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The Case of Electronic Products

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

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Abstract

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, though there are little gender differences 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 CRT (cathode ray tube) televisions, suggesting 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.

Keywords: Gender Gap; Extended Warranties; Advantageous Selection.

JEL classification: D40; J16; L11.

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1 Introduction

Extended warranties (or extended service contracts) are sold by retailers as an option at the purchase of a durable good such as an electronic product and an automobile. While a base warranty—provided (mandatory) by manufacturers—is usually valid for the first one year, an extended warranty provides an additional period (usually 2 to 3 years) for a repair without further charge. It is well known that electronics retail chains earn a considerable amount of revenues from selling extended warranties,¹ and as such, they are often criticized by the popular media. Some opponents even argue that consumers should avoid purchasing an extended warranty at all.²

This paper studies gender differences in extended warranty purchases in two major categories of electronic products: personal computers (PCs) and cathode ray tube televisions (TVs). In particular, our empirical analysis focuses on the gender gap in extended warranty purchases considering income status. We find that in the case of extended warranties for personal computer purchases, female consumers in low-income households are 16 percentage points more likely to purchase an extended warranty than the male counterparts, though this number for female consumers in middle- or high-income households is only 6 and 4 percentage points more, respectively, in comparison to men from low-income households. However, the gender gap is less apparent in the TV category: while a female consumer in a low-income household is 7 percentage points more likely to purchase an extended warranty than the average men in the same category do, female consumers from middle- and high- income households are 5.5 and 7.6 percentage points *less* likely to purchase one than men from low-income households do. In both categories, poorer women tend to purchase an extended warranty. While this may indicate that they are

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

²For example, *Consumer Reports* lists up 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. extended warranty market.

more risk-averse than women from middle- and high-income households, it may also imply that extended warranty purchase results from unthoughtful decision-making. In addition, the contrast between the PC and the TV categories may suggest that gender gap may matter more in extended warranty purchases for more mechanical products.

Furthermore, if we compare women with men in the PC sample, women are more likely to purchase an extended warranty for each income category. There would be two possible interpretations. The first one is that (i) if women are more likely to break down a computer than men, then our empirical finding would suggest *adverse* selection. However, (ii) if women are less likely to break down a computer than men, then it would suggest *advantageous* selection: those who need an extended warranty less are more likely to purchase one, and vice versa (see, e.g., Einav and Finkelstein (2011) and Mohoney and Weyl (2014)). The relationship is less apparent in the TV sample, though. We argue that our empirical results may suggest that advantageous selection prevails in the extended warranty market for PCs.

The rest of the 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.

2 Related Literature

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

2.1 Gender Differences in Risk Attitude

This paper empirically finds out gender gap in extended warranty purchases. Our empirical findings are in line with the existing experimental studies on gender differences in risk preferences (see, e.g., excellent surveys by Croson and Gneezy (2009) and by Meyers-Levy and Loken (2015)). Controlling for such demographics as education, age, race, and country of origin, the existing studies in experimental economics have repeatedly found strong

evidence that females are more risk averse than males both in the laboratory (usually, in the context of lottery choices) and in 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 is also consistent with Johnson and Powell’s (1994) finding that gender differences in risk attitude are quite small in the managerial subsample, while 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)).

2.2 Empirical Studies of Extended Warranty Purchases

There is a limited number of empirical studies of extended warranties by retailers.⁵ Chen, Karla, and Sun (2009) is the first among the recent empirical studies that focus on consumer decision-making in extended warranty purchases. Using detailed data from a retailer (including information on promotion (price promotion and advertising) and the warranty length), Chen, Karla, and Sun (2009) consider various factors that potentially influence

³Based on 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 have more overconfidence than women do), and (iii) *risk as challenges or threats*.

⁴Relatedly, Hanaoka, Shigeoka, and Watanabe (2014) study gender differences in *changes* in risk preference by using the variation in seismic intensity 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 unmarried men. This result would suggest that men’s risk preference is more subject to changes than women’s. However, in Hanaoka, Shigeoka, and Watanabe (2014). risk attitude is not measured based on the 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 (2014) also consider gambling and drinking as another measure for risk-taking behavior, this criticism still applies 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 purchase.

⁵Base 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. second-degree price discrimination; (3) as a *signal* of product quality; and (4) as an *incentive* mechanism form 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 the present paper, following Chu and Chintagunta’s (2011) findings, we take into account theories (1) and (2) that are behind our empirical results. On the other hand, using data from the US 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) argue, based on their counterfactual experiments, that if manufacturers are forced to provide three-month or two-year warranties *uniformly*, they would also 20 percent of their profits in either case. This result suggests that manufacturers considerably benefit from the sorting role of base warranties.

consumers' extended warranty purchase such as product characteristics, retailer actions, and consumer characteristics. Focusing on seven product categories (video, audio, phone, camera, computer, game, and mobile audio), Chen, Karla, and Sun (2009) estimate a structural model of binary choice (whether to purchase an extended warranty or not) based on the mean-variance utility to take into account risk aversion, and 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 extended warranty purchases, finding “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 “[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 extended warranty. In addition, we consider interactions between gender and income, while Chen, Karla and Sun (2009) do not. Regarding income, Chen, Karla and Sun (2009, p.620) conclude that “given everything else equal, lower-income consumers are more prone to buying” EWs. They argue two possible reasons. One is that “lower-income consumers are more sensitive to the replacement cost.” On the other hand, 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 extended warranty. However, in the PC category, higher-income consumers are more likely to purchase one.

Another recent study by Jindal (2015) provides an experimental study on extended warranty purchase to compare alternative theories from the traditional expected utility theory to behavioral economics.⁶ Jindal (2015) decomposes different preferences over risk/uncertainty into: (i) risk aversion; (ii) loss aversion (the magnitude of loss is larger than that of gain with the same amount); (iii) nonlinear weighting of failure probabilities. Allowing variation in failure probabilities (this is a target of estimation in Chen, Karla, and Sun (2009)) and variation in repair costs, Jindal (2015) finds that loss aversion explains

⁶Steiner and Otter (2014) is another experimental study on extended warranties to focus on consumers' information processing.

the data of stated choices significantly better than two competing theories, standard risk aversion (corresponding to the concavity of von Neumann–Morgenstern utility function) and nonlinear probability weighting. Jindal (2015) also finds that there is substantial heterogeneity in loss aversion among the subjects.^{7,8} While we remain agnostic about the actual psychological factors behind extended warranty purchases in this paper, our empirical results would imply how these factors are affected differently by consumers’ demographic characteristics.

2.3 Empirical Studies of Insurance Purchases

Cohen and Einav (2007) already find that women are more risk averse with data (from an auto insurance company in Israel) on deductible choices in auto insurance contracts. However, their sample does not include information on individual’s *income* (or wealth). They use wealth from the census data by using 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 wide variety of electronic products. Thus, we are able to study how product novelty is related to gender differences in extended warranty purchase. In particular, we compare the PC category with the CRT (cathode ray tube) TV category. While CRT television sets supposedly belonged to one of the traditional categories of electronic products in the period of the data for this study (December 1998 to November 2004), personal computers were probably deemed to be still relatively new electronic products for most households. In the empirical analysis below, we find that gender differences in extended warranty purchases are more apparent in the PC category than in the TV cate-

⁷Relatedly, by using the same dataset as in the present study (ISMS Durable Goods Dataset 1; see the next section), Abito and Salent (2015) introduce 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 would become lower by 80 percent if there were no overweighting of breakdown probabilities.

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

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

gory. In contrast to auto insurances, contract heterogeneity (most importantly, coverage length) would be less important in the case of extended warranties (as suggested by Chen, Karla and Sun (2009)) because a car owner, if he or she is not extremely poor, usually purchases an insurance at the purchase of a car, and thus insurance providers would care more about the variety of insurances (how long and how much the insurance covers).

3 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.

3.1 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 It is a customer-level transaction dataset collected from 1176 stores of an anonymous national consumer electronics retail chain in the U.S., located throughout the U.S.¹¹ The dataset covers 6 years (December 1998 to November 2004). It randomly selects 19,936 households, and for each randomly selected household, the transaction record is complete (at this retail chain) through the 6 years, yielding total 173,262 transactions, including extended warranty (EW) purchases.

We focus on transactions in the personal computer (PC) category (desktop and laptop) and the CRT (Cathode Ray Tube) television category (TV for short). 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 tiny percentage of associated purchases of an extended warranty. This is the reason why we choose these two categories for our study. During the sample period, LCD (Liquid Crystal Display) televisions had not gained popularity yet, and thus their share is very small in the ISMS Durable Goods Dataset 1. In addition, information on size is available for CRT televisions (they are

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

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

categorized as either 9-16 inches, 19-20, 25, 27, or 30 and larger). For each category, we exclude transactions with no information on (i) gender of the individual who made the transaction, (ii) his/her household's income, or (iii) PC and EW prices. Households with more than 4 PC/TV transactions in the data period are also excluded. Also excluded are transactions that were finally returned. Our final sample for the PC category has 2,683 PC transactions. For the TV category, there are 3,812 transactions.¹² Unfortunately, we have no information on a menu of extended warranties offered to a consumer when he or she purchased a PC.¹³

Regarding information on the demographic characteristics of a household to which the consumer who purchases a PC/TV belongs, five pieces of information are available: (1) age of the household head, (2) whether there are children living 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 age of 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 made a transaction. Thus, it is not possible to consider an interaction between gender and age.

To augment the ISMS data, we have collected information on breakdown probabilities of PCs from various issues of *Consumer Reports*. These are rates of breakdown in 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"

¹²We do not distinguish onsite and online transactions because the number of online transactions is negligible. This is probably because consumers would have preferred to purchase heavy products such as PCs and TVs at onsite stores. On the other hand, Abito and Salent (2015), by using the same ISMS Durable Goods Dataset 1, exploit the differences between onsite and online in frequency of extended warranty purchase to argue that aggressive attitude by store clerks cause so many consumers to purchase an extended warranty.

¹³Although Ni, Nelsen and Sun (2012, p.1009) document that "[e]ach record includes ... information such as brand purchased or returned, service contracts purchased 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 Baohong Sun and Scott Neslin) that the ISMS Durable Goods Dataset 1 does not include information on the length of coverage of extended warranties. In the ISMS Durable Goods Dataset 2, there is information on the length of coverage of extended warranties. However, the unit of observation is household, and hence only the *average* length of coverage of all extended warranties 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.

breakdown probabilities may vary across heterogeneous households, we assume they are common for all households. As for the TV category, we directly use Wang, Ata, and Islegen’s (2012) information, which bases on the December 2004 issue of *Consumer Reports*. These manufacturer-size specific failure rates are converted as the rates of breakdown in 5 years with normal usage. We also use these rates in the TV category for the entire data period.

3.2 Summary Statistics

Tables 1 and 2 show the summary statistics of the 2,683 PC transactions. Interestingly, 43 percent of all the PC transactions are accompanied by extended warranty purchase. The percentage is higher for laptops (47.4 percent) than for desktops (41.5 percent). About 38 percent of all the PC transactions were made by female consumers. Recall that each household is assigned to one of the nine income categories. We collect the lowest 3 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 is also true for EW purchase experience. About 8% of the households have purchased a PC prior to a current transaction. Among them, 14 % of the households have ever purchased an extended warranty for a PC. Turning to the PC characteristics in Table 2, about a quarter of all the PC transactions are laptop computers.¹⁵ On average, the laptop price is 1.8 times higher than the desktop price, though 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 as 0.7 times large as for a desktop. As expected, the ratio of extended warranty purchase is higher for laptop computers (47.4 percent for laptops and 41.5 percent for desktops). However, the average 5-year breakdown rate is lower for laptops (17.7 percent for laptops and 18.2 percent for desktops).¹⁶

[Tables 1 and 2]

¹⁴ Recall that the data is 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 of the data period to the second half: it was 16.3% in 1999-2001, and it doubled to 33.9% in 2002-2004.

¹⁶ This could partly reflect the difference in the manufacturers’ shares between desktops and laptops.

Tables 3 and 4 present the summary statistics of the 3,812 TV transactions. The overall attachment rate (warranty purchases as a percentage of television purchases) is about 29 percent. About 37 percent of all the TV transactions were made by female consumers. The income distribution is similar to the case of PCs (see Tables 1 and 3). A slightly higher percent (11%) of the households have purchased a TV prior to a current transaction in comparison to TV. Among them, about 10 % of the households have ever purchased an extended warranty for a TV. Turning to the product characteristics (Table 4), we consider two TV categories by size: “27 Inches and Smaller” and “31 Inches and Larger.” The latter category consists of about 28 percent of all the transactions, and its average price is as 3.1 times high as 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 5-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 extended warranty purchase 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 is in contrast to the case of PCs, where laptop computers, which have lower breakdown rates than desktop machines do, are associated with a higher average rate of extended warranty purchases.

[Tables 3 and 4]

4 Empirical Results

Recall that the price of an extended warranty is observed only if it is purchased. Thus, the price of an extended warranty 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.” Since in our case whether information is missing depends on observed components, namely, it is caused only by the purchase or non-purchase of EW, we can assume missing at random as a missing mechanism. Hence, this procedure provides us valid estimators in our empirical analysis (Enders, 2010). We do not think that the extended warranty price is affected by

a consumer’s demographic characteristics. This is especially true if the retailer in the data offers one-price plans only. However, if it offers menus with different prices, sorting might be affected by a consumer’s demographic characteristics. Even if so, the effect would not be large.¹⁷

Table 5 shows the probit estimates of the average/marginal effects in extended warranty purchases for the PC sample, and Table 6 shows the estimates for the TV sample. In the first column (Specification (1)), we focus on only two variables (except year dummies): natural log of the ratio of the extended warranty price to the product price, and the dummy for laptop. The price ratio has a negative effect on the extended warranty purchase, and it is 0.1% statistically significant. This 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 as twice large as that in the TV category. Note that we cannot straightforwardly compare the average/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 Tables 1 and 3 indicates that the demographic characteristics of the PC sample and the TV sample are quite similar. Therefore, the problem of scale parameter difference would be much smaller in our case. In all 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 manufacturer fixed effects are considered. Thus, we use manufacturer fixed effects when we take into account consumer characteristics below.

Now, 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: while gender has still no statistically significant effect, both income categories have statistically significant effects. The direction

¹⁷Chen, Karla, and Sun (2009, p.615) state that “[s]ome retailers, such as Circuit City and Wal-Mart, offer consumers a menu of ESCs (Extended Service Contracts) 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.

is positive for the low-income category, whereas it is negative for the high-income category. Finally, we consider an interaction of gender and income in Specification (6). The base category is Male \times (Income = Low). It is shown that female consumers from low-income households are 17 percentage points more likely to purchase an extended warranty than the male counterparts are. This effect is 1% statistically significant. However, this number for female consumers in the middle-income and the 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 an apparent contrast between men and women from low-income households. While females from low-income households are still more likely to purchase an extended warranty than the male counterparts are, the difference is only 7 percentage points, and it 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 extended warranty than those from middle-income households. The opposite is true from comparison between high-income and middle-income households. Particularly, as Specification (6) shows, men from high-income households are the least likely to purchase an extended warranty for a TV.

As a robustness check, Table 7 considers detailed information on consumer characteristics. Unfortunately, information on the age and the gender of the household head is missing for some observations. Columns 1 and 2 take into account the age of the household head and the gender dummy for the household head. Comparing the gender effect in Column 1 in Table 7 to Specification (5) in Table 5, one finds that statistical significance in the PC sample is now lost in this new specification, and moreover, the sign is reversed. This is because variables “Female” and “Female Household Head” are highly correlated: the correlation coefficient is 0.9853. This implies that if a woman purchases a PC, it almost means that she is a household head. As expected, “Female Household Head” positively contributes to the likelihood of extended warranty purchase. Regarding the TV sample, it appears that the inclusion of the two variables causes only small changes in the estimated effects for gender and income (compare Specification (5) in Table 6 and Column 2 in Table 7), although the correlation coefficient for “Female” and “Female Household Head” is also as high as 0.9894. Apparently, the estimate for gender becomes unstable. Columns 3 and

4 instead consider the presence of children in a household. Somewhat interestingly, the estimated effect for the children presence dummy is *negative* for both PC and TV samples, contrary to our intuition that the presence of children would make the household more willing to purchase an extended warranty. Unfortunately, statistical significance is lost for the gender dummy in the PC sample, and for the income dummies in the TV sample presumably because of reduction in the sample size.

[Table 7]

Lastly, if we go back to Table 5 and compare women with men in the PC sample, women are more likely to purchase an extended warranty for each income category. There would be two possible interpretations. The first one is that (i) if women are more likely to break down a computer than men, then our empirical finding would suggest *adverse* selection. However, (ii) if women are less likely to break down a computer than men, then it would suggest *advantageous* selection: those who need an extended warranty less are more likely to purchase one, and vice versa. The relationship is less apparent in Table 6 for the TV sample, though. To investigate this issue more, Table 8 considers how gender matters to cognition regarding extended warranty purchase, and shows the estimates of the average/marginal effects when past product purchase in the data period is considered. To mitigate the left-censored problem (i.e., purchase experience before the sample period is not observed), we use the transactions in the latter 3 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 extended warranty purchase. However, if we interact past purchase experience with gender, the effects are different across the two samples: while female consumers have an additional negative effect in the PC sample, those in the TV sample have a reverse positive effect.¹⁸ Thus, while women are, *ceteris paribus*, more likely to purchase an extended warranty for a more mechanical product (compare Specifications (4) and (5) in Table 5 and in Table 6), they may change attitude toward extended warranty purchase based on past experience to a greater extent than men do for

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

mechanical product such as a PC. However, women may be more conservative than men are for a less mechanical product such as a TV. In other words, if we interpret this as women’s perception about breakdown being more unstable for PCs, it would suggest that *advantageous* selection, rather than adverse selection, prevails in the market of extended warranties for PCs (at least in comparison to the market of TV extended warranties). However, if the estimates suggest that women are more adaptable in recognizing breakdown probabilities for mechanical products, it may be just the case that women are more likely to purchase an extended warranty than men are because they are more risk-averse.

[Table 8]

5 Concluding Remarks

This paper studies to what extent an individual’s demographic characteristics matter to his or her decision on extended warranty purchase. We find that female consumers from low-income households are more likely to purchase one. It is important to investigate what lies behind 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 breakdown? Although we remain agnostic about these “deep” determinants in the present paper, mainly due 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 extended warranty market. This market is considered as an aftermarket. As Farrell (2008) argues, it may be the case that extended warranty prices are “hidden”, and they are revealed when consumers are charged. A retailer behaves as a “*de facto* monopolist” when selling an extended warranty for a durable good if it is extremely costly to search for extended warranties before shopping, and a consumer has to decide whether to buy one at the purchase of the durable good (see. e.g., Cutler and Zeckhauser (2004), Ellison (2005) and Gabaix and Laibson (2006)). This may be related to “overinsurance” as Cutler and Zeckhauser (2004, p.28) and Sydnor (2010) point out. In particular, if the average woman has less probability of PC breakdown than the average man does, then *advantageous selection* may be prevailing in the market

of extended warranties for PCs in the sense that individuals who need *less* to be insured are *more* likely to purchase an insurance.¹⁹

Then, what are the effects of introducing competition in this market of *de facto* 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 extended warranty providers. With the mandatory participation of two big retailers (Argos and Dixons) in the UK (due to a legal agreement), it covers 75 percent of extended warranty sales, and shoppers can use it free to compare prices of various types of extended warranties. The OFT’s aim of creating the website is exactly to combat this situation of *de facto* monopoly. Then, the following questions naturally arise. How much will consumer welfare improve if the extended warranty price approaches to the “fair” price (i.e., the marginal cost) after competition in extended warranty sales by retailers and third-party extended warranty providers is introduced? Is it a significant change? Turning to the sellers’ side, how much profits will retailers still obtain after competition is introduced? Is their loss significantly large? These and other interesting questions are left for future research.

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¹⁹In contract to many cases of insurance contracts, retailer chains selling extended warranties do not usually keep information on actual breakdown accidents because technically extended warranty contracts are underwritten by third-party insurance agents. Thus, we need separate information sources to know the likelihood of women’s breaking down a computer. However, we must note that a home PC or TV is jointly used in a household: it can be the case that a female spouse purchases a PC or TV and its extended warranty and a male spouse breaks it down.

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

²¹Its URL is <http://www.compareextendedwarranties.co.uk/> (accessed June 2016).

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Table 1. Summary Statistics (PCs)

	Mean	Std. Dev.	Obs.
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

Note: All variables except “Age of Household Head” are 0-1 dummies.

Table 2. Summary Statistics (PCs; continued)

	Mean	Std. Dev.	5th %	Median	95th %	Obs.
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

Note: Prices are measured in 1999 dollars.

Table 3. Summary Statistics (TVs)

	Mean	Std. Dev.	Obs.
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

Note: All variables except “Age of Household Head” are 0-1 dummies.

Table 4. Summary Statistics (TVs; continued)

	Mean	Std. Dev.	5th %	Median	95th %	Obs.
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

Note: Prices are measured in 1999 dollars.

Table 5. Estimates of the Average/Marginal Effects in EW Purchases (PCs)

Dep var: EW Purchase	Specification					
	(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
<i>N</i>	2683	2683	2683	2690	2683	2683

Notes: Standard errors are in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. AIC stands

for Akaike's information criterion.

Table 6. Estimates of the Average/Marginal Effects in EW Purchases (TVs)

Dep var: EW Purchase	Specification					
	(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.

Table 7. Estimates of the Average/Marginal Effects in EW Purchases
(with detailed consumer characteristics)

Dep var: EW Purchase	Sample \times Specification			
	PC (7)	TV (7)	PC (8)	TV (8)
<u>Consumer Characteristics</u>				
Female	-0.0203 (0.1433)	0.169 (0.1255)	0.0290 (0.0271)	0.0421* (0.0212)
Income = Low	0.0528 (0.0300)	0.0791*** (0.0220)	0.0674 (0.0393)	0.0228 (0.0302)
Income = High	-0.0376 (0.0228)	-0.0399* (0.0176)	-0.0420 (0.0285)	-0.0409 (0.0223)
Age of Household Head	0.00023 (0.0007)	0.00016** (0.0007)		
Female Household Head	0.0805 (0.1434)	-0.142 (0.1257)		
Presence of Children			-0.0499 (0.0282)	-0.0504* (0.0211)
<u>Product Characteristics</u>				
ln(EW Price/TV Price)	-0.108*** (0.0284)	-0.0436** (0.0160)	-0.0887* (0.0370)	-0.0495* (0.0210)
Notebook	-0.0250 (0.0296)	-	0.0015 (0.0383)	-
31 Inches and Larger	-	0.0525** (0.0182)	-	0.0515* (0.0232)
<u>Fixed Effects</u>				
Year	Yes	Yes	Yes	Yes
Manufacturer	Yes	Yes	Yes	Yes
Log Likelihood	-1490.8	-1837.6	-928.4	-1092.3
AIC	3017.6	3725.1	1890.8	2232.5
N	2235	3169	1397	1912

Notes: Standard errors are in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

AIC stands for Akaike's information criterion.

Table 8. Estimates of the Average/Marginal Effects
in EW Purchases (in the latter 3 years)

Dep var: EW Purchase	Sample	
	PC	TV
<u>Consumer Characteristics</u>		
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)
<u>Product Characteristics</u>		
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)
<u>Fixed Effects</u>		
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.