exhibit more risk aversion than men. In the labor market context, many studies find that women gain less from negotiation and have lower preferences for risk taking (see, e.g., an excellent survey by Azmat and Petrongolo (2014)).

2. Empirical Studies of Extended Warranty Purchases

A limited number of empirical studies exists on EWs by retailers.[5] Chen, Karla, and Sun (2009) represent the first among recent empirical studies that focus on consumer decision making in EW purchases. Using detailed data from a retailer (including information on promotions (price promotions and advertising) and warranty length), Chen, Karla, and Sun (2009) consider various factors that potentially influence consumers' EW purchases, such as product characteristics, retailer actions, and consumer characteristics. Chen, Karla, and Sun (2009) focus on seven product categories (video, audio, phone, camera, computer, game, and mobile audio) and estimate a structural model of binary choice (whether or not to purchase an EW) on the basis of the mean-variance utility to take into account risk aversion. They then find that the coefficient for the variance term is statistically significant, indicating that consumers are indeed risk averse.

Chen, Karla, and Sun (2009) also mention gender differences in EW purchases and find "a puzzling result" (p.620) that, "[e]verything else being equal, men are more likely to purchase" EWs "than women." They claim that they cannot confirm one of their hypotheses (H5 in p.614) that states that "[w]omen are more likely to purchase" EWs "than men

because they are more risk averse." In contrast, our estimates suggest that women are more likely to purchase an EW. In addition, we consider interactions between gender and income, whereas Chen, Karla, and Sun (2009) do not. Regarding income, Chen, Karla, and Sun (2009, p.620) conclude that, "everything else equal, lower-income consumers are more prone to buying" EWs. They argue two possible reasons. One reason is that "lower-income consumers are more sensitive to replacement costs." In contrast, we find that lower-income men are the least prone to purchasing EWs. Thus, gender differences are more apparent for lower-income consumers. Interestingly, in the TV category, our estimates are consistent with Chen, Karla, and Sun (2009): lower-income consumers are more likely to purchase an EW. However, in the PC category, higher-income consumers are more likely to purchase an EW.

Another recent study by Jindal (2015) provides experimental research on EW purchases to compare alternative theories, from the traditional expected utility theory to behavioral economics.[6] Jindal (2015) decomposes different preferences over risk and/or uncertainty into: (i) risk aversion; (ii) loss aversion (the magnitude of a loss is larger than that of a gain of the same amount); and (iii) nonlinear weighting of failure probabilities. Allowing for variations in failure probabilities (an estimation target in Chen, Karla, and Sun (2009)) and in repair costs, Jindal (2015) finds that loss aversion explains the data of stated choices significantly better than two competing theories: standard risk aversion (corresponding to the concavity of the von Neumann-Morgenstern utility function) and nonlinear probability weighting. Jindal (2015) also finds that substantial heterogeneity in loss aversion exists among the subjects.[7,8] Although in this paper we remain agnostic about the actual psychological factors behind EW purchases, our empirical results imply how these factors are affected differently by consumers' demographic characteristics.

3. Empirical Studies of Insurance Purchases

Cohen and Einav (2007) use data (from an auto insurance company in Israel) on deductible choices in auto insurance contracts and find that women are more risk averse. However, their sample does not include information on an individual's *income* (or wealth). For a wealth measure, they use census data based on zip code information in the original data to match (the averaged) wealth to an individual.[9] In contrast, we are able to directly interact between gender and income because our sample has household-level information on both variables. In addition, the dataset that we use for this study (see the next section) originally covers a broad variety of electronic products. Thus, we are able to study how product novelty is related to gender differences in EW purchases. In particular, we compare the PC category with the CRT TV category. Whereas CRT TV sets supposedly belonged to one of the traditional categories of electronic products for the period of the data used for this study (December 1998 to November 2004), PCs were probably deemed to be still relatively new electronic products for most households. In the subsequent empirical analysis, we find that gender differences in EW purchases are more apparent in the PC category than in the TV category. In contrast to auto insurance, contract heterogeneity (most importantly, coverage length) is less important in the case of EWs (as suggested by Chen, Karla, and Sun (2009)) because a car owner—if he or she is not extremely poor—usually purchases insurance when purchasing a car. Thus, insurance providers care more about the variety of insurance (how long and the coverage).

Ⅲ. Data

In this section, we first explain how we construct our samples of PC and TV transactions from the original dataset. We then present the summary statistics of these samples.

1. Sample Construction

We use the INFORMS Society for Marketing Science (ISMS), Durable Goods Dataset 1 (see Ni, Neslin, and Sun (2012) for an introduction of the data).[10] The dataset is at the customer-level transaction and was collected from 1,176 stores of an anonymous national consumer electronics retail chain located throughout the United States.[11] The dataset covers six years (December 1998 through November 2004) and randomly selects 19,936 households. For each randomly selected household, the transaction record is complete (at this retail chain) for the six years, yielding a total of 173,262 transactions, including EW purchases.

We focus on transactions in the PC category (desktop and laptop) and the CRT TV category. According to Table 2 of Ni, Neslin, and Sun (2012), the latter category has the highest number of transactions in the ISMS Durable Goods Dataset 1, followed by the Music category and the PC category. However, the Music category has a small percentage of associated EW purchases. For this reason, we choose these two categories for our study. During the sample period, liquid crystal display (LCD) TVs had yet to gain popularity, thus their share is very small in the ISMS Durable Goods Dataset 1. In addition, information on size is available for CRT TVs (they are categorized as 9-16, 19-20, 25, 27, or 30 inches and larger). For each category, we exclude transactions with no information on (i) gender of the individual who made the transaction, (ii) his or her household income, or (iii) PC/TV and EW prices. Households with more than four PC/TV transactions in the data period are also excluded, as are transactions that were final returns. Our final sample for the PC category has 2,683 transactions, and the TV category has 3,812 transactions.[12] Unfortunately, we have no information on the menu of EWs offered to a consumer when he or she purchased a PC.[13]

Five pieces of information are available on the demographic characteristics of a household to which the consumer who purchases a PC and/or TV belongs: (1) age of the household head, (2) whether children live in the household, (3) income level of the household (nine categories; unfortunately, no dollar value is attached to each categorical number), (4) gender of the household head, and (5) gender of the household member who purchased a PC. Unfortunately, we cannot include information on the household's age or the number of children because almost half of the transactions in the original sample lack either piece of information. Furthermore, we have no information on the *age* of the consumer who executed a transaction. Thus, it is not possible to consider the interaction between gender and age.

To augment the ISMS data, we collected information on the breakdown probabilities of PCs from various issues of *Consumer Reports*. These breakdown rates are within five years with normal usage. *Consumer Reports* did not publish breakdown rates for laptops until 2004. Thus, we use these rates for the entire sample period. Although "actual" breakdown probabilities may vary across heterogeneous households, we assume that they are common for all households. Regarding the TV category, we directly use the information in Wang, Ata, and Islegen (2012), which is based on the December 2004 issue of *Consumer Reports*. These manufacturer-size-specific failure rates are converted as the rates of breakdown in five years with normal usage. We also use these rates in the TV category for the entire data period.

2. Summary Statistics

Tables 1 shows the summary statistics of the 2,683 PC transactions. Interestingly, 43 percent of all PC transactions are accompanied by EW purchases. The percentage is higher for laptops (47.4 percent) than for desktops (41.5 percent). Approximately 38 percent of all PC transactions were executed by female consumers. Recall that each household is assigned to one of the nine income categories. We collect the

lowest three categories into a new 'Low' category, and so on. The past experience of PC purchases by the same household is observed only in the data period.[14] This statement is also true for EW purchase experiences. Approximately 8 percent of households pur-

chased a PC before a current transaction. Among them, 14% of the households have ever purchased an EW for a PC. Turning to the PC characteristics in Panel B, about one quarter of all PC transactions are laptop computers.[15] On average, the laptop price is 1.8 times higher

<div style="text-align:center">Table 1. Summary Statistics (PCs)</div>

Panel A	Mean	Std. Dev.	N			
Consumer Characteristics						
Female	0.379	0.485	2683			
Age of Household Head	49.01	14.36	2582			
Female Household Head	0.375	0.484	2312			
Presence of Children	0.686	0.464	1397			
Household Income						
Low	0.184	0.388	2683			
Middle	0.417	0.493	2683			
High	0.398	0.490	2683			
Past PC Purchases (in a household)	0.079	0.270	2683			
Past EW Purchases (conditional on Past PC Purchases =1)	0.136	0.344	213			
Panel B	Mean	Std. Dev.	5%	Median	95%	N
PC Characteristics						
Laptop (dummy)	0.252	0.434	0	0	1	2683
Price	901.88	407.06	408.34	835.65	1671.30	2683
(Desktop)	754.82	297.24	390.19	699.99	1309.40	2006
(Laptop)	1337.62	375.56	835.65	1299.88	2036.84	677
Breakdown Rate (in 5 years)	0.180	0.014	0.15	0.19	0.19	2683
(Desktop)	0.182	0.014	0.15	0.19	0.19	2006
(Laptop)	0.177	0.011	0.16	0.18	0.19	677
Extended Warranty						
Purchase (dummy)	0.430	0.495	0	0	1	2683
(Desktop)	0.415	0.493	0	0	1	2006
(Laptop)	0.474	0.500	0	0	1	677
Price	225.47	68.34	129.98	209.98	349.99	1153
(Desktop)	213.45	60.81	127.03	202.96	339.29	832
(Laptop)	256.62	76.56	145.88	250.69	358.87	321
Ratio of EW Price to PC Price	0.259	0.088	0.143	0.250	0.400	1153
(Desktop)	0.283	0.086	0.182	0.267	0.421	832
(Laptop)	0.196	0.055	0.108	0.197	0.285	321

Notes: For Panel A, all variables except "Age of Household Head" are 0-1 dummies. For Panel B, prices are measured in 1999 dollars.

Table 2. Summary Statistics (TVs)

Panel A	Mean	Std. Dev.	N			
Consumer Characteristics						
Female	0.365	0.481	3812			
Age of Household Head	51.56	15.49	3653			
Female Household Head	0.354	0.478	3299			
Presence of Children	0.622	0.485	1912			
Household Income						
Low	0.190	0.393	3812			
Middle	0.403	0.491	3812			
High	0.406	0.491	3812			
Past TV Purchases (in a household)	0.106	0.308	3812			
Past EW Purchases (conditional on Past TV Purchases =1)	0.099	0.299	405			

Panel B	Mean	Std. Dev.	5%	Median	95%	N
TV Characteristics						
31 Inches and Larger (dummy)	0.278	0.448	0	0	1	3812
Price	391.11	364.70	92.84	278.54	1114.03	3812
(27 Inches and Smaller)	245.60	133.31	84.82	221.03	510.67	2753
(31 Inches and Larger)	769.38	484.31	329.87	603.52	1856.99	1059
Breakdown Rate (in 5 years)	0.092	0.027	0.066	0.091	0.132	3812
(27 Inches and Smaller)	0.088	0.018	0.066	0.093	0.128	2753
(31 Inches and Larger)	0.102	0.041	0.066	0.086	0.185	1059
Extended Warranty						
Purchase (dummy)	0.287	0.452	0	0	1	3812
(27 Inches and Smaller)	0.268	0.443	0	0	1	2753
(31 Inches and Larger)	0.336	0.473	0	0	1	1059
Price	89.29	68.92	27.85	66.30	250.69	1093
(27 Inches and Smaller)	56.72	33.10	24.24	47.12	109.99	737
(31 Inches and Larger)	156.70	74.69	74.27	148.55	334.25	356
Ratio of EW Price to TV Price	0.220	0.104	0.113	0.192	0.400	1093
(27 Inches and Smaller)	0.228	0.111	0.119	0.200	0.417	737
(31 Inches and Larger)	0.205	0.086	0.090	0.188	0.360	356

Notes: For Panel A, all variables except "Age of Household Head" are 0-1 dummies. For Panel B, prices are measured in 1999 dollars.

than the desktop price, although the EW price for a laptop is only 1.2 times higher than that for a desktop. Accordingly, the ratio of the EW price to the PC price for a laptop is 0.7 times large than for a desktop. As expected, the ratio of EW purchases is higher for laptop computers (47.4 percent for laptops and 41.5 percent for desktops). However, the average five-year breakdown rate is lower for laptops (17.7 percent for laptops and 18.2 percent for desktops).[16]

Table 2 presents the summary statistics of the 3,812 TV transactions. The overall attachment rate (warranty purchases as a percentage

of TV purchases) is approximately 29 percent. Approximately 37 percent of all TV transactions were executed by female consumers. The income distribution is similar to the case of PCs. A slightly higher percent (11%) of the households purchased a TV prior to a current transaction in comparison to PCs. Among them, approximately 10 percent of households have ever purchased an EW for a TV. Turning to product characteristics (Panel B), we consider two TV categories by size: "27 Inches and Smaller" and "31 Inches and Larger." The latter category consists of approximately 28 percent of all transactions, and its average price is 3.1 times higher than the average price of "27 Inches and Smaller" TVs. Accordingly, the average ratio of the EW price to the PC price is smaller for the "31 Inches and Larger" category (0.205/0.228＝89.9 percent smaller). The average five-year breakdown rate is higher for the "31 Inches and Larger" category (10.2 percent for 31-inch or larger TVs and 8.8 percent for 27-inch or smaller TVs). The frequency of EW purchases is also higher for the "31 Inches and Larger" category (33.6 percent for 31-inch or larger TVs and 26.8 percent for 27-inch or smaller TVs). This phenomenon contrasts with the case of PCs, where laptop computers—with lower breakdown rates than desktop machines—are associated with a higher average rate of EW purchases.

IV. Empirical Results

Recall that the price of an EW is observed only if it is purchased. Thus, the price of an EW for an observation with no EW purchase is imputed by a random draw from the normal distribution, where the mean and the variance are computed vis-a-vis a manufacturer-year-portability pair. This process can be regarded as a stochastic regression imputation assuming "missing at random." In our case, whether information is missing depends on observed components, namely, missing information is caused

only by the purchase or non-purchase of EW; therefore, we can assume missing at random as a missing mechanism. Hence, this procedure provides us with valid estimators in our empirical analysis (Enders, 2010). We do not believe that the EW price is affected by a consumer's demographic characteristics. This statement is especially true if the retailer in the data offers only one-price plans. However, if the retailer offers menus with different prices, sorting might be affected by a consumer's demographic characteristics. Even so, the effect is not large.[17]

Table 3 shows the probit estimates of the average and/or marginal effects in EW purchases for the PC sample (Panel A), and the estimates for the TV sample (Panel B). In the first column of each panel (Specification (1)), we focus on only two variables (except year dummies): the natural log of the ratio of the EW price to the product price, and the dummy for laptops. The price ratio has a negative effect on EW purchases and is statistically significant at the 0.1% level. This finding is true for both PC and TV samples. At the mean, the effect of a 1% change in the price ratio in the PC category is twice as large as that in the TV category. Note that we cannot make a straightforward comparison of the average and/or marginal effects across groups in the probit regression because the magnitude of the coefficients are affected by unobserved factors (Train, 2009). However, summary statistics in Panel A of Tables 1 and 2 indicate that the demographic characteristics of the PC sample and the TV sample are quite similar. Therefore, the problem of the scale parameter difference is much smaller in our case. In all of the specifications that we consider, the price effect is 0.1－1% statistically significant. Next, Specification (2) introduces manufacturer-portability- specific breakdown rates, whereas in Specification (3), manufacturer fixed effects are considered instead. In both PC and TV samples, Akaike's information criterion is lower when

Table 3. probit Estimates of the Average/Marginal Effects in EW Purchases

Panel A: PCs	Specification					
Dep var: EW Purchase	(1)	(2)	(3)	(4)	(5)	(6)
Consumer Characteristics						
Female				0.0537** (0.0194)	0.0516** (0.0194)	
Income = Low					0.0102 (0.0263)	
Income = High					−0.0349 (0.0210)	
Product Characteristics						
ln(EW Price/PC Price)	−0.131*** (0.0257)	−0.132*** (0.0257)	−0.105*** (0.0262)	−0.109*** (0.0263)	−0.110*** (0.0263)	−0.111*** (0.0262)
Notebook	0.00589 (0.0242)	0.0104 (0.0243)	−0.0249 (0.0269)	−0.0248 (0.0268)	−0.0203 (0.0269)	−0.0168 (0.0269)
Breakdown Rate		0.0133 (0.0072)				
Interactions						
Female × (Income = Low)						0.164*** (0.0242)
Female × (Income = Middle)						0.0666 (0.0370)
Female × (Income = High)						0.0439 (0.0386)
Male × (Income = Middle)						0.0517 (0.0345)
Male × (Income = High)						0.0070 (0.0345)
Fixed Effects						
Year	Yes	Yes	Yes	Yes	Yes	Yes
Manufacturer	No	No	Yes	Yes	Yes	Yes
Log Likelihood	−1811.0	−1809.3	−1794.3	−1790.5	−1788.5	−1784.5
AIC	3638.0	3636.6	3614.6	3609.0	3609.0	3605.0
N	2683	2683	2683	2683	2683	2683

manufacturer fixed effects are considered. Thus, we use manufacturer fixed effects when we subsequently take into account consumer characteristics.

Specification (4) considers gender. Its effect is positive for both Categories and is 1% statistically significant for the PC sample. When we additionally consider income in Specification (5), the effect of gender is still statistically significant in the PC sample, whereas neither (low nor high) income category has a statistically significant effect. However, in the TV sample, the opposite is true: whereas gender has still no statistically significant effect, both income categories have statistically significant effects. The direction is positive for the low-income category and is negative for the high-income

category. Finally, we consider an interaction between gender and income in Specification (6). The base category is Male × (Income = Low). It is shown that female consumers from low-income households are 17 percentage points more likely to purchase an EW than the male counterparts are. This effect is statistically significant at the 1% level. However, this number for female consumers in the middle-income and high-income categories is only 6 and 4 percentage points more than the base group, respectively, and there is no statistical significance. In contrast, in the TV sample, there is no such apparent contrast between men and women from low-income households. Although females from low-income households are still more likely to purchase an EW than male

Panel B: TVs	Specification					
Dep var: EW Purchase	(1)	(2)	(3)	(4)	(5)	(6)
Consumer Characteristics						
Female				0.0285 (0.0150)	0.0209 (0.0150)	
Income = Low					0.0807*** (0.0196)	
Income = High					−0.0384* (0.0162)	
Product Characteristics						
ln(EW Price/TV Price)	−0.0605*** (0.0137)	−0.0542*** (0.0139)	−0.0387** (0.0143)	−0.0392** (0.0143)	−0.0391** (0.0142)	−0.0394** (0.0141)
31 Inches and Larger	0.0621*** (0.0160)	0.0742*** (0.0164)	0.0440** (0.0168)	0.0444** (0.0168)	0.0478** (0.0167)	0.0475** (0.0167)
Breakdown Rate		−0.00870** (0.0028)				
Interactions						
Female × (Income = Low)						0.0686* (0.0319)
Female × (Income = Middle)						−0.0547 (0.0288)
Female × (Income = High)						−0.0762** (0.0294)
Male × (Income = Middle)						−0.0494 (0.0259)
Male × (Income = High)						−0.0972*** (0.0260)
Fixed Effects						
Year	Yes	Yes	Yes	Yes	Yes	Yes
Manufacturer	No	No	Yes	Yes	Yes	Yes
Log Likelihood	−2263.1	−2258.2	−2237.6	−2235.7	−2218.0	−2216.3
AIC	4542.2	4534.3	4515.1	4513.5	4482.0	4482.6
N	3812	3812	3812	3812	3812	3812

Notes: Standard errors are in parentheses. *$p<0.05$, **$p<0.01$, ***$p<0.001$. AIC stands for Akaike's information criterion.

counterparts are, the difference is only 7 percentage points and is 5% statistically significant. Thus, *gender differences are more apparent in the PC sample than in the TV sample*. In the latter category, income appears more responsible: as Specification (5) indicates, consumers from low-income households are more likely to purchase an EW than those from middle-income households. The opposite is true from a comparison between high-income and middle-income households. In particular, as Specification (6) shows, men from high-income households are the least likely to purchase an EW for a TV.

Lastly, if we look closely at Panel A of Table 3 and compare women with men in the PC sample, women are more likely to purchase an EW for each income category. Two possible interpretations exist. The first one is that (i) if women are more likely to break down a computer than men, then our empirical finding suggests *adverse* selection. However, (ii) if women are less likely to break down a computer than men, then *advantageous* selection is suggested: those who have less of a need for an EW are more likely to purchase one, and vice versa. However, the relationship is less apparent in Penal B for the TV sample. To further investigate this issue, Table 4 considers how gender matters to cognition regarding an EW purchase and shows the estimates of the average and/or marginal effects when past product purchases in the data period are considered. To mitigate the left-censored problem

Table 4. Estimates of the Average/Marginal Effects
(in the latter 3 years)

Dep var: EW Purchase	Sample	
	PC	TV
Consumer Characteristics		
Female	0.0557 (0.0292)	0.0266 (0.0221)
Income = Low	−0.0062 (0.0373)	0.0724** (0.0277)
Income = High	−0.0323 (0.0292)	−0.0166 (0.0224)
Past Product Purchases	−0.135** (0.0496)	−0.0939* (0.0368)
Past Product Purchases × Female	−0.0364 (0.0895)	0.0366 (0.0632)
Product Characteristics		
ln(EW Price/TV Price)	−0.108** (0.0372)	−0.070*** (0.0193)
Notebook	0.0214 (0.0349)	−
31 Inches and Larger	−	0.0487* (0.0231)
Fixed Effects		
Year	Yes	Yes
Manufacturer	Yes	Yes
Log Likelihood	−903.9	−1183.9
AIC	1837.7	2411.9
N	1364	2018

Notes: Standard errors are in parentheses. *$p<0.05$, **$p<0.01$, ***$p<0.001$. AIC stands for Akaike's information criterion.

(i.e., purchase experience before the sample period is not observed), we use the transactions in the latter three years of the data period (2002, 2003, and 2004) for estimation. In both PC and TV samples, past purchase experience has a negative effect on EW purchase. However, if we interact past purchase experience with gender, the effects are different across the two samples: female consumers have an additional negative effect in the PC sample, and those in the TV sample have a reverse positive effect.[18] Thus, although women are, *ceteris paribus*, more likely to purchase an EW for a more mechanical product (compare Specifications (4) and (5) in Panels A and B of Table 3), they may change their attitude toward an EW purchase on the basis of past experience to a greater extent than men do (as a result, the negative effect of past purchase experience is stronger for women) for a mechanical product such as a PC. However, women may be more conservative than men in altering their cognition about breakdowns for a less mechanical product such as a TV. Thus, an interpretation of this finding that women's initial perception about breakdowns is more unstable for PCs (women correct their perceptions more quickly than men do) suggests that *advantageous* selection−rather than adverse selection−prevails in the market of EWs for those who purchase a PC for the first time (at least relative to the market of TV EWs).

V. Concluding Remarks

This paper studies the extent to which an individual's demographic characteristics matter to his or her decision regarding an EW purchase. We find that female consumers from low-income households are more likely to purchase

EWs. It is important to investigate the reasons for this result. Is it because female consumers from low-income households are most risk averse? Is it because they are most likely to have misconceptions about breakdowns? Although we remain agnostic about these "deep" determinants in the present paper, mainly attributable to the data limitation, it is interesting and important to study how gender matters to these determinants.

It is also important to model interactions in the EW market. This market is considered an aftermarket. As Farrell (2008) argues, it may be the case that EW prices are "hidden" and are revealed when consumers are charged. A retailer behaves as a "*de facto* monopolist" when selling an EW for a durable good if it is extremely costly to search for EWs before shopping, and a consumer must decide whether to buy one when purchasing the durable good (see, e.g., Cutler and Zeckhauster (2004), Ellison (2005) and Gabaix and Laibson (2006)). This finding may be related to "overinsurance", as Cutler and Zeckhauser (2004, p.28) and Sydnor (2010) point out. In particular, if the average woman faces a lower probability of a PC breakdown than the average man does, then *advantageous selection* may be prevailing in the market of EWs for PCs in the sense that individuals who need *less* to be insured are *more* likely to purchase insurance.[19]

Then, what are the effects of introducing competition in this *de facto* market monopoly? In July 2013, (then) the UK's Office of Fair Trading (OFT)[20] launched a website called "Compare Extended Warranties"[21] in cooperation with participating EW providers. Given the mandatory participation of two large retailers (Argos and Dixons) in the United Kingdom (through a legal agreement), the website covers 75 percent of EW sales and shoppers can use it for free to compare prices of various types of EWs. The OFT's aim of creating the website is precisely to combat the *de facto* monopoly situation. Then, the following

questions naturally arise. How much will consumer welfare improve if the EW price approaches the "fair" price (i.e., the marginal cost) after competition in EW sales by retailers and third-party EW providers is introduced? Is it a significant change? Turning to the sellers' side, how much in profits will retailers still obtain after competition is introduced? Is their loss significantly large? These and other interesting questions are left for future research.

Notes

1) For example, according to Robert Berner's article in *Bloomberg Businessweek* ("textquotedblleft The Warranty Windfall, December 19, 2006; http://www.businessweek.com/stories/2004-12-19/the-warranty-windfall), Circuit City's estimated 2014 profits from EWs represented 45 percent of its total operating profits. Unfortunately, the details on profitability are usually unclear because companies are not obliged to disclose information specific to sales and profits from EWs.

2) For example, *Consumer Reports* lists the reasons "why we recommend against buying service plans" at http://www.consumerreports.org/cro/extended-warranties/buying-guide.htm (accessed June 2016). See, e.g., Pope, Ishida, Kaufman, and Langrehr (2014) on the institutional characteristics of the U.S. EW market.

3) On the basis of psychological studies, the following three factors are mentioned by Croson and Gneezy (2009) as causes of gender differences: (i) *emotions* (women react to uncertain situations and adverse outcomes more fearfully than men do), (ii) *overconfidence* (men tend to be more overconfident than women), and (iii) *risk as challenges or threats*.

4) Relatedly, Hanaoka, Shigeoka and Watanabe (2018) study gender differences in *changes* in risk preferences by using variations in seismic intensity related to the Great East Japan Earthquake (March 11, 2011). They find that changes in risk tolerance after a natural disaster are experienced mainly by men, especially old, less educated, and unmarred men. This result suggests that men's risk preference is more subject to changes than women's. However, in Hanaoka, Shigeoka and Watanabe (2018), risk attitude is not measured on the basis of actual behavior: when asked, the respondent answers as if he or she becomes more

risk tolerant, but he or she may become just insane and less sober rather than more risk tolerant. Although Hanaoka, Shigeoka and Watanabe (2018) also consider gambling and drinking as another measure of risk-taking behavior, this criticism still applies and these behaviors may be motivated by changes in preferences and environments that are unrelated to risk. In contrast, the present study uses a dataset on actual insurance purchases.

5) Base warranties by manufacturers are studied by Chu and Chintagunta (2009, 2011). Chu and Chintagunta (2011) empirically compare four competing theories of warranty: (1) *risk-sharing* mechanism; (2) *sorting* mechanism (heterogeneity in risk attitude, and it is private information) and second-degree price discrimination; (3) as a *signal* of product quality; and (4) as an *incentive* mechanism for manufacturers to reveal and improve product quality. Chu and Chintagunta (2011) find supporting evidence for (1) and (2), but not for (3) or (4). In contrast, using data from the U.S. server market, Chu and Chintagunta (2009) propose and estimate a structural model of base warranty demand and its pricing to quantify the value of base warranties, decomposing it into its insurance value and its sorting (price discrimination) value. In particular, Chu and Chintagunta (2009) use their counterfactual experiments to argue that if manufacturers are forced to provide three-month or two-year warranties *uniformly*, they also generate 20 percent of their profits in either case. This result suggests that manufacturers benefit considerably from the sorting role of base warranties.

6) Steiner and Otter (2014) provide another experimental study on EWs that focuses on consumers' information processing.

7) Relatedly, by using the same dataset as is used in the present study (ISMS Durable Goods Dataset 1; see the next section), Abito and Salant (2018) introduce the overweighting of breakdown probabilities instead of standard risk aversion and argue that it better explains the data. Their counterfactual experiments show that the retailer's profit is reduced by 80 percent if there is no overweighting of breakdown probabilities.

8) In a different vein, Wang, Ata, and Islegan (2012) used the same data source as in the present study and estimate a dynamic model of demand for a durable good and its EW, assuming risk-neutrality. They find that EWs are overpriced for high-end brands and underpriced for low-end brands.

9) Cohen and Einav (2007) do not use income information in their benchmark estimation because 20 percent of the individuals would have been dropped. See Cohen and Einav's (2007, p.761) Footnote 33.

10) It is available (at a charge) at https://www.informs.org/Community/ISMS/ISMS-Research-Datasets/.

11) Unfortunately, no geographical information (such as ZIP code) for each transaction is contained.

12) We do not distinguish onsite and online transactions because the number of online transactions is negligible. This phenomenon results probably because consumers would have preferred to purchase heavy products such PCs and TVs at onsite stores. In contrast, Abito and Salant (2018) use the same ISMS Durable Goods Dataset 1 to exploit the differences between onsite and online in the frequency of EW purchases to argue that an aggressive attitude by store clerks causes many consumers to purchase an EW.

13) Although Ni, Neslin, and Sun (2012, p.1009) document that "[e]ach record includes ... information such as brand purchased or returned, service contracts purchased or returned, product category, price paid or refunded, *length of coverage of the service contract* and time and location of the transaction" (italics added), it is verified (from personal communication with Scott Neslin and Baohong Sun) that the ISMS Durable Goods Dataset 1 does not include information on the length of coverage of EWs. The ISMS Durable Goods Dataset 2 contains information on the length of coverage of EWs. However, the unit of observation is the household and, hence, only the *average* length of coverage of all EWs purchased during the sample period is observed for each household. In addition, no information on household characteristics is included in the ISMS Durable Goods Dataset 2.

14) Recall that the data are collected from only one retail chain: a household may have purchased a PC at a different retail chain.

15) The share of laptop computers doubled from the first half to the second half of the data period: it was 16.3% in 1999-2001 and doubled to 33.9% in 2002-2004.

16) This finding could partly reflect the difference in PC vendors' shares between desktops and laptops.

17) Chen, Karla, and Sun (2009, p.615) state that

"[s]ome retailers, such as Circuit City and Wal-Mart, offer consumers a menu of extended service contracts (ESCs) that vary in length and price, whereas others, such as Best Buy and Target, provide only one plan." Unfortunately, the identity of the electronics retailer is not disclosed in the ISMS Durable Goods Datasets 1 and 2.

18) Unfortunately, we are not able to consider the effects of past EW purchases because, in both samples, all of those who purchased an EW in the past also purchased an EW in the current transaction. Hence, there is no variation. Interestingly, the majority is men in both samples (69% in the PC sample and 60% in the TV sample).

19) In contrast to many insurance contract cases, retailer chains selling EWs do not usually keep information on actual breakdown accidents because, technically, EW contracts are underwritten by third-party insurance agents. Thus, we need separate information sources to understand the likelihood of a woman breaking a computer. However, we must note that a home PC or TV is jointly used in a household: a female spouse may purchase a PC or TV and its EW, and a male spouse may break it.

20) The OFT closed on March 31, 2014, splitting its responsibilities among a number of different organizations. The main body was succeeded on April 1, 2014, by the Competition & Markets Authority.

21) Its URL is http://www.compareextendedwarranties.co.uk/ (accessed May 2018).

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