보험개발연구 제19권 제2호 2008년 7월

Testing for the Presence of Moral Hazard in the Automobile Insurance Market using the Mixed Proportional Hazard Model*

Mixed Proportional Hazard 모델을 사용한 자동차보험시장에서의 도덕적 해이에 대한 실증연구

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이용우

In this paper, with access to the Korean automobile insurance data set, I test for the presence of the moral hazard in the automobile insurance market. So far, most empirical research on asymmetric information in the automobile insurance markets have explored the conditional correlation approach. However, in this methodology, it is almost impossible to distinguish moral hazard and adverse selection separately. Given this circumstance, there have been some recent empirical tests using dynamic data sets to attempt the separation of two phenomena. Among them, I employ the mixed proportional hazard model based on Abbring, Chiappori, Heckman and Pinquet (2002) to distinguish the moral hazard phenomenon separately from adverse selection, controlling for unobserved heterogeneity. Different from the empirical result using the French data in Abbring, Chiappori, Heckman and Pinquet (2002), I have detected the existence of moral hazard in the Korean automobile insurance market. This would suggest that the market imperfections such as moral hazard are market-specific phenomenon.

※ Key Words: automobile insurance contract, mixed proportional hazard model, moral hazard, unobserved heterogeneity

학술진흥재단 분류 연구분야 코드 : B051605

* I thank Jaap Abbring, Vassilis Hajivassiliou, Hidehiko Ichimura, Sokbae Lee for valuable comments on this work. Also, I would like to thank anonymous referees who enable me to improve this paper. All remaining errors are mine.

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논문 투고일: 2008. 04. 06, 논문 게재 확정일: 2008. 07. 24

Ⅰ. Introduction

Since the seminal papers by Arrow (1963), Arrow (1965), Akerlof (1970) and Rothschild and Stiglitz (1976), the 'informational asymmetries' in various market contexts have been one of the main concerns in economics. Before these theoretical contributions exploring the (plausibly) catastrophic phenomenon, the general equilibrium theory was established quite solidly at the heart of the mainstream economics.

However, as Salanie (1998) points out, there are at least three major problems that challenged the general equilibrium theory: Firstly, each economic agent interacts between them, which is missing in the general equilibrium theory. Secondly, there are no appropriate considerations on the many established organizational institutions governing economic relationships. Finally, informational asymmetries are entirely neglected. Contract theory (economics of information, in general) has arisen naturally enough in response to these drawbacks in the general equilibrium theory[1].

Needless to say, the presence of informational asymmetries is not only a theoretical problem but also a fairly practical problem in the sense that it has affected individuals in society on the daily basis.

For instance, as individuals, we are more or less all dependent on the professional services – such as those medical and legal services provided, becoming more and more specialized[2]. This is a very similar situation to the 'lemon' problem analyzed by Akerlof (1970) since the buyers of these services are likely to have less information about the quality of services than

1) Stiglitz (2000) describes the contribution of economics of information as an intellectual revolution.
2) An interesting question would begin by analyzing how these agents have been trading in this market.

experts have. Also, as an employee, most individuals in industrialized societies are affected by many different kinds of financial and non-financial motivational mechanisms devised by firms in order to take account of informational asymmetries (for the comprehensive discussions, see Milgrom and Roberts (1992)).

Although most economists have been aware of, and cognizant of, the importance of the presence of informational asymmetries in economic activities and trades between agents, there has been relatively little empirical research on this problem; especially when compared with the rather flourishing field of theoretical research. This, it has been suggested, has been mainly due to the difficulties of obtaining the relevant data sets to develop the empirical work. With access to the Korean automobile insurance data set in this paper, I focus on empirical test for the presence of moral hazard in the automobile insurance market.

So far, most empirical research on automobile insurance markets has explored the 'conditional correlation' approach based on the predictions by Rothschild and Stiglitz (1976) and Shavelle (1979). As well presented in Chiappori (2000) and Chiappori and Salanie (2003), this method tests whether the choice of a contract is correlated with accident probability, controlling for observables (for instance, Chiappori and Salanie (1997), Chiappori and Salanie (2000), Dionne, Gourieroux and Vanasse (2001), Richaudeau (1999) and Puelz and Snow (1994)). However, as research along these trajectories has emphasized, there is a reverse causality between moral hazard and adverse selection. Therefore, within the static framework, it is almost impossible to distinguish them except for the situation where a natural experiment can be applied (see Browne and Puelz (1999), Chiappori, Durand and Geoffard (1998) and Dionne, Maurice, Pinquet and Vanasse (2001)).

As Chiappori (2000) points out, in practice the distinction between adverse selection and moral hazard may be crucial, especially from a normative point of view. For instance, if hidden action is the main cause of the presence of asymmetric information, the introduction of stronger incentive system[3] is likely to be useful and justified. However, if the selection is the main driving force, low risk types must sacrifice some desired insurance protection in order to avoid being pooled with high risk types. Thus, the problem is not resolved without a cost as Doherty (2000) correctly points out. In this case, the introduction of sophisticated risk classification mechanism tends to be more effective[4].

Given these circumstances, there have been some recent empirical tests using dynamic data sets to attempt the separation of two phenomena.

Among them, Abbring, Chiappori, Heckman and Pinquet (2002), Abbring, Chiappori and Pinquet (2003) and Abbring, Chiappori, Heckman and Pinquet (2003) take the contracts as given and concentrate on their implications for observed behavior[5]. Methodologically, their studies build on and extend the literature on state dependence and unobserved heterogeneity in event history data (see Heckman and Borjas (1980) for a formal definition of occurrence dependence). They use a French data base and focus on the role of the existing experience rating system, working through the 'bonus-malus' coefficient in the contracts. With this system, the insurance premium associated with any particular contract depends,

3) For instance, the reductions in the amount of coverage, or stronger monetary penalty on the behaviors correlated with accident occurrence.

4) That is, insurance premiums should be based on many relevant observable individual and car characteristics.

5) This approach is justified because optimal contract in the theoretical dynamic insurance is inconclusive or relies on very strong assumptions that are difficult to maintain within an applied framework (for a discussion, see Chiappori and Salanie (2003)).

among other things, on the past history of the contracts. They show that this scheme has a very general property: that is each accident increases the marginal cost of having accidents in the future. Therefore, under moral hazard, any accident increases cautious efforts and reduces accident probability. That is, for any given individual, moral hazard induces a negative contagion phenomenon. The occurrence of an accident in the past reduces accident probability in the future. However, this prediction holds only conditional upon individual characteristics, whether observable or unobservable. As is well known, unobserved heterogeneity induces the opposite – positive contagion. Past accidents are typical of bad drivers and, as a result, are a good predictor of a higher accident probability in the future. Thus, problem lies in controlling unobserved heterogeneity. Using a proportional hazard duration model controlling for unobserved heterogeneity, they accept the null hypothesis of no moral hazard.

In this paper, using the model presented by Abbring, Chiappori, Heckman and Pinquet (2002), I test for the presence of moral hazard in the dynamic insurance context with the Korean data set. Primarily, this work contributes to the field of empirical contract theory by enlarging the applied area using the Korean data set. Secondly, I contribute to the literature by implementing the novel numerical analysis in the theoretical part. Lastly, in my empirical result, I found out the evidence of the presence of moral hazard in the Korean automobile insurance market. This is in the stark contrast with result in Abbring, Chiappori, Heckman and Pinquet (2002) and Abbring, Chiappori and Pinquet (2003).

In section II, I briefly describe the features of the Korean automobile insurance data set I have obtained. In section III, IV and V, I describe the theoretical model, the empirical model and the empirical results in turn. Then, I briefly discuss the limitations of this paper and conclude in the last section.

II. Data

I have obtained two panel data sets on automobile insurance contracts from two Korean automobile insurance companies (A and B) that have been operating since 1983.

Company A has a market share of approximately 13.20% in the total market. The data set from this company covers 5 calendar years between 01/01/1998 and 30/06/2002. This is equivalent to 4 entire contract years at maximum. The total number of policyholders contained in the data set are 607,824: samples are limited to those who are younger than 31 years old in 1998.

Company B has a market share of 4.59% in the market. The data set covers 4 calendar years between 01/01/1999 and 30/09/2002. This contains 3 full contract years at maximum: the total number of policyholders in the data set is 990,199.

Both data sets have 4 broad categories: individual characteristics; contract information; information on car; information on accident occurrence (to be precisely, claims history for each individual).

For my empirical work, a crucial information is the last component. In particular, I use the number of claims and claim date for each claim for each individual. Also, we do not include the accidents that are not at fault.

III. Theoretical Model

A brief sketch of the theoretical model is as follows.

Time is discrete and infinite horizon. At each time t, the agent receives some fixed income, W. With probability $1-p_t$, the agent has an accident and incurs a fixed monetary loss, L. The agent is covered by an insurance contract involving a fixed deductible, D and a premium, Q_t. Thus, an agent's consumption at each period is $W - Q_t$ without an accident, and $W - Q_t - D$ if an accident occurs.

The premium Q_t depends on the past experience. Specifically, the evolution of Q_t is governed by the following 'bonus-malus' coefficient:

$$Q_{t+1} = \begin{cases} \delta Q_t \text{ if no accident} \\ \gamma Q_t \text{ if an accident} \end{cases},$$

where $0 < \delta < 1$, and $\gamma > 1$.

The no accident probability p_t is subject to moral hazard. At each time t, the agent chooses an effort level, $e_t \geq 0$, for some deterministic function p. It is assumed that p is twice differentiable with $p' > 0$ and $p'' < 0$. The cost of effort is assumed to be separable. That is, the agent attaches utility $u(x) - c(e)$ to an income x if s/he exerts effort e, where c is a cost function of making an effort. Thus, the agent's expected time t utility is

$$v(e_t, Q_t) = p(e_t)u(W - Q_t) + (1-p(e_t))u(W-Q_t-D) - c(e_t).$$

The agent is risk averse with an increasing and strictly concave utility function.

The agent chooses effort levels $e_1, e_2, \cdots$ so as to maximize expected discount utility, with discount factor, $0 < \rho < 1$. That is, the agent solves the program $\max_{e_1,\ldots} \sum_t \rho^t v(e_t, Q_t)$,

where Q_t satisfies the premium evolution described above.

This is a standard optimum control problem with one dimensional state variable Q_t and control variable e_t. The value function satisfies the following Bellman equation:

$$V(Q)=\max_e -c(e)+(1-p(e))[u(W-Q-D)+\rho V(\gamma Q)]+p(e)[u(W-Q)+\rho V(\delta Q)].$$

The first crucial property of the value function is that it is decreasing in Q. Secondly, it is concave[6].

Apart from the formal proofs, I also implement the numerical analysis using the value function iteration method[7]. For a numerical method, I specify the functional forms and numerical values as follows:

- utility function : $u(\cdot)=\ln(\cdot)$
- probability of no accident : $p(e)=1-\frac{1}{1+e}$
- effort cost : $c(e)=e^2$
- $\rho=0.9$, $\delta=0.95$, and $\gamma=1.25$

Logarithmic utility function captures a risk aversion of an agent. No accident probability lies between 0 and 1, depending on the value of effort level ($e\in[0,\infty]$). Effort cost function is specified as quadratic.

The results from value function iteration are given by figure 1 and figure 2.

6) Formal proofs are given in the final version of Abbring, Chiappori, Heckman and Pinquet (2002). Different proofs done by me are also provided on the request.

7) The matlab code for numerical analysis is also available upon request. Value function iteration is most widely used method to solve Bellman equation. For the details of the value function iteration, there are many references. For the formal treatments, see Adda and Cooper(2003), Sargent (1987) or Stokey and Lucas (1989).

To attain qualitative results, the first order condition for the Bellman equation is derived:

$$p'(e) = \frac{c'(e)}{u(W-Q)+u(W-Q-D)+\rho(V(\delta Q)-V(\gamma Q))}$$

By defining $\zeta(e) = -p'(e)$, we have

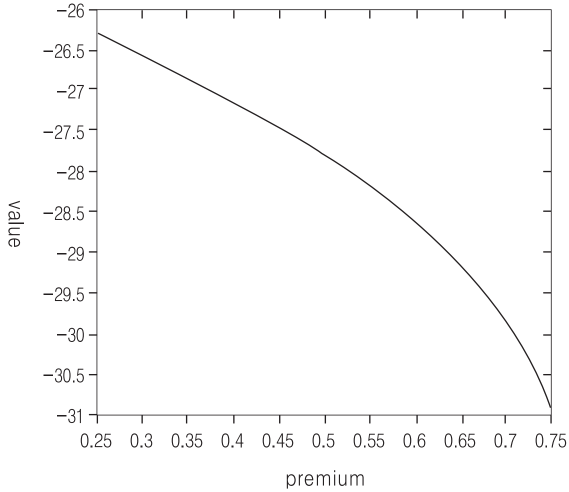
$$\zeta(e) = \frac{c'(e)}{u(W-Q-D)-u(W-Q)+\rho V(\gamma Q)-V(\delta Q))}$$

Concavity of V implies that the right hand side of the last formula is increasing in Q. Since ζ is increasing, this implies, in turn, that e increases with Q. This is the main result for the negative occurrence prediction. If there is an accident, the agent faces higher premiums in the next period due to the experience rating scheme. Then, as a consequence of experienced rating scheme a higher level of effort is induced in order to reduce accident occurrence under moral hazard.

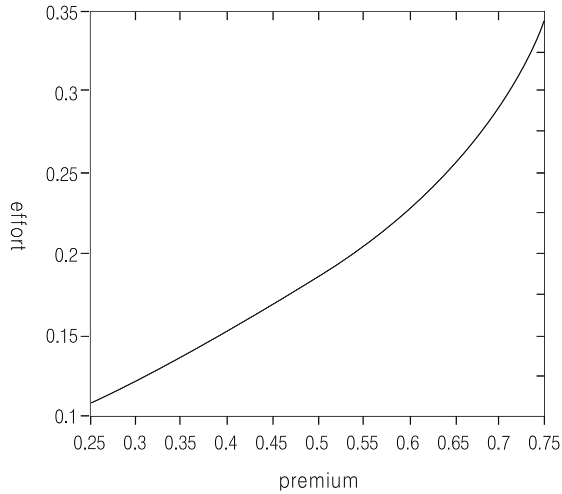
These theoretical predictions are summarized in the figure 1 and 2. Figure 1 clearly shows that the value function is decreasing and concave function of premium. That is, each individual' s lifetime utility is negatively affected by

premium increase (via accident occurrence) and the rate gets heavier when premium is higher. Figure 2 illustrates the crucial policy function. We can see that accident premium increase (via accident occurrence) naturally increase effort level to avoid accident occurrence under moral hazard.

〈Figure 1: Premium-Value〉



〈Figure 2: Premium-Effort〉



Ⅳ. Empirical Model

Given the theoretical prediction, the empirical model is presented. The analysis focuses on the occurrence of automobile insurance contract claims in a single insurance contract year, i.e. the period bounded by two consecutive contract renewal dates.

Let time have its origin at the start of the contract year. Then, if a contract year is of length T, it can be represented by the interval $[0,T]$. Let T_k be the time of the k-th claim. Denote the corresponding counting process by $N[0,T]:=\{N(t);0\leq t\leq T\}$, where $N(t):=\{k:T_k\leq t\}$, counts the number of claims in the contract year up to time t. $N[0,T]$ is the focus of the model and empirical analysis.

The intensity θ of claims at time t, conditional on the claim history $N[0,t):=\{N(u);0\leq u<t\}$, up to time t and a nonnegative unobservable covariate λ, is

$$\theta(t|\lambda,\ N[0,t))=\lambda\beta^{N(t-)}\psi(t)$$ [8],

with a baseline hazard, $\psi:[0,\infty)\rightarrow[0,\infty)$, an integrable function and $\beta>0$ a scalar parameter. Denote $\Psi(t):=\int_0^t\psi(u)du$. With normalization $\Psi(T)=1$, λ captures the scale of θ. It is assumed that λ has marginal distribution G[9].

The parameter β captures occurrence dependence effects controlling for unobserved heterogeneity. Moral hazard leads to a decline in the intensity of

8) In a mixed proportional hazard model, we also have observed covariates term, $e^{X(t)'\gamma}$. In my estimation, I do not include this part, since this term does not affect identification of the model and this causes computational burden without any improvement on the empirical results.

9) For a more formal treatment of a mixture model, see Lancaster (1997).

claims with the number of previous claims ($\beta<1$). As shown in the theoretical part, the number of previous claims increases the future premium and, therefore, the previous claims should decrease the claim intensity under moral hazard. For this to happen, β should be less than 1. Without moral hazard, it is expected that $\beta=1$. That is, the accident intensity is entirely driven by unobserved heterogeneity and seasonal effect only, without any effect of previous accident occurrence on driving behavior. Distinguishing these two cases and estimating β is the focus of empirical analysis.

V. Empirical Results

The empirical model is estimated by maximum likelihood method[10]. The piecewise-constant specifications of ψ has been chosen. With $q \geq 1$ pieces[11], the contract year $[0,T]$ is partitioned in q equally sized intervals, with ψ constant on each interval:

$$\psi(t) = \sum_{j=1}^{q} \psi_j I\left(\frac{j-1}{q} \leq \frac{t}{T} < \frac{j}{q}\right),$$

with $\psi_1, \cdots, \psi_q \geq 0$ parameters to be estimated, up to the normalization

10) Matlab code for this maximum likelihood estimation is provided on request. I implement quasi-Newton algorithm on matlab.
11) In the estimation, a contract year is partitioned in 12 monthly pieces.

$\Psi(T) = (T/q) = \sum_{j=1}^{q} \psi_j = 1$. For the distribution of λ_i, discrete distribution

with two points of supports is employed. This is natural enough to capture conventional two types (high risk and low risk type) classification of agents in contract theory. In addition, this specification possesses an advantage since it is nonparametric (see Michaud and Tatsiramos (2005)). In this case, I estimate the support points, λ^a, $\lambda^b > 0$, and one probability, $\Pr(\lambda = \lambda^a) = 1 - \Pr(\lambda = \lambda^b)$.

Overall, we want to estimate β, λ^a, λ^b, $\Pr(\lambda = \lambda^a) = 1 - \Pr(\lambda = \lambda^b)$, and $\psi_1, \cdots, \psi_{11} \geq 0$.

For a comparison, I present empirical result from Abbring, Chiappori, Heckman and Pinquet (2002). The data is the insurance contracts from a French insurance company in a given and common calendar time period of two years, October 1, 1987 – September 30, 1989. The number of observations is given in the following table.

number of observations by number of claims	
$M_{0,n}$ (no claims)	74,566
$M_{1,n}$ (1 claims)	4,831
$M_{2,n}$ (2 claims)	270
$M_{3,n}$ (3 claims)	15
$M_{4,n}$ (4 claims)	2

Overall, using their own data set, they found no evidence of moral hazard. The estimate for β is 0.974 with estimated standard error 0.677. With regard to contract time effects, they do not reject the stationarity(that is, $\psi \equiv 1$).

Conversely, I have detected the negative occurrence dependence phenomenon (that is, moral hazard phenomenon). I present here my results for the 1998 data set of company A and the 1999 data set of company B in table 1 and in table 2[12].

Further to this, I estimate with subsamples to see whether the sample size makes a difference to the results: especially with regard to the t-values[13]. In this exercise, I construct subsamples according to some individual characteristics. I have divided the samples for company A using gender and for company B using gender, marital status and age. This work also complements my estimation in the sense that it includes the individual effects indirectly, particularly with regard to the points mentioned in footnote 8. In the table 3, I present some results: here only coefficient βs are reported and we can clearly see that sample size does not make a difference.

12) I also estimated for company A 1999 and 2000 data, and company B data 2000. Qualitatively, results are the same. That is, $0<\beta<1$. I do not present these results for a compactness of a paper.

13) It could be argued that my finding is merely an artifact of the extremely large sample size of the data sets that comprise the study. Therefore, it is worth estimating with subsamples comparable to the previous study.

〈Table 1: Discrete Heterogeneity; 12 time intervals (company A 1998)〉

occurrence dependence	
β	0.5369 (0.0399)
unobserved heterogeneity	
λ^a	0.0594 (0.0010)
λ^b	1.5119 (0.2154)
$\Pr(\lambda=\lambda^a)$	0.9878 (0.1483)
$\Pr(\lambda=\lambda^b)$	0.0122 (0.1483)
piecewise constant ψ	
ψ_1	1.1929 (0.0342)
ψ_2	1.0799 (0.0317)
ψ_3	1.0436 (0.0304)
ψ_4	0.9935 (0.0297)
ψ_5	1.0232 (0.0300)
ψ_6	0.9792 (0.0295)
ψ_7	0.9317 (0.0289)
ψ_8	0.9585 (0.0295)
ψ_9	0.9177 (0.0291)
ψ_{10}	1.0043 (0.0310)
ψ_{11}	0.9264 (0.0297)
number of observations by number of claims	
$M_{0,n}$ (no claims)	182,441
$M_{1,n}$ (1 claims)	12,100
$M_{2,n}$ (2 claims)	776
$M_{3,n}$ (3 claims)	81
$M_{4,n}$ (4 claims)	14
$M_{5,n}$ (5 claims)	3
log-likelihood	-50,502

Note: Standard errors are in parenthesis.

〈Table 2: Discrete Heterogeneity;12 time intervals (company B 1999)〉

occurrence dependence	
β	0.5356 (0.0234)
unobserved heterogeneity	
λ^a	0.0821 (0.0013)
λ^b	1.3936 (0.1109)
$\Pr(\lambda=\lambda^a)$	0.9650 (0.0835)
$\Pr(\lambda=\lambda^b)$	0.0350 (0.0835)
piecewise constant ψ	
ψ_1	1.1990 (0.0200)
ψ_2	1.1150 (0.0180)
ψ_3	1.1054 (0.0172)
ψ_4	1.0325 (0.0163)
ψ_5	1.0245 (0.0162)
ψ_6	1.0184 (0.0162)
ψ_7	0.9976 (0.0163)
ψ_8	0.9306 (0.0159)
ψ_9	0.9249 (0.0162)
ψ_{10}	0.8940 (0.0162)
ψ_{11}	0.8809 (0.0164)
number of observations by number of claims	
$M_{0,n}$(no claims)	396,729
$M_{1,n}$(1 claims)	40,635
$M_{2,n}$(2 claims)	4,148
$M_{3,n}$(3 claims)	521
$M_{4,n}$(4 claims)	87
log-likelihood	-159,260

Note: Standard errors are in parenthesis.

〈Table 3: Some Results from Subsamples〉

data	subsample	sample size	coefficient β
Company A (1998)	female	$M_{0,n}$: 29,448 $M_{1,n}$: 2,498 $M_{2,n}$: 173 $M_{3,n}$: 12 $M_{4,n}$: 1	0.4978 (0.1060)
Company B (2000)	married male and 18≤age<40	$M_{0,n}$: 70,068 $M_{1,n}$: 7,515 $M_{2,n}$: 1,017 $M_{3,n}$: 127 $M_{4,n}$: 35	0.4325 (0.0318)
Company B (2000)	unmarried female and age ≥ 40	$M_{0,n}$: 15,559 $M_{1,n}$: 2,025 $M_{2,n}$: 268 $M_{3,n}$: 33 $M_{4,n}$: 5	0.4886 (0.0892)

Note: Standard errors are in parenthesis.

Ⅵ. Conclusion

In this study, I test for the presence of moral hazard in the Korean automobile insurance market using the model based on Abbring, Chiappori, Heckman and Pinquet (2002). Different from the previous result in the empirical contract theory using automobile insurance data set, I have detected the presence of moral hazard in the Korean automobile insurance market. In this section, I conclude the paper with some discussions about the promising future research agenda.

As noted, in France, with experience rating system, the insurance premium associated with any particular contract depends, among other things, on the past history of the contracts. Particularly, after each year without an accident, the coefficient is decreased by a factor, δ, which is between 0 and 1. However, if there is an accident occurrence, it increases by a factor, $\gamma (> 1)$. This system is characterized as a proportional experience rating system and the model used in this paper has been based on the French system.

Therefore, there should be some cautions in the interpretation of empirical results. The Korean experience rating system is distinctively different from the French system: which is a proportional system[14]. This implies that when I apply their theory to the Korean data set this would suggest a possible changes in the interpretation of test for moral hazard. Particularly, depending on the agent's current experience rating state, under the presence of moral hazard, individual claim rates may also depend positively on the past claim if the experience rating system is nonproportional. However, this difference would affect the statistics' behavior under the alternative. Overall, my result holds only approximately. Given this circumstance, it would be a natural extension to characterize the theoretical properties of agent's behavior under the presence of nonproportional experience rating system.

Another natural direction of future research would necessitate a fully

14) Basically, the Korean system is nonproportional and much more complicated due to taking account of the severity of an accident as well as the number of accidents.

structural estimation in the dynamic context. Since I have access to panel data sets, this work is likely to be addressed. Particularly, within this agenda, contract and effort choice need to be explicitly incorporated[15]: and further, an underlying unobserved heterogeneity would be considered in a more direct way.

Overall, the main aim is to quantify the moral hazard phenomenon. So far, most research has focused on detecting the presence of asymmetric information in the various market contexts. Even though these are the path breaking works, it may be the time to measure the magnitude of the asymmetric information.

15) Contract choices over time are missing in all the previous empirical dynamic insurance literatures. The only exception is Dahchour, Dionne and Michaud (2004) that incorporates contract choices over time in the dynamic bivariate probit model. Also, Lee (2005) implements the same methodology using the Korean automobile insurance data set.

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요 약

많은 경제학자들이 실증계약이론의 중요성을 인식해 오고 있었지만 넘쳐나는 이론적 연구와 비교했을 때 이 연구주제에 대해 상당히 적은 연구가 행해져 왔다. 이렇게 실증분야의 연구가 활발하지 못한 이유는 관련 데이터를 얻기가 어렵다는 사실에 기인한다. 본 연구에서는 한국의 자동차보험 데이터를 가지고 자동차 보험 시장에 도덕적 해이 현상이 존재하는지를 검증한다. 현재까지 자동차 보험 시장의 비대칭적 정보와 관련된 실증연구들은 Rothschild와 Stiglitz (1976), 그리고 Shavelle (1979)의 이론적 연구들에 기반한 '조건부 상관관계 (conditional correlation)' 에 초점을 맞춰 왔다. 하지만, 이 방법론을 통해서는 비대칭 정보의 존재만을 검증할 수 있을 뿐이다. 즉, 도덕적 해이와 역선택을 분리하여 검증하는 것이 거의 불가능하다. 이러한 상황에서 두 현상을 분리하기 위하여 동적 데이터를 이용한 몇 가지 실증분석이 시도되었다. 그들 가운데, 본 연구에서는 관찰되지 않는 이질성(unobserved heterogeneity)을 통제하면서 도덕적 해이를 역선택으로부터 분리하는 방법론으로 Abbring, Chiappori, Heckman, Pinquet (2002)에 의해 제기된 mixed proportional hazard 모델을 사용한다. 이론 부분을 보완하기 위하여 이들이 시도하지 않았던 수치적 분석도 아울러 행해진다. 주요하게는 이들이 프랑스 데이터를 통해 얻은 실증적 결과와는 달리 본 연구에서는 한국의 자동차 보험 시장에 도덕적 해이 현상이 존재함을 보인다. 이는 도덕적 해이등과 같은 시장의 불완전성이 시장의 특수성에 기인하는 것일 수 있다는 것을 보여준다.

※ 국문색인어: 관찰되지 않는 이질성, 도덕적 해이, 자동차 보험 계약, mixed proportional hazard 모델