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Individual Risk Preferences and Better Car Replacement

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Abstract

We conduct a survey to examine the impact of individual risk preferences on better car replacement decision in the insurance market. The survey consists of a lottery choice task and an insurance questionnaire. Our results strongly support contentions that consumers are significantly influenced by their risk attitudes and the insurance premium. Further, we find that female consumers are more influenced by their degree of risk aversion than male consumers when making such insurance decision. Moreover, our results show that when the level of risk aversion is controlled, the individual risk preferences have different magnitudes of impact on insurance decision making.

JEL Classifications: C91, G22

Keywords: better car replacement, individual risk preferences, insurance premium, purchasing decision, risk aversion, risk attitudes

1. Introduction

Most insurance companies nowadays are pretty good at providing coverages on automobiles. In a push to attract more customers, one auto insurer, Liberty Mutual, is currently offering "Better Car Replacement [TM]" to raise car replacement a notch. This coverage is expected to exceed the standard

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new car replacement coverage[1] and loan/lease gap insurance coverage[2] offered in the current auto insurance market.

Liberty Mutual specifies that if you have this exclusive "Better Car Replacement ™" coverage and if your car is totaled in an accident, it will not only replace car but give you the money for a car that is one model year newer with 15K fewer miles on it than your current car. Imagine you have a 2007 vehicle with 35K miles on it. If and only if, you are involved in a total loss accident, under this coverage Liberty Mutual will replace it with a 2008 model with 20K miles on it. Your new car has to be in the same class and trim type as the car you wrecked.

This coverage does have lists of conditions.[3] More importantly, this coverage is not free. The extra cost consumers need to pay is layered into the existing policy that is believed to be determined by driver's demographic information, driving record, and the other actuarial factors. But it has been noted that a policy with such coverage could climb by anywhere from 5 to 40 percent.[4]

The introduction of "Better Car Replacement ™" coverage has gotten huge attention among insurance professionals and consumers alike. However, there is little or no literature so far studying consumers' decision making associated with the better car replacement coverage. When individuals make decisions whether to have this optional coverage, it is essential and critical to understand what factors may drive their decisions. As pointed out by Cohen and Einav (2007), it is important to know the degree of risk aversion when analyzing decisions under uncertainty, as risk aversion is the primary reason for the existence of insurance markets.

In this paper, by using a survey we address how individual risk preferences may affect individual purchasing decision to have the better car replacement. The survey consists of a lottery choice task and an insurance questionnaire. The lottery pair design is used in the task to infer individual risk attitudes and the questionnaire focusing on the better car replacement is used to analyze preferences of individuals for such coverage while observing the surcharge on their premiums.

The statistical specification in this paper involves the joint estimation of risk attitudes and better car replacement coverage decisions. We consider models that allow for both observable individual characteristics and structural errors. The estimates show that age and smoking behavior have significant effects when referring individual risk attitudes. To test the hypotheses of the impact of risk preferences on better car replacement purchases, we examine the data obtained from the survey and find that the individual degree of risk aversion and the price of insurance have significant impacts on the decision making. More interestingly, our results reveal that subjects with a relatively lower degree of risk aversion behave more like risk-neutral agents when making their purchasing decisions. Their degree of risk aversion does not necessarily contribute to their insurance coverage decisions.

Our study is unique in two ways. First, previous studies use insurance decisions to infer the utility function and the risk preferences (e.g., Cicchetti & Dubin, 1994; Halek & Eisenhauer, 2001).

[1] Three insurance companies are offering new car replacement policy: Liberty Mutual, Allstate and Travelers. For example, Liberty Mutual provides this coverage on all auto policies with collision and comprehensive insurance. Allstate's coverage applies only to new vehicles within their first three years. Travelers' coverage pays only to replace your car with a new vehicle of the same make and model during the first five years.

[2] Gap insurance pays the difference between the actual depreciated value of the car and the amount of money you owe on it.

[3] To collect the new wheels, Liberty Mutual has to declare your car a total loss; the original claim must come under collision or comprehensive coverage; you still have to pay the deductible under whichever policy option applies; you cannot get it for leased vehicles or motorcycles; and it is not offered in North Carolina.

[4] See Consumerreports.com.

This method fails to consider individual heterogeneity in the risk preferences and is unable to use such preference heterogeneity to explain the patterns of insurance coverage in the insurance markets. In our paper, to elicit risk preferences, our survey used the lottery pair experimental design of Hey and Orme (1994). The big advantage of this design over the others is that the task is relatively simple and context free. To estimate risk attitudes, our approach involves direct estimation by maximum likelihood of the structural model of a latent choice process in which the core parameters defining risk attitudes can be estimated.

Second, instead of using a probit model over the entire sample alone to investigate the impact of risk preferences on insurance coverage purchases (e.g., Schlesinger, 1981; Cutler, Finkelstein & McGarry, 2008; Barseghyan, Prince, & Teitelbaum, 2011), we adopt a conditional probit model in which the level of risk aversion is controlled. Two subsamples are drawn by the centile of risk aversions (e.g., below the 50^{th} percentile and above the 50^{th} percentile). Such settings allow us to disentangle the impact of risk preferences from other factors that may affect the decisions and observe the different magnitude of impacts when the level of risk aversion is controlled.

Section 2 reviews the prior literature on insurance decision making. Section 3 proposes testable hypotheses. Section 4 illustrates our survey design and methodology. Section 5 performs econometric analysis. Section 6 draws general conclusions.

2. Literature Review

There is a vast literature on insurance decision. Factors that influence insurance purchases have been the focus of insurance research for many years Schlesinger (1981) examines the choice of an insurance contract when insurance is of the deductible type. The optimal choice discussed in the paper is shown to be directly related to the insured's degree of risk aversion. Cicchetti and Dubin (1994) study residential customers' choice behavior related to the insurance against the risk of telephone line trouble in the home. By determining the shape of the utility function and the degree of risk aversion, they conclude that risk aversion varies systematically and that the decision making is in line with the expected utility maximization.

De Meza and Webb (2001) assume that individuals are exposed to exogenously determined risk. They find that risk-tolerant individuals are more likely to be disinclined to insure though they participate in the insurance market due to the low premiums created by the presence of more risk averse types. Halek and Eisenhauer (2001) collect life insurance data to estimate the degree of risk aversion for each of nearly 2400 households and examine attitudinal differences toward pure risk across demographic subgroups. Cutler *et al*. (2008) present empirical evidence in five different insurance markets[5] and suggest that preference heterogeneity may be essential in explaining the differential patterns of coverage in the insurance markets.

By using a unique data set, Barseghyan *et al*. (2011) demonstrate that households' deductible choices in auto and home insurance reflect their stable risk preferences. The results show that household possibly exhibit higher degree of risk aversion in their home deductible choices than their auto deductible choices. Barseghyan, Molinari, O'Donoghue and Teitelbaum (2013) estimate a structure model of risky choice that incorporates "standard" risk aversion and probability distortions by using data on insurance deductible choices. Their results illustrate the importance of the probability distortions in explaining the aversion to risk manifested in deductible choices.

Previous studies have looked at risk aversion that might be significant in explaining the demand for insurance. However, they are unable to point out how risk aversion predominantly influences

[5] Five insurance markets: life insurance, health insurance, annuities, long-term care insurance, and Medigap.

consumer's purchasing behavior in specific environments. In this paper, we examine not only the general impact of risk aversion on insurance purchases but also its different magnitudes on genders. Besides, we also look into groups of individuals with different level of risk aversion and analyze their purchasing behavior in the insurance market.

3. Hypotheses

As explained above, this paper postulates that individual risk preferences and the change of insurance premium will affect purchasing decisions of better car replacement coverage. We thus formulate the following hypotheses.

H1. Subjects with higher degree of risk aversion will be more likely to purchase better car replacement coverage.

It is suggested by most literature that individuals with higher degree of risk aversion will purchase more insurance (Schlesinger, 1981; Halek & Eisenhauer, 2001; Cutler *et al*., 2008). With better car replacement, the insured expects to be restored to a better financial condition after loss occurs. Thus, more risk-averse subjects are expected to be more likely to have this optional coverage. However, as pointed out by Barseghyan *et al*. (2011 & 2013), because of the probability distortion among the insureds, they may exhibit less risk aversion when making auto insurance decision. If this is the case, it is possible that their risk preferences may not contribute much to the insurance purchasing decisions.

H2. Subjects will be less likely to purchase better car replacement coverage when the insurance premium is higher regardless of their risk preferences.

Pricing is a major factor in most purchases. Prior studies examine whether consumers are sensitive to premium level when making insurance purchases. Their findings show that consumer demand is negatively related to the price of insurance. Browne and Kim (1993), for example, discover a negative relationship between life insurance demand and expected prices. In this paper, we investigate whether observing premium surcharge will altered the process of evaluation of the better car replacement. We believe that when premiums are relatively higher individuals with different level of risk attitudes will all have less incentive to purchase better car replacement.

4. Survey

4.1. Survey Description

A total of 130 subjects were invited from the College of Business at Shippensburg University to participate in the experiment. Each subject was asked to respond to two tasks, including a lottery choice task and an insurance questionnaire.

To elicit and estimate risk preferences, this survey used a random lottery pair experimental design of Hey and Orme (1994). The task in this design is relatively simple and context free compared to others. Lotteries are presented to the subjects in color on paper and the information on the probabilities of each pie slice is included. Figure 1 demonstrates an example of such lottery pair. Subjects were instructed to complete all 5 lottery choices.

To elicit individual preferences over better car replacement, insurance decisions were framed in a less abstract context. Subjects were introduced to this coverage and their general preferences were

examined. Further, by varying the premium surcharge,[6] we were able to observe how the price of better car replacement affects subjects' purchasing decisions.

In addition, subjects were asked to provide demographic information regarding their age, gender, and race. Information about their smoking behavior and current auto insurance coverage were also collected.[7]

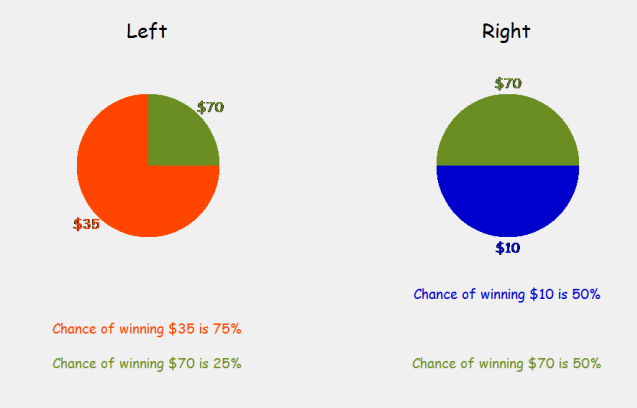

Figure 1. Example of lottery choice task

4.2. Econometrics

To estimate risk attitudes, we use a more preferable approach which involves direct estimation by maximum likelihood of a structural model of latent choice process (Camerer & Ho, 1994). This approach is outlines as follows.

Assume that utility function is defined by

$$U(\chi) = \frac{(\omega+\chi)^{(1-\gamma)}}{1-\gamma} \tag{1}$$

where ω is some measure of background consumption, χ is the lottery prize in the risk preference tasks, and $\gamma \neq 1$ is the parameter to be estimated. For $\gamma = 1$, assume $U(x) = \ln(w + x)$ if needed. Thus, γ is the coefficient of CRRA: $\gamma = 0$ corresponds to being risk neutral, $\gamma < 0$ to being risk loving, and $\gamma > 0$ to being risk averse. Let there be k possible outcomes (e.g. k=2) in the lottery. Under EUT the probabilities for each outcome k, p_k , are those induced in the task, and the expected utility is the probability-weighted utility of each outcome in each lottery i,

$$EU_i = \sum_{k=1,\ldots,4}(p_k \times U_k). \tag{2}$$

The expected utility for each lottery pair is calculated for a candidate estimate of γ and the index

$$\nabla EU = EU_R - EU_L \tag{3}$$

[6] Premium in our survey was intentionally increased from 25% to 40% with better car replacement as optional coverage.

[7] Subjects reported in the survey whether they carry collision coverage on their own vehicles.

is calculated, where EUL is the "left" lottery and EUR is the "right" lottery in the risk preference tasks. This latent index, based on latent preferences, is then linked to the observed choices using a standard cumulative normal distribution function Φ(.), as[8]

$$prob(lottery_R) = \Phi(\nabla \text{EU}) \quad (4)$$

An important extension of this core model is to allow for subjects to make errors (e.g., mistakes due to carelessness and inattentiveness). The notion of error here is the probability of choosing a lottery that is not one when the EU of that lottery exceeds the EU of the other. One important error specification, popularized by Hey and Orme (1994), posits the latent index as

$$\nabla EU = \frac{(EU_R - EU_L)}{\mu} \quad (5)$$

instead of equation (3) where μ is a structural "noise parameter" used to allow errors from the perspective of the deterministic EUT model.

Hence, the likelihood of the observed choice, conditional on EUT and the specified utility function, depends on the estimates of γ and μ given the above statistical specifications and observed choices. The conditional log-likelihood would be

$$\ln L^{RA}(\gamma, \mu, \omega, \chi) = \sum_i \left(\left(\ln \phi(\nabla EU) | y_i = 1\right)\right) + \left(\ln \phi\left(1 - (\nabla EU)\right) | y_i = 0\right)\right) \quad (6)$$

where $y_i = 1$ (or 0) denotes the choice of the option "right" (or "left") lottery in risk preference task i and χ represents a vector of individual characteristics reflecting age, sex, race, and so on.

In addition, the dependent variable used in the main probit model to examine the effects of individual risk preferences on better car replacement was measured by a dichotomous variable *choice*. Each *choice* was categorized as either a decision to have better car replacement coverage or not. Variable, *prem_rate*, was used to capture the different magnitudes of increase in the insurance premium surcharge. A list of demographic information such as *age*, *gender*, *race*, and *smoking* was also considered in the analysis.

5. Results

Table 1 presents the maximum likelihood estimates for the risk attitudes. In the model, we allow risk attitude, γ, to be linear functions of the observable characteristics of individuals. Binary indicators are included for gender, race,[9] smoke and collisions.

Smoking behavior is commonly used in the behavioral economics to access the individual's willingness to take risks (Dohmen *et al*., 2011). Our results show that non-smokers are significantly more risk averse than smoker which is consistent with prior literature. Age in our sample has significantly negative effects on the degree of risk aversion. The majority of our subjects were between 19 and 22 years old (80%). We believe that these younger drivers are more risk averse due to their lack of driving experience as more than 76% of them purchased optional collision coverage on their vehicles.

[8] A logit specification can also be applied.

[9] In our sample, more than 90% of subjects were white.

Table 1. Estimates of risk aversion of the EUT model allowing heterogeneity

Parameter	Estimate	Standard Error	p-Value	95% Conf. Interval	
age	-0.0949	0.0290843	0.001	-0.151882	-0.037874
gender	0.56652	0.6188334	0.36	-0.646369	1.779414
race	0.03771	0.1181827	0.75	-0.193928	0.26934
smoke	-0.1958	0.1167556	0.093	-0.424678	0.032995
collision	0.09992	0.1640684	0.543	-0.221652	0.421485
constant	2.11845	0.6378275	0.001	0.868332	3.36857

Table 2 captures the significant impacts of individual risk preferences and premium surcharge on better car replacement purchasing decision. In Column 1 we present the general probit model with full set of samples. The variable *risk_aversion* is significant at the 5% level in the model. Examining the results from this model, we find support for H1, suggesting that more risk averse individuals are more likely to purchase better car replacement coverage. Meanwhile, variable *prem_rate* is highly significant at the 1% level. This supports H2 set forth above concerning the negative impact of premium increase on the insurance decision-making process.

In addition, to investigate the impacts of risk preferences and premium increase on different genders, we test two alternative models (Column 2 and Column 3 in Table 2) by only using either female or male subjects. Our results suggest that female subjects are more influenced by their degree of risk aversion and the insurance premium surcharge when making purchasing decision compared to male subjects. It seems that male subjects' decisions are more driven by the price change rather than by their risk attitudes. This interesting finding may help insurance companies selling better car replacement coverage to target specific group of consumers through market segmentation.

Table 2. Probit models

	(1)	(2)	(3)
VARIABLES	Model 1 (Full Sample)	Model 2 (Female)	Model 3 (Male)
risk_aversion	3.297**	5.120**	0.435
	(1.581)	(2.326)	(1.280)
prem_rate	-5.884***	-8.141***	-4.801***
	(0.965)	(1.867)	(1.150)
age	0.313**	0.444**	0.0693
	(0.158)	(0.225)	(0.144)
gender	-1.989**		
	(0.945)		
race	0.172	0.0400	0.276
	(0.258)	(0.586)	(0.314)
constant	-5.924	-11.43*	-0.483
	(3.696)	(6.541)	(3.344)
Observations	260	94	166

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Furthermore, we also test whether risk preferences and premium change have the same magnitude of effects among subjects with different degree of risk aversion. That is, when the level of risk aversion is controlled, whether such significant impacts of risk aversion and premium change on better car replacement coverage are still observable. More specifically, two subsamples are defined by centile of risk aversion over all samples. Model 4 and 5 of Table 3 includes observations with a degree of risk aversion below the 50th percentile and above the 50th percentile, respectively. Note that for less risk averse subjects, their risk attitudes does not contribute to their purchasing decisions. On the other hand, the risk preferences of those with a higher degree of risk aversion significantly affect their decision ($p<0.01$ in Model 5 of Table 3). This finding is in line with the threshold argument discussed in Liu (2015) that more risk averse individuals will be more likely to buy more coverage if their degree of risk aversion is above a given threshold. Individuals with low degree of risk aversion behavior more like risk natural and their risk preferences have no significant impact on their purchasing decisions. As shown in both Model 3 and Model 4, premium increase has significantly negative influence among all subjects regardless of their risk preferences.

Table 3. Conditional models

	(1)	(2)
VARIABLES	Model 4 (γ below the 50th percentile)	Model 5 (γ above the 50th percentile)
risk aversion	-1.374	0.590***
	(1.278)	(0.305)
prem_rate	-6.684***	-5.210***
	(1.563)	(1.223)
age	-0.117	0.0229
	(0.105)	(0.150)
race	0.362	-0.0159
	(0.342)	(0.467)
constant	4.265*	0.926
	(2.547)	(3.191)
Observations	116	144

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

6. Conclusion

The purpose of this paper is to examine the impact of individual risk preferences on better car replacement coverage purchasing decision. Our results strongly support contentions that consumers are significantly influenced in their decisions by their risk preferences and the insurance premium.

Interestingly, we find that female consumers are more influenced by their degree of risk aversion and the premium change when making insurance decision compared to male consumers. Female consumers' decisions to have better car replacement coverage are more driven by their individual risk preferences and the premium surcharge they observe from the market. Further, when the level of risk aversion is controlled, individual risk preferences have different magnitudes of impacts on consumers' purchasing decisions. Individuals with lower degree of risk aversion behavior like risk neutral agents and their risk preferences do not contribute much to their insurance purchasing decisions.

This paper's main implication is related to the influence of individual risk preferences on insurance buyers' decision making. With more and more insurance companies promote better car replacement coverage to exceed other standard auto coverage in the market, our findings imply that a specific segment of consumers may be targeted in promoting better car replacement and that for consumers whose purchasing decisions are less driven by their risk attitudes, additional incentives may be considered.

Finally, this paper also points to future research avenues. Like other survey study, self-selection bias may exist due to the fact that it is relatively hard to have our subjects to represent the population of all consumers in the insurance market. Future research may examine the impacts in a real market environmental setting. Next, our survey only focuses on one specific insurance product. Future studies may use a variety of insurance products to verify and generalize the findings in our paper.

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