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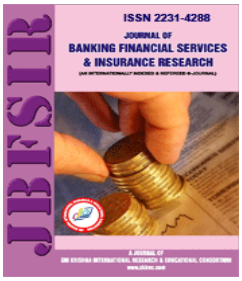

TESTING FOR THE RISK PERCEPTION AND ASYMMETRIC INFORMATION IN TAIWAN'S AUTO INSURANCE MARKET

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ABSTRACT

Using a unique set of data on holders of automobile liability insurance issued by a large insurance firm based in Taiwan, this paper examines whether there is asymmetric information in the automobile insurance market. The task is particularly done by classifying policyholders either as beginners or experienced drivers based on their driving experience and analyzing the conditional coverage-claim correlation involving these two groups. According to the bivariate probit regressions and the two stages probit regressions, the empirical results suggest that, supporting only the experienced drivers, their choice of a higher insurance coverage is associated with more accident claims. However, results do not provide evidence of a positive correlation between the choice of insurance coverage and the occurrence of a claim in a subsample composed of beginner drivers. This paper provides strong and robust evidence that a policyholder who perceives more risk could be more knowledgeable about his choice of insurance coverage.

KEYWORDS: *automobile liability insurance, asymmetric information, beginners, experienced drivers.*

INTRODUCTION

Since the seminal work by Rothschild and Stiglitz (1976), and Shavell (1979), exploring the problems of asymmetric information has become a major issue in the insurance literature. Two types of asymmetric information could exist in the insurance market: adverse selection and moral hazard. If the adverse selection problem exists in the insurance market, as

predicted by the model by Rothschild and Stiglitz (1976), policyholders with high frequency risk choose insurance contracts with a relatively higher level of coverage. On the other hand, according to Shavell (1979), moral hazard refers to the tendency of insurance protection to alter the motivation of a policyholder to prevent loss. As such, policyholders with a higher coverage may have less incentive to avoid an accident. Thus, adverse selection and moral hazard both imply that a positive correlation exists between the choice of coverage and the occurrence of a claim.

In the past two decades, empirical studies had repeatedly proposed the need to examine the presence of asymmetric information in various insurance markets by testing the relationship between the choice of coverage and the occurrence of a claim. Their results are mixed, however. Some papers[1] find no evidence of asymmetric information in the insurance market, but others[2] do.

The purpose of this paper is to reexamine whether the problem of asymmetric information exists in the insurance market. However, contrary to prior research, this study focuses on the relationship between the risk perception (driving experience) of a policyholder and asymmetric information problems. Although Chiappori and Salanie (2000), and Cohen (2005) employ the years of possessing a driver's license as determinant of driving experience, to the knowledge of the authors of this paper, years of possession of a driver's license cannot represent "actual driving experience." This is because some people, even after obtaining their licenses, still do not drive. This study thus uses the age of a driver and the age of his insured car as proxy for driving experience. Therefore, this study categorizes policyholders into beginners and experienced drivers based on their "actual driving experience." This study also analyzes the conditional correlation between insurance coverage and accident claims in 2007 for these two groups.

In Taiwan, automobile insurance is operated through compulsory insurance and voluntary insurance. Customers can opt for different types of insurance coverage for automobile and liability protection. Four main types of insurance policies are sold in Taiwan's automobile insurance market: automobile damage insurance, automobile theft insurance, voluntary third-party liability insurance, and compulsory liability insurance. Automobile damage insurance and theft insurance, which are purchased voluntarily, provide coverage protection for property damage and vehicle theft. However, most policyholders purchase automobile damage insurance for new cars only; few people purchase it in subsequent years. This "short-term nature" of automobile damage insurance presents difficulties in observing asymmetric information on insured car owners with older vehicles. Meanwhile, compulsory liability insurance offers the most basic protection for bodily injury. Voluntary automobile third-party liability insurance, which provides supplementary liability coverage protection for bodily injury and property damage, is the most frequently purchased type of insurance year after year. In the present paper, we focus on the analysis of automobile third-party liability insurance.

[1] Cawley and Philipson (1999); Chiappori and Salanie (2000); Dionne et al. (2001); Saito (2006).

[2] Browne (1992); Browne and Doerpinghaus (1993); Puelz and Snow (1994); Dionne and Gagne (2002); Fong (2002); Finkelstein and Poterba (2004); Finkelstein and McGarry (2006); Li et al. (2007); Wang et al. (2008); and Kim et al. (2009).

This study uses a unique set of data on holders of automobile third-party liability insurance issued by a large insurance firm based in Taiwan. The data cover the period January 2007 to December 2007 and employ two methodologies commonly used to test asymmetric information: those by Chiappori and Salanie (2000), and Dionne et al. (2001). Using both empirical models, this study finds that policyholders with more driving experience and who choose higher insurance coverage file more accident claims; however, this study finds no evidence of a positive correlation between the choice of coverage and the occurrence of a claim among beginner drivers. This paper compliments the literature that supports the theory of asymmetric information, as it finds that when policyholders have advantageous private risk information, they could be more knowledgeable about their choice of coverage protection.

The remainder of this article is organized as follows. In Section 2, we introduce our data set and propose empirical procedures. The estimation results are reported in Section 3, and Section 4 concludes the paper.

II. DATA AND METHODOLOGY

The data set is obtained from a large property and casualty insurance company in Taiwan. The data set includes information about 114,732 voluntary third-party liability insurance policyholders who joined the insurer during from January 1, 2007 to December 31, 2007. It includes all the information that the insurer has about each contract. Thus, these data covers not only the choice of coverage and claim records, but also the information of policyholders and the insured cars. Therefore, the data consists of all the observable variables that the studied insurer offered for each contract, including the coverage choice, claim records, age, sex, car age, size, car value, the urban area, the car brand, and the region, which permits us to control potential deceptiveness in the conditional correlation between insurance coverage and accident claims. The definitions of the variables are shown in Table 1.

TABLE 1 THE DEFINITION OF VARIABLES

Variables	Definition
coverage	a dummy variable equals 1 if the policyholder i purchases bodily injury liability insurance in an amount equal to or larger than NTD:2,000,000 and property damage liability insurance in an amount equal or larger than NTD:500,000 in 2007 policy year; 0 otherwise
claim	a dummy variable equals 1 if the policyholder i makes at least one accident claim in 2007policy year; 0 otherwise
age	the age of policyholder
sex	a dummy variable equals 1 if the policyholder i is a female; 0 otherwise
car age	the age of the insured car

car usage	a dummy variable equals 1 if the policyholder i specifies the primary use of the insured car as for family use, 0 otherwise (i.e., commercial use)
urban	a dummy variable equals 1 if the policyholder i lives in the city,0 otherwise
car size	(reference group = the engine capacity less than 1500cc)
car size (1)	a dummy variable equals 1 if the insured car is of engine capacity from 1,501 cc to 2,000 cc; 0 otherwise
car size (2)	a dummy variable equals 1 if the insured car is of engine capacity larger than 2,000 cc; 0 otherwise
carvalue (1)	a dummy variable equal to 1 if the insured car is between the values NT$500,000 and NT$800,000; 0 otherwise
carvalue (2)	a dummy variable equal to 1 if the insured car is between the values NT$800,001 and NT$1,200,000; 0 otherwise
carvalue (3)	a dummy variable equal to 1 if the value of the insured car is more than NT$1,200,000; 0 otherwise
brand	(reference group = other than six major car brands in Taiwan)
brand_t	a dummy variable equals 1 if the insured car is made by Toyota; 0 otherwise
brand_n	a dummy variable equals 1 if the insured car is made by Nissan;, 0 otherwise
brand_m	a dummy variable equals 1 if the insured car is made by Mitsubishi; 0 otherwise
brand_f	a dummy variable equals 1 if the insured car is made by Ford; 0 otherwise
brand_a	a dummy variable equals 1 if the insured car is made by Mazda; 0 otherwise
brand_h	a dummy variable equals 1 if the insured car is made by Honda; 0 otherwise
region	(reference group = if the insured car is registered in the North of Taiwan)
region_m	a dummy variable equals 1 if the insured car is registered in the

	Midst of Taiwan; 0 otherwise
region_s	a dummy variable equals1 if the insured car is registered in the South of Taiwan; 0 otherwise
region_e	a dummy variable equals 1 if the insured car is registered in the East of Taiwan; 0 otherwise

Samples for this study are divided into "beginners" and "experienced drivers" because risk perception could be different between these two groups. If policyholders have more driving experience, then they may have more risk information and may be able to evaluate the choice of coverage for their insurance purchase. On the other hand, drivers with less driving experience may have less knowledge about their choice of insurance coverage. Although prior research employs the years of possession of a driver's license as determinant of driving experience, this study does not use the same determinant. Instead, this study uses the age of a driver and the age of an insured car as the proxy for driving experience. If the policyholder is younger than 30 years old and the age of the insured car is less than three years, then the policyholder is categorized as a beginner. If the age of the insured car is more than three years, then the policyholder is categorized as an experienced driver. However, for the policyholders who is older than 30 years old and the age of the insured car is less than three years, we cannot determine that they should be belonged to beginners or experienced drivers, thus, we exclude this group policies (n=47,319). This category suggests that beginners are those who have less than three years of driving experience, whereas experienced drivers are those who have at least three years of driving experience. Using these two categories, this study obtains 67,413 (114,732 - 47,319) automobile liability insurance contracts in 2007 and reviews 4,470 contracts of beginners and 62,943 contracts of experienced drivers. The descriptive statistics of the variables are displayed in Table 2.

Our testing procedure starts to test whether asymmetric information exists in the insurance market, most researchers examined the conditional correlation between insurance coverage and accident claims, suggesting that asymmetric information introduce a positive coverage-claims correlation. Therefore, our testing procedure examined whether the correlation between the choice of coverage and the occurrence of a claim is significantly positive.

With regard to the choice of coverage, the automobile liability insurance provides a single fixed coverage amount for the sufferer's bodily injury and property damage protection. Specifically, six different amount levels are included for the offer for bodily injury coverage: 0.5, 1, 1.5, 2, 2.5, and 3 million in N.T. dollars. For property damage protection, six different levels of coverage were available: 0.1, 0.2, 0.3, 0.4, 0.5, and 1 million in N.T. dollars. Policyholders can choose any combination for their coverage choice. Table 3 summarizes the number of policyholders who selected five common coverage combinations in 2007. The first option, combination A, referred to herein as "basic," offered a "basic" coverage protection and a "basic" premium (NTD: 2,464). The other four combination contracts included in the menu offered to potential customers were: combination B, which supplies a medium defense, coming with a premium equal to on average 1.14 times the basic premium; combination C, which also provides a medium defense, coming with a premium equal to on average 1.10

times the basic premium; combination D, which offers a medium high shield, coming with a premium equal to on average 1.24 times the basic premium; and combination E, which provides the largest coverage protection, coming with a premium equal to on average 1.33 times the basic premium. In our sample of 67,413 policyholders, the five coverage combinations account for 48.91 percent; approximately 5.11 percent of the policyholders choose combination A, followed by 0.85 percent, 5.69 percent, 7.79 percent, and 29.47 percent respectively, for the remaining four combinations.

TABLE 2 DESCRIPTIVE STATISTICS

Variables	Total samples	Beginner drivers	Experienced drivers
	Mean	Mean	Mean
coverage	0.3915	0.5157	0.3827
	(0.4881)	(0.4998)	(0.4860)
claim	0.0526	0.0604	0.0520
	(0.2232)	(0.2383)	(0.2221)
age	43.8050	27.8711	44.9365
	(10.5912)	(2.1343)	(10.0252)
sex	0.4471	0.4376	0.4478
	(0.4972)	(0.4961)	(0.4973)
car age	6.9782	2.1787	7.3190
	(3.3444)	(0.7252)	(3.1922)
car usage	0.8465	0.8201	0.8484
	(0.3604)	(0.3841)	(0.3586)
urban	0.2309	0.2081	0.2326
	(0.4214)	(0.4060)	(0.4225)
car size (1)	0.4970	0.5072	0.4963
	(0.5000)	(0.5000)	(0.5000)
car size (2)	0.3471	0.3145	0.3494
	(0.4760)	(0.4644)	(0.4768)

carvalue (1)	0.5693	0.5980	0.5672
	(0.4952)	(0.4904)	(0.4955)
carvalue (2)	0.1607	0.1568	0.1610
	(0.3672)	(0.3637)	(0.3675)
carvalue (3)	0.0408	0.0092	0.0431
	(0.1979)	(0.0953)	(0.2030)
brand_t	0.1138	0.0293	0.1198
	(0.3175)	(0.1687)	(0.3247)
brand_n	0.3746	0.5016	0.3656
	(0.4840)	(0.5001)	(0.4816)
brand_m	0.2982	0.3456	0.2949
	(0.4575)	(0.4756)	(0.4560)
brand_f	0.0712	0.0345	0.0738
	(0.2572)	(0.1824)	(0.2615)
brand_a	0.124	0.0157	0.0122
	(0.1106)	(0.1242)	(0.1096)
brand_h	0.0058	0.0134	0.0052
	(0.0758)	(0.1151)	(0.0722)
region_m	0.3571	0.3926	0.3546
	(0.4792)	(0.4884)	(0.4784)
region_s	0.1547	0.1237	0.1569
	(0.3616)	(0.3293)	(0.3637)
region_e	0.0215	0.0154	0.0219
	(0.1449)	(0.1233)	(0.1463)
observations	67,413	4,470	62,943

Standard deviations are in parentheses

Although five combination contracts serve as the criteria for coverage choice, theoretically, it is easy to understand that adopting the strictest approach may obtain a convincing result. Combination E fits the mode, and the highest protection; thus we selected it as the partition to differentiate policyholders' coverage choice: If a policyholder purchases an insurance amount of bodily injury liability equal to or larger than NTD: 2,000,000 and property damage liability equal or larger than NTD: 500,000, he/she will be regarded as someone with high coverage protection; meanwhile, all others will be judged as having low coverage protection.

TABLE 3 THE LAYER OF COVERAGE CHOICE AND THE NUMBER OF POLICYHOLDERS

Coverage Combination	Bodily injury	Property damage	Degree of Protection	N	Under N	Above N
A	1M	0.3M	low	3,445 (5.11%)	15,230 (22.59%)	52,183 (77.41%)
B	1M	0.5M	medium	572 (0.85%)	34,316 (50.90%)	33,097 (49.10%)
C	1.5M	0.3M	medium	3,834 (5.69%)	23,763 (35.25%)	43,650 (64.75%)
D	1.5M	0.5M	medium high	5,251 (7.79%)	35,351 (52.44%)	32,062 (47.56%)
E	2M	0.5M	high	19,866 (29.47%)	41,020 (60.85%)	26,393 (39.15%)

Notes: The total number of policyholders in the sample is 67,413. N represents the number of policyholders for each coverage combination. Under N represents the number of policyholders who chose their coverage under each combination. Above N represents the number of policyholders who selected their coverage above each combination, including the number of policyholders who chose each coverage combination.

To assess the evidence of a conditional positive correlation between insurance coverage and accident claims, we define the choice of coverage and the occurrence of a claim in two ways: First, the binary variable for the choice of coverage was stated as follows: If the policyholder i purchases bodily injury liability insurance in an amount equal to or larger than NTD 2,000,000 and property damage liability insurance in an amount equal or larger than NTD 500,000, then coverage is coded as 1; otherwise, it is coded as 0. The other binary

variable expresses the occurrence of a claim as follows: If the policyholder i has filed at least one accident claim in a policy year, then claim is coded as 1; otherwise, it is coded as 0. We then follow Chiappori and Salanie's (2000) approach and run a bivariate probit regression to obtain two error terms, namely, ε_i and η_i, where ε_i and η_i jointly have a bivariate normal distribution with zero means, unit variances, and a correlation coefficient ρ. For the independent variables of the bivariate probit model, we employ certain variables (X_i) observed by the insurer, including the policyholder's age, sex, car age, size, the urban area, the car brand, and the region. In this model, ρ measures the correlation between the insurance coverage and the accident claims after the influence variables are accounted for. We then test its significance under the null hypothesis of $\rho = 0$ in 2007 for beginner and experienced drivers.

We also regress the two-stage probit regressions proposed by Dionne et al. (2001) to test the existence of asymmetric information problems, we estimate the choice of coverage by probit regression in the first stage.

$$Prob(\text{cov}\,erage = 1 | X_i) = \Phi(X_i \gamma) \qquad (1)$$

Where X_i is the initial exogenous variables, γ is the vector of regression coefficients, and Φ is the density and cumulative distribution function of N(0,1).

In the second stage, we regress the occurrence of claim filing by the following probit regression:

$$Prob(claim = 1) = \Phi(\text{cov}\,erage\,\beta_1 + E(\text{cov}\,erage)\beta_2 + X_i \gamma) \qquad (2)$$

Where E(coverage) is the estimator from the first stage model. We add the estimated expected choice of marketing channel $E(\text{cov}\,erage)$ into Equation (2) to take into account the nonlinear effects and test the coverage-claim correlation. We expect coefficient β_1 to be positive, which means that choosing higher insurance coverage are associated with more accident claims.

III. ESTIMATION OF RESULTS

We first ran the bivariate probit regressions for beginner and experienced drivers in 2007. The results are provided in Table 4. For beginner drivers, the correlation between the error terms ρ has a positive value of 0.0208, which is not statistically significant. This result is consistent with the findings of Chiappori and Salanie (2000) and Cohen (2005), who discovered the nonexistence of a statistically significant positive coverage-claim correlation for the subsample of policyholders with less than three years of driving experience. We present the major test results from the subsample estimation to demonstrate that insureds with less than three years of driving experience are unable to obtain private risk information.

However, for experienced drivers, the correlation coefficient between the error terms ρ has a significant positive value of 0.0335 in 2007. This finding makes it possible to reject the independence of the insurance coverage and accident claims for this group. This result is

consistent with the findings of Cohen (2005), who determined the existence of a statistically significant positive coverage-claim correlation for the subsample of policyholders with more than three years of driving experience. We present the major test results from the subsample estimation to show that policyholders with more than three years of driving experience understand their private risk perception.

TABLE 4 THE CONDITIONAL CORRELATION BETWEEN COVERAGE AND HAVING A CLAIM

	Beginner drivers		Experienced drivers	
Variable	Dependent variable : coverage			
	Coefficient	p-value	coefficient	p-value
Intercept	-0.2910***	0.0042	0.3528***	<.0001
sex	-0.0512***	0.0006	-0.0470***	<.0001
age	0.0205***	<.0001	0.0013***	<.0001
car age	-0.0478***	<.0001	-0.0347***	<.0001
car usage	0.0873***	<.0001	0.0730***	<.0001
urban	0.0701***	<.0001	0.0043	0.3215
car size(1)	0.0415	0.1934	0.0363***	<.0001
car size(2)	0.1300***	0.0004	0.1081***	<.0001
car value(1)	0.1057***	0.0001	0.0400***	<.0001
car value(2)	0.1302***	0.0003	0.1043***	<.0001
car value(3)	0.4837***	<.0001	0.2420***	<.0001
brand_t	0.1059**	0.0412	0.0351***	<.0001
brand_n	0.0317	0.3398	0.0246***	0.0002
brand_m	0.1230***	0.0004	0.0309***	<.0001
brand_f	-0.1253**	0.0138	-0.0298***	0.0007
brand_a	0.1002	0.1297	0.0045	0.7971
brand_h	0.1781**	0.0109	0.0662**	0.0105

region_m	0.1483***	<.0001	0.1361***	<.0001
region_s	0.0742***	0.0014	0.0733***	<.0001
region_e	-0.2779***	<.0001	-0.1211***	<.0001

Dependent variable : having a claim

	coefficient	p-value	coefficient	p-value
intercept	0.0507	0.3146	-0.0063	0.2973
Sex	0.0074**	0.0246	0.0091***	<.0001
age	0.0017	0.8563	0.0013***	<.0001
car age	0.0050**	0.0447	-0.0017***	<.0001
car usage	0.0110	0.3081	0.0014	0.6226
urban	0.0089**	0.0367	0.0037*	0.0834
car size(1)	0.0159	0.9198	0.0021	0.5779
car size(2)	0.0182	0.8021	0.0041	0.3194
car value(1)	0.0137*	0.0963	0.0006	0.8560
car value(2)	0.0178	0.4063	0.0008	0.8511
car value(3)	0.0407*	0.0763	0.0114*	0.0512
brand_t	0.0258	0.4904	0.0094**	0.0111
brand_n	0.0165	0.9852	-0.0028	0.3845
brand_m	0.0174	0.7035	-0.0037	0.2602
brand_f	0.0254	0.2016	-0.0008	0.8467
brand_a	0.0329	0.8061	0.0001	0.9934
brand_h	0.0349	0.6005	0.0132	0.2920
region_m	0.0079	0.4676	0.0071***	0.0004
region_s	0.0115	0.5949	0.0032	0.2242
region_e	0.0293	0.2770	0.0183***	0.0028

ρ	**0.0208**	**0.0335*** **
observations	**4,470**	**62,943**

***,**, and * indicate significance at 1%, 5%, and 10% level respectively

The second test results from Equation (2) using two-stage probit regressions are shown in Table 5. The estimation results for beginners and experienced drivers are shown in Models 1 and 2, respectively. In Model 1, the estimated value for β_1 is 0.0895, suggesting that no significant positive correlation between the choice of coverage and the occurrence of a claim exists. This result is consistent with those of the bivariate probit regression. The next estimation results for Model 2 demonstrate that a positive coverage-claim correlation exists for the subsample of policyholders with more than three years of driving experience. The estimated coefficient for coverage is 0.1420, suggesting that the strong correlation is significant at the 1% level. Therefore, the estimation results indicate strong evidence of an information asymmetry for policyholders.

TABLE 5 PROBIT REGRESSION OF THIRD-PARTY LIABILITY INSURANCE ON HAVING A CLAIM

	Dependent Variable: Having a claim			
Variables	Model 1		Model 2	
	coefficient	p-value	Coefficient	p-value
intercept	-0.8798	0.3472	-2.0430***	<.0001
coverage	0.0895	0.1590	0.1420***	<.0001
E(coverage)	2.4861	0.3805	-0.4017	0.2842
sex	0.2711*	0.0851	0.0608**	0.0148
age	-0.0566	0.3456	0.0114***	<.0001
car age	0.0361	0.7972	-0.0245*	0.0643
car usage	-0.1208	0.6483	0.0309	0.4221
urban	-0.0303	0.8870	0.0357*	0.0729
car size(1)	-0.0801	0.6598	0.0334	0.3821
car size(2)	-0.3457	0.3838	0.0724	0.2040
car value(1)	-0.0789	0.8080	0.0152	0.6641

car value(2)	-0.2256	0.5818	0.0323	0.5632
car value(3)	-0.7712	0.5871	0.1524	0.1461
brand_t	-0.4656	0.2315	0.0968***	0.0088
brand_n	-0.0892	0.6010	-0.0188	0.5541
brand_m	-0.2698	0.4769	-0.0222	0.5075
brand_f	-0.0047	0.9911	-0.0160	0.7067
brand_a	-0.1970	0.6127	0.0012	0.9877
brand_h	-0.6279	0.2759	0.1371	0.2296
region_m	-0.3405	0.4257	0.1007*	0.0649
region_s	-0.1515	0.5144	0.0501	0.1802
region_e	0.9446	0.2366	0.1313*	0.0655
observations	4,470		62,943	
Log Likelihood	-2879.64		-12696.73	

***,**, and * indicate significance at 1%, 5%, and 10% level respectively; Model 1 represents the beginners; Model 2 represents the experienced drivers

To summarize, according to the methods suggested by Chiappori and Salanie (2000) and Dionne et al. (2001), a strongly positive and statistically significant correlation between the choice of coverage and the occurrence of claim filing is observed only in the subsample of experienced drivers. The results support the prediction that a policyholder with higher risk perception would be more knowledgeable about his/her coverage choice.

V. CONCLUDING REMARKS

Using a unique data set to examine whether asymmetric information exists in the automobile insurance market. This paper focuses on the issue of customer's risk perception and asymmetric information problems. By analyzing the conditional coverage-claim correlation between beginners and experienced drivers, the empirical results suggest that, supporting only the experienced drivers, their choice of a higher insurance coverage is associated with more accident claims. However, results do not provide evidence of a positive correlation between the choice of insurance coverage and the occurrence of a claim in a subsample composed of beginner drivers. Thus, this paper contributes to the recent literature arguing that who perceives more risk could be more knowledgeable about his choice of insurance coverage.

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