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保險議價之理論與實證研究

The Theoretical and Empirical Studies of Insurance Bargaining

黃依潔

Yi-Chieh Huang

指導教授：曾郁仁 博士

Advisor: Larry Yu-Ren Tzeng, Ph.D.

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依潔　謹序

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摘要

本論文理論上與實證上研究模糊、風險趨避及議價能力對保險議價結果之影響，由兩部分組成。第一部分之論文為「模糊狀況下的一個合作保險議價模型」，為保險議價之理論研究。其分析當一個風險趨避及模糊趨避的客戶透過合作保險議價之方式與一個風險中立之保險公司購買保險時，最適保險契約如何分別受到模糊趨避增加以及模糊程度增加影響。文中首先證明存在模糊狀況（損失機率不確定）下之最適保障為全險，且存在模糊狀況下之最適保費相較不存在模糊狀況下之最適保費高。其次發現，當客戶之模糊趨避程度增加以及模糊程度增加時，均使最適保費提高。第二部分之論文為保險議價之實證研究，探討影響保費折扣多寡之因素。使用臺灣任意汽車責任險（財產損失）之資料，檢視是否被保險人之風險趨避及議價能力與其獲得之保費折扣比率相關。在控制了被保風險及核保變數後，結果發現，平均而言，比較風險趨避之被保險人（購買多種保障之被保險人）及議價能力較弱之被保險人（有理賠紀錄之被保險人）均獲得顯著較低的保費折扣比率。

關鍵詞：保險議價、合作議價、模糊、模糊趨避、風險趨避、議價能力、保費折扣。

Abstract

This dissertation, which is divided into two parts, theoretically and empirically investigates effects of ambiguity, risk aversion, and bargaining power on outcomes of insurance bargaining. Specifically, the first part of dissertation "Cooperative Insurance Bargaining Model with Ambiguity" theoretically analyzes how the optimal insurance contract will be affected by an increase in ambiguity aversion and an increase in ambiguity by studying a cooperative insurance bargaining game with a risk-neutral insurer and a risk-and-ambiguity-averse client. I first show that full coverage is optimal in the presence of ambiguity and that the optimal premium becomes higher because of the introduction of ambiguity. Subsequently, both an increase in ambiguity aversion and an increase in ambiguity are found to raise the optimal premium. The second part of dissertation "Who Obtains more Discount on Insurance Premiums?" uses the data on Taiwanese auto liability insurance for property damage to empirically examine whether an insured's risk aversion and bargaining power are associated with his/her premium discount ratios. After controlling insured risks and underwriting variables, the results suggest that, on average, both more risk-averse insured (represented by the insured with multiple types of coverage) and the insured with weaker bargaining power (represented by the insured with claim records) obtain significantly lower premium discount ratios.

Keywords: insurance bargaining; cooperative bargaining; ambiguity; ambiguity aversion; risk aversion; bargaining power; premium discount

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1 A Cooperative Insurance Bargaining Model with Ambiguity

1.1 Introduction

A non-competitive relationship between insurance companies and clients may be observed in many countries. One case is that where the insurance companies and their clients are in the same conglomerate. These insurance companies have interlocking business relationships with the firms in the same group due to top-down management, centralized control or equity ownership connections. For example, Tokio Marine and Fire Insurance, which is a subsidiary of Tokio Marine Holdings, the largest non-mutual private insurance group in Japan, belongs to one of the major keiretsu in Japan, Mitsubishi. Tata AIG General Insurance and Tata AIG Life Insurance are among the firms in the Tata group, which is the largest private corporate group in India in terms of market capitalization and revenues. The insurance companies and their clients negotiate over the terms of the insurance and seek to draw up contracts which can benefit both parties. Therefore, an analysis of cooperative relationship in insurance is important.

With regard to the literature on insurance bargaining, Kihlstrom and Roth (1982) first investigated the Nash solution of a cooperative bargaining game between a risk-neutral insurance company and a risk-averse client. They found that the optimal insurance contract is full-coverage, and that when the insured becomes more risk averse, he/she settles with the insurance company on a higher premium. Schlesinger (1984) further generalized Kihlstrom and Roth's (1982) model, and showed that the insurance company's expected profit increases with the insured's risk aversion. Viaene et al. (2002) proposed a non-cooperative bargaining game, and found that the insurance company obtains a higher premium when the insured has a lower discount factor.[1] Moreover, Quiggin and Chambers (2009) studied how bargaining power will affect the efficiency of insurance contracts, and found that stronger bargaining power of the clients results in more social welfare.

This paper extends this line of the literature by studying the effects of ambiguity and ambiguity aversion in a cooperative insurance bargaining model. Ambiguity characterizes a situation where a decision maker is uncertain about the information which affects his/her decisions, and ambiguity aversion is an aversion to such an uncertainty. The significant influence of ambiguity and ambiguity aversion on individuals' decisions under risk has been noted in the literature.[2] Regarding insurance, the demand for insurance and the design of insurance contracts would be different under ambiguity and ambiguity aversion. For example, Snow (2011) proved that the demands for both self-insurance and self-protection increase with ambiguity aversion. Alary et al. (2013) considered multiple states of Nature, and found that, under certain conditions, ambiguity aversion increases the demand for self-insurance but decreases the demand for self-protection.[3] Although the above literature has provided fruitful findings, none of them focus on a cooperative-based context. To the best of my knowledge, this paper is the first to study the cooperative insurance

[1]In Viaene et al.'s (2002) paper, the effect of a lower discount factor is regarded as the effect of more risk aversion or more impatience.

[2]For example, Epstein and Schneider (2008) found that when the reliability of information quality is uncertain, ambiguity-averse investors require more excess returns for poor signals, especially when fundamentals are volatile. Gollier (2011) showed that, under certain conditions, a more ambiguity-averse agent will demand fewer ambiguous assets when the distribution of a risky asset's return is uncertain. In addition, he showed that an increase in ambiguity aversion results in higher equity premiums under the ambiguous distribution of states.

[3]Huang (2012) examined the impact of ambiguity aversion on effort when either the target wealth distribution or the initial wealth distribution is ambiguous. She showed that a decision maker with greater ambiguity aversion will make more effort when the starting distribution is ambiguous, but may make less effort when the target distribution is ambiguous.

bargaining under ambiguity.

Following the framework of Kihlstrom and Roth (1982), this paper sets up a cooperative bargaining game with a risk-neutral insurance company and a risk-and-ambiguity-averse client. The literature has provided several approaches to model the decision under ambiguity.[4] In this paper, Klibanoff et al.'s (2005) smooth model of ambiguity aversion is employed. Klibanoff et al. (2005) set up a two-stage model in which the decision process is decomposed into risk and ambiguity: the "expected utility" of an ambiguity-averse agent is the expected ambiguity function over the ambiguous beliefs, and the ambiguity function is a concave function of the traditional expected utility over risk. The ambiguity function captures the attitude toward ambiguity and the distribution of ambiguous beliefs capture ambiguity. In other words, their model can separate the ambiguity preferences and the ambiguous beliefs, which helps to analyze the effects of an increase in ambiguity aversion and an increase in ambiguity on the optimal insurance.

For the results, I first show that the negotiations turn out to be a full-coverage insurance contract, which suggests that the full-coverage result found by Kihlstrom and Roth (1982) is robust in the presence of ambiguity. Furthermore, both an increase in the client's ambiguity aversion and an increase in ambiguity are found to induce the client to pay a higher premium for the full-coverage insurance contract.

The rest of the paper is organized as follows. Section 1.2 examines a cooperative insurance bargaining game under ambiguity. Sections 1.3 and l.4 analyze the effects of an increase in ambiguity aversion and an increase in ambiguity on the optimal premium, respectively. Finally, Section 1.5 concludes the paper.

[4]For example, the maxmin expected utility model (Gilboa and Schmeidler, 1989), the Choquet expected utility (Schmeidler, 1989), the α-maxmin (Ghirardato et al., 2004), and the smooth model of ambiguity aversion (Klibanoff et al., 2005).

1.2 A Cooperative Insurance Bargaining Game

Suppose that there are two agents in a cooperative bargaining game: one is a risk-neutral insurance company and the other is a risk-and-ambiguity-averse client. The client endowed with ω_C is uncertain about the probability of the occurrence of a potential loss L but subjectively believes the the no-loss probability has an F distribution. To hedge the risk, the client negotiates with the insurance company. The negotiations could turn out to be successful or they could break down. If they are successful, the two agents will sign an insurance contract and simultaneously determine the terms of the insurance contract $C = \{P, Q\}$, where P is the insurance premium and $Q \in [0, L]$ is the coverage. However, if the negotiations break down, no insurance contract will be agreed upon.

By adopting the ambiguity preference setting in Klibanoff et al. (2005),[5] when there is an agreement, the client's utility function is given by

$$U_C\left(P, Q; F\right) = \phi^{-1}\left[\int \phi\left(\pi u\left(\omega_C - P\right) + \left(1-\pi\right) u\left(\omega_C - P - L + Q\right)\right) dF\left(\pi\right)\right], \quad (1)$$

where u is the client's utility function with $u' > 0$ and $u'' < 0$. ϕ with $\phi' > 0$ captures the client's degree of ambiguity aversion. When ϕ is linear, the agent is ambiguity neutral, and when $\phi'' < 0$, the agent is ambiguity averse. If there is a disagreement, the client's utility function is

$$U_C\left(0, 0; F\right) = \phi^{-1}\left[\int \phi\left(\pi u\left(\omega_C\right) + \left(1-\pi\right) u\left(\omega_C - L\right)\right) dF\left(\pi\right)\right]. \quad (2)$$

[5] To make the utility of the ambiguity-averse client equal to the expected utility when there is no ambiguity, I further take an inverse function of the ambiguity function based on the setting in Klibanoff et al. (2005) as in Treich (2009), Gollier (2011), and Alary et al.(2013).

Thus, the client's utility gain from reaching an agreement as opposed to a disagreement with the insurance company could be modeled as

$$\Delta U_C = U_C\left(P, Q; F\right) - U_C\left(0, 0; F\right). \tag{3}$$

Assume that the insurance company endowed with ω_I does not have ambiguous beliefs. Let α denote the objective probability of no-loss, $\alpha \in (0, 1)$. Thus, the gain for the insurance company from reaching an agreement as opposed to a disagreement with the client is

$$\Delta U_I = \alpha\left(\omega_I + P\right) + (1 - \alpha)\left(\omega_I + P - Q\right) - \omega_I = P - (1 - \alpha)\,Q. \tag{4}$$

Note that introducing ambiguity should be "logically inconsequential for an ambiguity-neutral decision maker" (Snow, 2010 and 2011). Therefore, it is reasonable to assume that the client's ambiguous beliefs are unbiased, i.e.,

$$\alpha = \int \pi dF\left(\pi\right), \tag{5}$$

as in Snow (2010 and 2011).

By adopting Nash's solution (1950), Kihlstrom and Roth (1982) have proposed that, in a cooperative insurance bargaining game, the insurance company and the client will jointly set up an insurance contract to maximize the social welfare function SW, which is the product of the utility gains from the insurance of both agents.[6]

[6] Nash (1950) proposed that, this methodology can be applied to find the solution of a bargaining game when the model satisfies the following four properties: Pareto optimality, symmetry, independence of irrelevant alternatives, and independence of equivalent utility representatives. Since the model in this paper posses these four properties as in Kihlstrom and Roth's model, the same approach is adopted.

In other words, the objective function is as follows:

$$\max_{P,Q} SW = \Delta U_I \times \Delta U_C. \tag{6}$$

The corresponding first-order conditions (FOCs) are

$$\frac{\partial SW}{\partial P} = \Delta U_C + \Delta U_I \frac{\partial U_C\left(P,Q;F\right)}{\partial P} = 0, \tag{7}$$

and

$$\frac{\partial SW}{\partial Q} = -\left(1-\alpha\right)\Delta U_C + \Delta U_I \frac{\partial U_C\left(P,Q;F\right)}{\partial Q} = 0, \tag{8}$$

where

$$\begin{aligned}\frac{\partial U_C\left(P,Q;F\right)}{\partial P} &= \frac{-1}{\phi'\left(U_C\left(P,Q;F\right)\right)}\\ &\quad\times \int \phi'\left(\pi u\left(\omega_C-P\right)+\left(1-\pi\right)u\left(\omega_C-P-L+Q\right)\right)\\ &\qquad\quad \times\left[\pi u'\left(\omega_C-P\right)+\left(1-\pi\right)u'\left(\omega_C-P-L+Q\right)\right]dF\left(\pi\right)\\ &< 0.\end{aligned}$$

and

$$\begin{aligned}\frac{\partial U_C\left(P,Q;F\right)}{\partial Q} &= \frac{u'\left(\omega_C-P-L+Q\right)}{\phi'\left(U_C\left(P,Q;F\right)\right)}\\ &\quad\times \int \left(1-\pi\right)\phi'\left(\pi u\left(\omega_C-P\right)+\left(1-\pi\right)u\left(\omega_C-P-L+Q\right)\right)dF\left(\pi\right)\\ &> 0.\end{aligned}$$

Assume that the second-order conditions (SOCs) of the objective function (6) hold, and that both agents could obtain positive utility gains from reaching an agreement to sign an insurance contract, i.e.,

$$\Delta U_C > 0 \text{ and } \Delta U_I > 0. \tag{9}$$

As a result, an optimal allocation (P^*, Q^*) which satisfies FOCs (7) and (8) and maximizes the social welfare exists.

From these FOCs, I find that $Q^* = L$ as shown in the following lemma.

Lemma 1 *In a cooperative bargaining game, the risk-neutral insurance company and the risk-averse and ambiguity-averse client will settle on full coverage, i.e., $Q^* = L$, when the client's ambiguous beliefs regarding the no-loss probability are unbiased.*

Proof. *Rearranging the above two FOCs (7) and (8) yields*

$$\Delta U_C = -\Delta U_I \frac{\partial U_C (P, Q; F)}{\partial P},$$

and

$$(1-\alpha) \Delta U_C = \Delta U_I \frac{\partial U_C (P, Q; F)}{\partial Q}.$$

From the assumptions (9) and $\alpha \in (0,1)$, the internal solution Q^* should satisfy the following equation:

$$\frac{1}{1-\alpha} = -\frac{\frac{\partial U_C(P,Q;F)}{\partial P}}{\frac{\partial U_C(P,Q;F)}{\partial Q}}.$$

If $Q^* = L$, the right-hand side of the above equation can be written as

$$-\frac{\frac{\partial U_C(P,Q;F)}{\partial P}}{\frac{\partial U_C(P,Q;F)}{\partial Q}} = \frac{1}{\int(1-\pi)\,dF(\pi)} = \frac{1}{1-\alpha},$$

which is equal to the left-hand side. Since the SOCs hold, I have $Q^* = L$. ■

Kihlstrom and Roth (1982) have pointed out that full coverage is optimal in a cooperative insurance bargaining game when the client is risk averse and the insurer is risk neutral. Lemma 1 indicates that introducing ambiguity preferences for the client does not change their findings. The intuition of Lemma 1 is similar to the intuition of Kihlstrom and Roth (1982). Klibanoff et al.'s (2005) smooth model sets the ambiguity function as a "expected-utility-like functional form" (Baillon et al., 2011). The ambiguity-averse decision maker would prefer a mean-preserving contraction in terms of expected utility value. This characteristic is similar to the characteristic of a risk-averse decision maker who would prefer a mean-preserving contraction in terms of the payoff. Since a full-coverage contract can equalize the payoffs and the expected utility values for different states, under the unbiased ambiguous beliefs assumption, I will find that full coverage is optimal, as in Kihlstrom and Roth (1982).

Although introducing ambiguity and ambiguity preferences does not affect the optimal coverage, it does affect the optimal premium. With full coverage, the social welfare function is then

$$\begin{aligned} SW &= \Delta U_I \times \Delta U_C \\ &= [P-(1-\alpha)L]\left[u(\omega_C - P) - U_C(0,0;F)\right]. \end{aligned} \tag{10}$$

Thus, the FOC will become

$$\frac{\partial SW}{\partial P} = u\left(\omega_C - P\right) - U_C\left(0,0;F\right) - \left[P - \left(1-\alpha\right)L\right]u'\left(\omega_C - P\right) = 0. \tag{11}$$

When there is no ambiguity for the client, the social welfare function under full coverage is

$$\widehat{SW} = \left[P - \left(1-\alpha\right)L\right]\left\{u\left(\omega_C - P\right) - \left[\alpha u\left(\omega_C\right) + \left(1-\alpha\right)u\left(\omega_C - L\right)\right]\right\}. \tag{12}$$

The corresponding FOC is then

$$\frac{\partial \widehat{SW}}{\partial P} = u\left(\omega_C - P\right) - \left[\alpha u\left(\omega_C\right) + \left(1-\alpha\right)u\left(\omega_C - L\right)\right] - \left[P - \left(1-\alpha\right)L\right]u'\left(\omega_C - P\right) = 0. \tag{13}$$

Snow (2010) have shown that introducing a mean-preserving spread of the beliefs will reduce the utility of an ambiguity-averse individual, i.e.,

$$\begin{aligned} \alpha u\left(\omega_C\right) + \left(1-\alpha\right)u\left(\omega_C - L\right) &> \phi^{-1}\left[\int \phi\left(\pi u\left(\omega_C\right) + \left(1-\pi\right)u\left(\omega_C - L\right)\right)dF\left(\pi\right)\right] \\ &= U_C\left(0,0;F\right). \end{aligned}$$

Thus, if there is a $\hat{P}^*$ such that

$$\left.\frac{\partial \widehat{SW}}{\partial P}\right|_{\hat{P}^*} = 0,$$

then I will have

$$\left.\frac{\partial SW}{\partial P}\right|_{\hat{P}^*} > 0.$$

In other words, ambiguity induces an ambiguity-averse client with unbiased beliefs to pay a higher premium.

1.3 An Increase in Ambiguity Aversion

In this section, I examine how the optimal premium will change if the client becomes more ambiguity averse. Let $\psi = h(\phi)$ where $h' > 0$ and $h'' < 0$. Since ψ is a concave transformation of ϕ, a client with ambiguity function ψ has higher degree of ambiguity aversion than a client with ambiguity function ϕ as defined in Klibanoff et al. (2005).[7]

Will the optimal premium increase with the client's ambiguity aversion? The result is shown as follows:

Proposition 1 *The optimal premium will be higher if the risk-averse and ambiguity-averse client becomes more ambiguity averse.*

Proof. *Denote P_ϕ^* as the optimal premium when the client's ambiguity function is ϕ such that*

$$\left.\frac{\partial SW}{\partial P}\right|_{\phi} = u\left(\omega_C - P_\phi^*\right) - \phi^{-1}\left[\int \phi\left(\pi u\left(\omega_C\right) + (1-\pi)\, u\left(\omega_C - L\right)\right) dF(\pi)\right]$$
$$- \left[P_\phi^* - (1-\alpha)\, L\right] u'\left(\omega_C - P_\phi^*\right) = 0, \tag{14}$$

[7] Although I have taken an inverse function of the expected ambiguity function based on the setting in Klibanoff et al. (2005), the way in which I compare the ambiguous attitudes between individuals does not change.

and P_ψ^* *as the optimal premium under ambiguity function* ψ. *Because the SOCs hold,* $P_\psi^* \geq P_\phi^*$ *if and only if*

$$\left.\frac{\partial SW}{\partial P}\right|_\psi = u\left(\omega_C - P_\phi^*\right) - \psi^{-1}\left[\int \psi\left(\pi u\left(\omega_C\right) + (1-\pi)\, u\left(\omega_C - L\right)\right) dF\left(\pi\right)\right]$$
$$- \left[P_\phi^* - (1-\alpha)\, L\right] u'\left(\omega_C - P_\phi^*\right) \geq 0. \quad (15)$$

Subtract equation (14) from equation (15), which gives $P_\psi^* \geq P_\phi^*$ *if and only if*

$$\phi^{-1}\left[\int \phi\left(\pi u\left(\omega_C\right) + (1-\pi)\, u\left(\omega_C - L\right)\right) dF\left(\pi\right)\right]$$
$$- \psi^{-1}\left[\int \psi\left(\pi u\left(\omega_C\right) + (1-\pi)\, u\left(\omega_C - L\right)\right) dF\left(\pi\right)\right] \geq 0. \quad (16)$$

Let $y\left(\phi\right)$ *denote the willingness to pay of the client with ambiguity function* ϕ *to eliminate ambiguity* $F\left(\pi\right)$, *i.e.,*

$$\begin{aligned} & \alpha u\left(\omega_C - y\left(\phi\right)\right) + (1-\alpha)\, u\left(\omega_C - L - y\left(\phi\right)\right) \\ = \;& \phi^{-1}\left(\int \phi\left(\pi u\left(\omega_C\right) + (1-\pi)\, u\left(\omega_C - L\right)\right) dF\left(\pi\right)\right), \end{aligned}$$

or

$$\begin{aligned} & \phi\left(\alpha u\left(\omega_C - y\left(\phi\right)\right) + (1-\alpha)\, u\left(\omega_C - L - y\left(\phi\right)\right)\right) \\ = \;& \int \phi\left(\pi u\left(\omega_C\right) + (1-\pi)\, u\left(\omega_C - L\right)\right) dF\left(\pi\right). \end{aligned}$$

Thus, I have

$$
\begin{aligned}
& \psi^{-1}\left[\int \psi\left(\pi u\left(\omega_C\right)+(1-\pi) u\left(\omega_C-L\right)\right) dF(\pi)\right] \\
= & \ \psi^{-1}\left[\int h\left(\phi\left(\pi u\left(\omega_C\right)+(1-\pi) u\left(\omega_C-L\right)\right)\right) dF(\pi)\right] \\
\leq & \ \psi^{-1}\left[h\left(\int \phi\left(\pi u\left(\omega_C\right)+(1-\pi) u\left(\omega_C-L\right)\right) dF(\pi)\right)\right] \\
= & \ \psi^{-1}\left[h\left(\phi\left(\alpha u\left(\omega_C-y(\phi)\right)+(1-\alpha) u\left(\omega_C-L-y(\phi)\right)\right)\right)\right] \\
= & \ \alpha u\left(\omega_C-y(\phi)\right)+(1-\alpha) u\left(\omega_C-L-y(\phi)\right) \\
= & \ \phi^{-1}\left[\int \phi\left(\pi u\left(\omega_C\right)+(1-\pi) u\left(\omega_C-L\right)\right) dF(\pi)\right],
\end{aligned}
$$

where the second line follows from the definition of ψ, the third line follows from Jensen's inequality, the fourth line follows from the definition of $y(\phi)$, the fifth line follows from the property of the inverse function, and the last line follows from the definition of $y(\phi)$. In other words, Equation (16) holds. ∎

The intuition underlying Proposition 1 is as follows. For one thing, when the client becomes more ambiguity averse, he/she is willing to pay more premiums to eliminate the uncertainty regarding ambiguous beliefs (Snow, 2010). For the other thing, an increase in the premium will increase the insurer's gain from bargaining. As a result, both parties will settle on a higher premium to make them better off.

1.4 An Increase in Ambiguity

In this section, I focus on the effect of an increase in ambiguity. Suppose that the distribution of the client's ambiguous beliefs shifts from F to G. As noted by Snow (2010, 2011), due to the unbiased assumption (Equation (5)), an increase in ambiguity is a mean-preserving spread on the distribution of the no-loss probability.

Thus, an increase in ambiguity means that G is a mean-preserving spread of F as defined as follows:

Definition 1 *A distribution G is a mean-preserving spread of the distribution F (written as "G MPS F") if*

$$F^{(2)}(\pi) \leq G^{(2)}(\pi), \forall \pi, \text{ and} \int \pi \, dF(\pi) = \int \pi \, dG(\pi),$$

where $F^{(2)}(\pi) = \int_0^{\pi} F(t)\, dt$ and $G^{(2)}(\pi) = \int_0^{\pi} G(t)\, dt$.

Since these two distributions have the same mean, full coverage is still optimal. The effect of an increase in ambiguity on the optimal premium is shown in the following proposition:

Proposition 2 *If G MPS F, then the optimal premium under F will be lower than the optimal premium under G for all risk-averse and ambiguity-averse individuals.*

Proof. *Since the SOCs hold, the optimal premium under F (P^*) will be lower than the optimal premium under G if and only if*

$$\left.\frac{\partial SW}{\partial P}\right|_G = u(\omega_C - P^*) - U_C(0,0;G) - [P^* - (1-\alpha)L]\, u'(\omega_C - P^*) \geq 0. \quad (17)$$

Note that

$$\left.\frac{\partial SW}{\partial P}\right|_F = u(\omega_C - P^*) - U_C(0,0;F) - [P^* - (1-\alpha)L]\, u'(\omega_C - P^*) = 0. \quad (18)$$

Thus, condition (17) can be rewritten as

$$U_C(0,0;F) \geq U_C(0,0;G). \quad (19)$$

Since ϕ^{-1} is an increasing function, the condition is equivalent to

$$\int \phi\left(\pi u\left(\omega_C\right)+(1-\pi) u\left(\omega_C-L\right)\right) dF(\pi) \geq \int \phi\left(\pi u\left(\omega_C\right)+(1-\pi) u\left(\omega_C-L\right)\right) dG(\pi). \tag{20}$$

Let

$$Z=\int \phi\left(\pi u\left(\omega_C\right)+(1-\pi) u\left(\omega_C-L\right)\right)[dF(\pi)-dG(\pi)].$$

If Z is positive, then condition (20) holds. Integrating Z by parts, I get

$$\begin{aligned}
Z &= \int \phi\left(\pi u\left(\omega_C\right)+(1-\pi) u\left(\omega_C-L\right)\right)[dF(\pi)-dG(\pi)] \\
&= -\left[u\left(\omega_C\right)-u\left(\omega_C-L\right)\right] \int \phi'\left(\pi u\left(\omega_C\right)+(1-\pi) u\left(\omega_C-L\right)\right)[F(\pi)-G(\pi)] d\pi \\
&= \left[u\left(\omega_C\right)-u\left(\omega_C-L\right)\right]^2 \int \phi''\left(\pi u\left(\omega_C\right)+(1-\pi) u\left(\omega_C-L\right)\right)\left[F^{(2)}(\pi)-G^{(2)}(\pi)\right] d\pi.
\end{aligned}$$

Since G MPS F, by definition 1, $F^{(2)}(\pi)-G^{(2)}(\pi) \leq 0, \forall \pi$. Moreover, $\left[u\left(\omega_C\right)-u\left(\omega_C-L\right)\right]^2$ is nonnegative, and ϕ'' is negative because ϕ is a concave function. Consequently, $Z \geq 0$. ■

Snow (2010) indicated that there is an increase in ambiguity if the distribution of the ambiguity beliefs has a mean-preserving spread. Proposition 2 shows that an increase in ambiguity will raise the optimal premium. The intuition is as follows. The ambiguity-averse client is averse to mean-preserving spreads in the space of probabilities, and a full-coverage insurance contract could make the client unaffected by such spreads, which provides he/she an incentive to pay a higher premium for it. Therefore, the negotiation will turn out to be a full-coverage insurance contract with a higher premium.

1.5 Conclusions

This paper has studied cooperative insurance bargaining under an increase in ambiguity aversion and an increase in ambiguity, respectively. When the loss probability is uncertain for the risk-and-ambiguity-averse client, I show that the client settles with the insurance company on a full-coverage insurance contract and that the optimal premium becomes higher due to the introduction of ambiguity. Moreover, the client is found to pay a higher premium for the full-coverage insurance contract when an increase in ambiguity aversion and an increase in ambiguity occur.

It is noted that the optimal premiums under different cases have implied relationships among one another. Denote P_0 as the optimal premium in the absence of ambiguity, P_1 as the optimal premium in the presence of ambiguity, P_2 as the optimal premium due to an increase in ambiguity aversion, and P_3 as the optimal premium due to an increase in ambiguity. The results suggest that $P_2 \geq P_1 \geq P_0$ and $P_3 \geq P_1 \geq P_0$. If having the data which could be used to measure risk aversion (e.g., the data of risk premium), ambiguity aversion (e.g., the data of ambiguity premium), and ambiguity, one can empirically test the relationships by controlling the degree of risk aversion as a future study. For example, the information provided by the questionnaires from Health and Retirement Study (HRS) could be employed in the future study.

In addition, in this paper, the insurance bargaining is modeled as a cooperative game as in Kihlstrom and Roth (1982). Viaene at al. (2002) proposed a non-cooperative bargaining game to study the insurance contract in equilibrium. A further study which analyzes a non-cooperative insurance bargaining game under ambiguity could be valuable. Moreover, as Muthoo (1995) and Ponsati and S$\acute{a}$kovics (1998) who studied the non-cooperative bargaining dames with outside options, a future study investigating the optimal insurance contract by considering that the client can bargain with other insurance companies in the case that the bargain breaks down would be fruitful.

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2 Who Obtains more Discount on Insurance Premiums?

2.1 Introduction

While the factors determining automobile insurance premiums have been well-studied in the literature on automobile insurance pricing (Brockett and Golden, 2007; Derrig and Tennyson, 2011; Bair et al. 2012)[8], the causes of differential premium discount have received less attention in the literature. For example, it is generally believed that, due to risk considerations, the automobile insurance premiums paid by drivers who have previously filed a claim should be higher. However, it is less obvious whether these drivers should receive less discount. It is noted that previous studies on insurance pricing focused on the final price that an insured pays, and this paper extends this line of the literature but investigate the discount between the initial price that an insurer offers and the final price that an insured pays.

Specifically, the first purpose of this paper is to examine whether the risk aversion of an insured is associated with more premium discount. This study can be regarded as an empirical study on insurance bargaining. Since Kihlstrom and Roth (1982) pioneered the study of bargaining in the insurance market and showed that a more risk-averse individual settles with an insurance company on a higher insurance premium, some papers have provided insightful findings by using alternative insurance bargaining models (e.g., Schlesinger, 1984; Viaene et al., 2002). However,

[8]By reviewing many papers, Brockett and Golden (2007) noted that some biological characteristics (such as a lack of responsibility) and psychobehavioral characteristics (such as a sensation-seeking personality type) are associated with risky driving which further affects insured losses. Derrig and Tennyson (2011) highlighted the importance of premium rate regulation and found that the cross-subsidizing of premiums aggravate the insurance costs. In addition, Bair et al. (2012) found that vehicle maintenance records can predict the probability of an accident.

most of them are theoretical papers and have provided little empirical support for their predictions. Therefore, this paper intends to fill this gap in the literature.

Second, this paper tests the impact of bargaining power on premium discount. As mentioned in the literature, the stronger the bargaining power that an individual has, the more the benefit that he/she receives (e.g., Yavas and Yang, 1995; Arnold, 1999; Harding et al., 2003; Casterella et al., 2004; Colwell and Munneke, 2006; Quiggin and Chambers, 2009). Nevertheless, few papers empirically examine this issue in the insurance market, which leads to my secondary purpose.

A unique data set based on Taiwanese automobile liability insurance for property damage is used to examine this research question. The data are hand-collected from a large insurance company and cover new policies issued from 2005 to 2007. The special feature of the data set is that it contains both the premium that an insurance company initially offers and the premium that a policyholder finally pays. I choose automobile liability insurance for property damage for several reasons. First, automobile liability insurance has no deductible, and so I can therefore avoid the confounding effect resulting from different deductibles. Second, I specifically employ the data on automobile liability insurance for property damage rather than bodily injury because the coverage for bodily injury is much more complicated than that for property damage.[9] I intend to use relatively homogeneous data in my analysis. By further selection, the sample comprises 14,185 observations.

To compare the relative size of premium discount among insured paying different premiums, I use the ratio of the premium discount but not the amount of the premium discount as the measure. The premium discount ratio is defined as 1

[9]The coverage for bodily injury provides indemnity based on per person or per accident while the coverage for property damage provides indemnity only based on per accident.

minus the premium that a policyholder finally pays divided by the premium that an insurance company initially offers.

In this paper, more coverage (multiple types of insurance coverage) is employed as a proxy for more risk aversion. Other things being equal, an individual with a higher degree of risk aversion would purchase more coverage as shown by De Meza and Webb (2001), Cohen and Einav (2007), Li and Peng (2011), and Schmitz (2011). In particular, to capture risk aversion, I create a dummy variable which is equal to zero if the policyholder only purchases automobile liability insurance for property damage (ALIPD) and is equal to one if the policyholder purchases not only ALIPD but also auto comprehensive insurance, auto collision insurance, auto theft insurance or auto liability insurance for bodily injury. On the other hand, claim records are used as a proxy for the strength of the bargaining power of policyholders. The policyholders whose cars do not have records of claims are good customers. Good customers have lower costs of switching their coverage to other insurance companies and thus might have stronger bargaining power.

To obtain the pure effects of risk aversion and bargaining power, I control estimated insured risks and all underwriting variables such as gender, marital status, age, residential region, displacement, import car, and car age. The influence of recession is also controlled since macroeconomic factors might influence both an insureds willingness to buy and an insurer's willingness to sell.

After controlling risks as well as the characteristics of both cars and car owners, I find strong support for the view that policyholders with multiple types of coverage obtain significantly lower premium discount ratios. The finding is consistent with the theoretical result on insurance bargaining that more risk-averse individuals will pay higher premiums. Moreover, the policyholders who have never filed a claim are found to obtain significantly higher discount ratios, which is compatible with the result of previous papers that an individual's bargaining gain increases with his/her bargaining power.

The rest of the paper is organized as follows. Section 2.2 develops the hypotheses. Section 2.3 describes the data and methodology. The empirical results are shown in Section 2.4. Finally, Section 2.5 concludes the paper.

2.2 Hypotheses

The purpose of this paper is to examine whether an insureds risk aversion and bargaining power are significantly related to his/her premium discount ratio. The hypotheses regarding risk aversion and bargaining power are developed in this section.

More risk-averse individuals might obtain lower discount ratios. The theoretical literature on insurance bargaining has demonstrated that, other things being equal, as an insured becomes more risk averse, he/she will pay more premiums to an insurer when buying insurance either through cooperative or non-cooperative bargaining ways. For example, Kihlstrom and Roth (1982) showed this result by investigating a cooperative bargaining game between a risk-neutral insurance company and a risk-averse client. Schlesinger (1984) proposed a more generalized model and found that when the insured is more risk averse, the insurance company obtains more expected profit. Moreover, Viaene et al. (2002) also obtained this result in a non-cooperative bargaining game.[10] Hence, more risk aversion is expected to be associated with

[10]Viaene et al. (2002) studied the effect of a discount factor on the premium in a non-cooperative bargaining game. They described the effect of a discount factor as the effect of risk aversion and found that, when the insureds discount factor gets lower (the insured becomes more risk averse),

lower premium discount ratios, which is expressed as the following hypothesis:

Hypothesis 1: *More risk-averse insured might obtain lower premium discount ratios than less risk-averse insured.*

To capture more risk aversion, more coverage is used as its proxy. More risk-averse individuals will buy more coverage. As shown by De Meza and Webb (2001), more risk-averse individuals buy more coverage and engage in more self-protection to reduce their risks than less risk-averse individuals, which results in a negative relationship between insurance coverage and risks, i.e., advantageous selection. Schmitz (2011) noted that risk aversion is a source of advantageous selection in the German private health insurance market.[11] He found that risk-averse individuals are more likely to buy private supplementary insurance and to have lower risks.

Some papers also found evidence of the relationship between risk aversion and insurance coverage by estimating the level of risk aversion or finding proxies for risk aversion with insurance data. For example, Cohen and Einav (2007) estimated the boundary for the individual level of risk aversion from the data on the deductible choice of automobile insurance policies. They claimed that the estimated boundary is the lower bound for the degree of risk aversion of an individual who chooses a low-deductible (high-coverage) policy. In addition, the purchase of voluntary automobile liability insurance other than comprehensive vehicle insurance for physical damage is found to be a proxy for risk aversion by using the data for Taiwan (Li and Peng, 2011).[12] Therefore, in this paper, the insured with more coverage are supposed to be the more risk-averse insured, being thereby expected to obtain lower discount

he/she settles with the insurer on a higher premium.

[11]However, Fang et al. (2008) found that cognitive ability instead of risk aversion is an important source of advantageous selection in the Medigap insurance market.

[12]Nevertheless, they noted that when considering the coverage amount of voluntary automobile liability insurance, it may not necessarily be a proxy for risk aversion.

ratios.

The other hypothesis is about bargaining power. An individual with greater bargaining power could acquire more favorable terms or outcomes when bargaining with his/her counterparty. This has been theoretically shown and empirically tested in different industries. In the industry of real estate, the selling price of a house is commonly determined through a bargain between a seller and a buyer. Some theoretical papers show that when a sellers bargaining power is relatively strong, the selling price of his/her house is higher (e.g., Yavas and Yang, 1995; Arnold, 1999)[13]. From then on, many empirical papers such as Harding et al. (2003) and Colwell and Munneke (2006)[14] have examined this prediction and have found evidence supporting it.

Other industries like the audit industry and the insurance industry are also investigated. For example, Casterella et al. (2004) examined the relationship between clients bargaining power and audit pricing. Their result revealed that, in general, when a firm has greater bargaining power, its audit fee is lower.[15] Quiggin and Chambers (2009) studied how bargaining power will affect the efficiency of insurance contracts. They theoretically demonstrated that social welfare increases with the clients bargaining power. Thus, based on the above papers, the insured with greater bargaining power are expected to obtain higher discount ratios. This relationship is stated in the following hypothesis:

[13]Yavas and Yang (1995) theoretically and empirically examined the role of the listing price in selling real estate. One of their theoretical results showed that as a sellers bargaining power increases, the ex-post transaction price also increases. Similarly, in his search-and-bargaining model, Arnold (1999) proved that the greater a sellers bargaining power, the higher the expected selling price, thus leading to a higher expected return of the seller.

[14]Harding et al. (2003) and Colwell and Munneke (2006) respectively used data in the housing market and office market to test this relationship. Both of their results suggested that bargaining power affects the transaction price.

[15]This result, however, is only significant in the large-firm sample when dividing the full sample into two subsamples according to firm size.

Hypothesis 2: *The insured with stronger bargaining power might obtain higher premium discount ratios than those with weaker bargaining power.*

No claim records are used as a proxy for stronger bargaining power. Those who have never filed a claim might have greater bargaining power since they can relatively more easily switch their coverage to other insurance companies than those who have already filed a claim. Alternatively, to attract good customers, insurers might be willing to offer these customers better premium discount ratios, which would give them an advantage when bargaining over discount ratios. Accordingly, the owners of the cars without claim records might have stronger bargaining power and are expected to have higher premium discount ratios.

2.3 Data and Methodology

2.3.1 Data

This paper employs the data on ALIPD in Taiwan to test the hypotheses.[16] ALIPD provides an insured with protection in case his/her vehicle causes damage to other people's property. The data are provided by a leading property and casualty insurance company in Taiwan and cover new policies[17] from 2005 to 2007.

The information contained in the data is composed of four elements. The first concerns the characteristics of policyholders: with or without other types of insurance coverage besides ALIPD, gender, marital status, age, and living region. The second has to do with the characteristics of the insured vehicles: claim records, engine displacement, import or domestic, and years old. The third element is about

[16]It is suitable for examining the research questions by using the data on ALIPD. Premium discount is commonly observed in the auto insurance market. The sample also reveals this feature: 80% (see Table 2) of policyholders have premium discount.

[17]The data therefore do not include the renewed policies.

the insurance contracts, including the policy number, issue date, the premiums that initially offered by the insurance company and the premiums that finally paid by the policyholders. The last element is about the claims, including the claim date, claim amounts, and settlement date. By connecting the 12-digit policy number with the claim data, I can verify the claim information for each policy. As a result, based on these internal data, it is able to calculate the premium discount ratio as well as estimate the insured risk for each policy.

I further conduct the following procedure to obtain the final sample. First, only the policies issued by direct writers are included. Second, the insured that are corporations are subsequently excluded. Next, I select the policies with an insurance coverage amount of $500,000 for the analysis. Finally, the claim data are extended to the year 2010 to ensure that each claim was completely settled without involving a loss which has been reported but has not yet been settled. The final sample consists of 14,185 observations.

The sample produced from the above procedure could help to obtain more accurate results. For one thing, the policies issued by direct writers have an advantage of avoiding the confounding effect of different marketing channels on the premium discount ratios. Non-direct writers, such as auto dealer insurance agents, often mix the discount on auto sales with the discount on insurance premiums. Thus, focusing on the policies issued by direct writers could alleviate this problem. For another thing, selecting the policies with a coverage amount of $500,000 generates the largest sample size. Furthermore, in doing so, the possibility that the premium discount ratios vary with the coverage amounts can be excluded since all the policies in the sample have an identical coverage amount.

2.3.2 Measurement of Variables

For the sake of examining whether risk aversion and bargaining power have a direct impact that is not via risks on the premium discount ratios, controlling for the influence of insured risks is crucial. Accordingly, I estimate the insured risk, and then regard it as a control variable when testing the hypotheses. All the variables and their definitions are listed in Table 1.

[Insert Table 1 here]

An insured risk can be measured in terms of the accident probability or the claim amount. In this paper, the expected claim amount is used to measure an insured risk in order to consider both of the measurements. Hence, in the first step – estimating risks, the dependent variable is the claim amount defined as the total claim amount of a policy when all its claims are settled. As for the independent variables, a dummy variable insurance is used to denote multiple types of insurance coverage (more coverage). Because all the policies in the sample have an identical coverage amount, more coverage here means multiple types of coverage which is defined as an insured with any of the following types of insurance in addition to ALIPD: Type-A/Type-B auto comprehensive insurance[18], auto collision insurance, auto theft insurance, and auto liability insurance for bodily injury. The proxy for stronger bargaining power is no claim records denoted by the variable past claim which is a dummy variable equalling 0 if the insured car has no claim records.[19] I also include the demographic variables and insured vehicle variables as independent variables. In addition, oil

[18]Type-B auto comprehensive insurance provides indemnities for losses resulting from fire, floods, thunder, drops, and collision, whereas Type-A auto comprehensive insurance not only includes the coverage of Type-B insurance but also provides indemnities for intentional damage from the third party.

[19]An insured vehicle with claim records here means that the insured has previously filed a claim for any type of auto insurance or liability insurance.

price and year dummy variables are included to respectively reflect driving costs and control the year effect.

In the next step – testing the hypotheses, the dependent variable premium discount ratio is defined as 1 minus the premium that the policyholder finally pays divided by the premium that the insurance company initially offers. The main independent variables are insurance and past claim which have been defined in the previous step. To control risks, the predicted expected claim amount which is the expected claim amount estimated by the first step is included as a control variable. For other control variables, in addition to demographic variables, vehicle variables, and year dummy variables, a business cycle variable recession is included and indicates whether a policy is issued in the month when the economy is in a period of recession.

2.3.3 Models

The expected claim amount is first estimated for each policy. The relationship between the expected claim amount and the independent variables is modeled by a Tobit regression[20] as follows (the subscript i denotes the i-th policy):

$$L_i = X_i\beta_i + u_i, \tag{21}$$

where L_i is the claim amount; X_i represents a vector of the independent variables; u_i is the random error term with a truncated normal distribution; and β_i is a vector of regression coefficients for X_i. The vector of estimated coefficients $\hat{\beta}_i$ obtained

[20]Due to the high percentages of the zero claim amounts and the zero ratios on premium discount (96% and 20%, respectively, not shown), Tobit regression models are employed in estimating risks and examining the hypotheses.

from Equation (21) is used to compute the predicted expected claim amount of each policy.

Subsequently, I examine the relationships between risk aversion/bargaining power and the premium discount ratios by using the following Tobit regression model (the subscript i denotes the i-th policy):

$$DoP_i = Y_i\alpha_i + \hat{L}_i\gamma_i + e_i, \tag{22}$$

where DoP_i is the premium discount ratio; Y_i is a vector of the independent variables; $\hat{L}_i$ is the predicted expected claim amount estimated by Equation (21); e_i is the random error term with a truncated normal distribution; and α_i and γ_i are the vectors of the coefficients for Y_i and $\hat{L}_i$, respectively.

2.4 Empirical Findings

In this section, I present the characteristics of the sample and check that the independent variables used to explain the discount ratios can also explain the insurance premiums. Subsequently, I show the results of the risks estimation and the analysis of premium discount ratios. All the results are displayed in Tables 2, 3, 4, and 5.

The summary statistics of all the variables are shown in Table 2, which reveals the characteristics of the sample.[21] On average, the premium that the insurance company initially offers is NT\$1,618 and the premium that the policyholder finally pays is NT\$1,296. The average discount amount is NT\$240. In addition, the percentage of the policyholders in the sample with premium discount is rather higher

[21] I also examine the whole sample, which contains the policyholders with not only ALIPD but also other types of insurance (auto comprehensive insurance, auto collision insurance, auto theft insurance or auto liability insurance for bodily injury). The summary statistics of the premium discount ratios in the whole sample are found to be almost the same as those in the ALIPD sample.

(80% on average), and a policyholder can obtain a 15% discount on average and a 34% discount at most on his/her premium. For the distribution of claim amount, each policy in total yields a claim amount of NT$880 dollars when all its claims have been settled, but the variation is rather great, with a range from NT$0 dollars to NT$449,450 dollars. Furthermore, I find that 72% of insured buy not only ALIPD, but also other types of auto and liability insurance, which suggests that it is quite common for the insured in the sample to have multiple types of coverage. Finally, the number of the insured vehicles with claim records is moderate (28%).

[Insert Table 2 here]

Before showing the main results, I use an OLS regression to check whether the independent variables employed in the model of the discount ratios are indeed the determining factors of insurance premiums. For the dependent variable premiums, two definitions are adopted: premium initially offered and premium finally paid. The results are provided in Table 3. The signs and the significance of the independent variables are generally consistent with the findings in previous papers. Hence, I confirm that the insurance premiums are significantly correlated with these variables.

[Insert Table 3 here]

Next, I estimate insured risks, and the results are shown in Table 4. Two variables are found to significantly affect the risks (the expected claim amounts). An insured whose car with claim records has a significantly lower risk. A possible explanation could be that the insured whose car with claim records had been charged an additional premium due to the experience rating scheme (bonus-malus), so that he/she would drive more carefully to avoid an accident. The other significant variable is car age 1. The risks associated with new cars are significantly higher than those associated with old cars. A rationale could be that the owners of new cars are unfamiliar with driving the cars, thereby incurring more damage on other people's property due to over acceleration or improper driving in reverse.

[Insert Table 4 here]

Let us now turn to the focus of this paper – whether more risk aversion and stronger bargaining power are associated with a higher premium discount ratio. The results are presented in Table 5. First take a look at the variable predicted expected claim amount, which is significantly negative at the 0.01 level. It indicates that, on average, an insured with a higher risk receives a significantly lower premium discount ratio, which is consistent with the result that policyholders with higher risks are charged higher premiums.

[Insert Table 5 here]

After controlling for insured risks and underwriting variables, I find evidence supporting the hypotheses. In particular, the relationship between the variable insurance and the premium discount ratio is significantly negative at the 0.01 level, which is consistent with Hypothesis 1 that more risk-averse insured would obtain lower discount ratios than less risk-averse insured. In addition, the past claim variable is found to have a significantly negative relationship with the premium discount ratio at the 0.01 level. In other words, the insured with stronger bargaining power would obtain higher discount ratios than the insured with weaker bargaining power, which is consistent with Hypothesis 2.

This paper could serve as a complement to the literature on insurance bargaining. For one thing, since multiple types of coverage (more coverage) are used to capture more risk aversion according to the literature (e.g., De Meza and Webb, 2001; Cohen and Einav, 2007; Li and Peng, 2011; Schmitz, 2011), my results could support the theoretical results on insurance bargaining that more risk aversion will induce an individual to settle with an insurer on a higher premium (Kihlstrom and Roth, 1982; Schlesinger, 1984; Viaene et al., 2002). In addition, it is noted that the policyholders who have not filed a claim in the past are supposed to have stronger bargaining power. As a result, the result obtained in many papers is that the stronger the bargaining power that an individual has, the more the benefit that he/she obtains (e.g., Yavas and Yang, 1995; Arnold, 1999; Harding et al., 2003; Casterella et al., 2004; Colwell and Munneke, 2006; Quiggin and Chambers, 2009), a finding which is also confirmed in the ALIPD market.

As for the results of the other variables, one interesting result concerns the variable for recession. It suggests that, on average, the insured obtain significantly higher premium discount ratios in the periods of recession than in the periods of non-recession. One explanation could be that, if most people are risk averse, buying insurance would give rise to larger marginal disutility since they have less money in the periods of recession. Hence, they would bargain with insurers over higher discount ratios to reduce the reduction in marginal utility. Another explanation could be that insurers would offer customers higher discount ratios to raise their willingness to buy insurance, because people might reduce their expenditure in the periods of recession by purchasing less insurance.

2.5 Conclusions

By using a unique data set for the Taiwanese ALIPD market, this paper examines who obtains greater discount on insurance premiums. After taking the impact through risks into consideration, I find significant evidence supporting the view that both risk aversion and bargaining power influence premium discount ratios. More specifically, the results reveal that the insured who are more risk averse, i.e., the insured who purchase multiple types of coverage, receive significantly lower premium discount ratios. Furthermore, the policyholders with greater bargaining power, i.e., the policyholders whose cars do not have claim records, are found to receive significantly higher discount ratios.

This paper could be viewed as an empirical study on insurance bargaining. I provide evidence for the theoretical predictions of insurance bargaining proposed by Kihlstrom and Roth (1982), Schlesinger (1984), and Viaene et al. (2002). Moreover, I also confirm that the positive relationship between bargaining power and bargaining outcomes found in previous papers (e.g., Yavas and Yang, 1995; Arnold, 1999; Harding et al., 2003; Casterella et al., 2004; Colwell and Munneke, 2006; Quiggin and Chambers, 2009) also exists in the ALIPD market.

Further research could be conducted in two ways. First, in this paper, I investigate the effects of risk aversion and bargaining power by examining their proxies. Further research could directly examine the two effects. As in Cohen and Einav (2007), if data are available which can be used to estimate the policyholders degree of risk aversion, one could provide more convincing evidence for the hypotheses. Second, it should be noted that this paper provides a preliminary but not comprehensive study on the factors determining premium discount. Beyond risk aversion and bargaining power, other factors such as ambiguity and ambiguity aversion might affect premium discount. Huang et al. (2013) have theoretically shown that both ambiguity and ambiguity aversion induce an insured to pay higher premiums for full coverage when buying insurance through bargaining. As a result, future studies could also be extended to empirically examine these effects.

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Table 1: Definitions of Variables

Variable	Definition	Step 1	Step 2
Discount amount	The premium that the insurance company initially offers- The premium that the policyholder finally pays ($)		
With discount ratio	Number of the policyholders who obtain premium discount/Number of all the policyholders		
Dependent variable			
Premium initially offered	The premium that the insurance company initially offers ($)		
Premium finally paid	The premium that the policyholder finally pays ($)		
Claim amount	Total claim amount of a policy after all its claims are settled ($)	V	
Premium discount ratio	1-(The premium that the policyholder finally pays/The premium that the insurance company initially offers)		V
Independent variable			
Predicted expected claim amount	Predicted expected claim amount estimated by Equation (1) ($)		V
Insurance	1 if an insured purchases any of the following insurance besides ALIPD: Type-A/Type-B auto comprehensive insurance, auto collision insurance, auto theft insurance, and auto liability insurance for bodily injury; 0 otherwise	V	V
Past claim	1 if an insured vehicle has claim records; 0 otherwise	V	V
Male	1 if an insured is male; 0 otherwise	V	V
Marriage	1 if an insured is married; 0 otherwise	V	V
Insured age 20	1 if an insured's age is less than 20; 0 otherwise	V	V
Insured age 2040	1 if an insured's age is between 20 and 40; 0 otherwise	V	V

Table 1: Definitions of Variables

Variable	Definition	Step 1	Step 2
Insured age 4070	1 if an insured's age is between 40 and 70; 0 otherwise	V	V
(Reference group: the insured whose ages are larger than 70)			
North	1 if an insured lives in the northern part of Taiwan; 0 otherwise	V	V
Midland	1 if an insured lives in the central part of Taiwan; 0 otherwise	V	V
South	1 if an insured lives in the southern part of Taiwan; 0 otherwise	V	V
(Reference group: the insured who live in the eastern part of Taiwan)			
City	1 if an insured lives in Taipei city, New Taipei city, Taichung city or Kaohsiung city; 0 otherwise	V	V
Displacement 1.6	1 if displacement of an insured vehicle is less than 1.6 liters; 0 otherwise	V	V
Displacement 1.6-2.4	1 if displacement of an insured vehicle is between 1.6 and 2.4 liters; 0 otherwise	V	V
(Reference group: the insured vehicle whose displacement is larger than 2.4 liters)			
Import	1 if an insured vehicle is imported; 0 otherwise	V	V
Car age 1	1 if an insured vehicle is less than 1 year old; 0 otherwise	V	V
Car age 1-5	1 if an insured vehicle is between 1 and 5 years old; 0 otherwise	V	V
(Reference group: the insured vehicle whose ages are larger than 5 years)			
Oil price	Average oil price of Premium 95 gasoline during the policy year ($)	V	
Recession	1 if the monthly monitoring indicator compiled by the Council for Economic Planning and Development is Yellow-blue or Blue[15]; 0 otherwise		V
Year 2005	1 if the policy was issued in the year 2005; 0 otherwise	V	V
Year 2006	1 if the policy was issued in the year 2006; 0 otherwise	V	V
(Reference group: the policies which were issued in the year 2007)			

[15] The monthly monitoring indicators Yellow-blue and Blue respectively indicate that the economy is transitional and sluggish.

Table 2: Summary Statistics of Variables

Variable	Mean	Std. Deviation	Median	Min	Max
Premium initially offered	1618.1400	372.1752	1573.0000	1112.0000	4600.0000
Premium finally paid	1295.5600	306.4023	1258.0000	796.0000	3588.0000
Discount amount	240.3431	159.4514	243.0000	0.0000	1163.0000
With discount ratio	0.8016	0.3988	1.0000	0.0000	1.0000
Premium discount ratio	0.1487	0.0898	0.1502	0.0000	0.3402
Claim amount	879.6885	8974.4800	0.0000	0.0000	449450.0000
Predicted expected claim amount	1026.5500	335.5388	966.0902	418.1765	17453.4000
Insurance	0.7185	0.4497	1.0000	0.0000	1.0000
Past claim	0.2823	0.4501	0.0000	0.0000	1.0000
Male	0.4025	0.4904	0.0000	0.0000	1.0000
Marriage	0.9069	0.2905	1.0000	0.0000	1.0000
Insured age 20	0.0001	0.0119	0.0000	0.0000	1.0000
Insured age 2040	0.4603	0.4984	0.0000	0.0000	1.0000
Insured age 4070	0.5304	0.4991	1.0000	0.0000	1.0000
North	0.4632	0.4087	0.0000	0.0000	1.0000
Midland	0.2233	0.4164	0.0000	0.0000	1.0000
South	0.2983	0.4575	0.0000	0.0000	1.0000
City	0.3330	0.4713	0.0000	0.0000	1.0000
Displacement 1.6	0.3182	0.4658	0.0000	0.0000	1.0000
Displacement 1.6-2.4	0.5523	0.4973	1.0000	0.0000	1.0000
Import	0.2705	0.4442	0.0000	0.0000	1.0000
Car age 1	0.1314	0.3379	0.0000	0.0000	1.0000
Car age 1-5	0.5418	0.4983	1.0000	0.0000	1.0000
Oil price	27.7236	2.1293	27.3603	24.0167	31.9875
Recession	0.4744	0.4994	0.0000	0.0000	1.0000
Year 2005	0.3452	0.4755	0.0000	0.0000	1.0000
Year 2006	0.3492	0.4767	0.0000	0.0000	1.0000
Sample size			14185.0000		

Table 3: Results of the OLS Regression on Premiums

The dependent variable is premium initially offered or premium finally paid. Premium initially offered is the premium that the insurance company initially offers, and premium finally paid is the premium that the policyholder finally pays. * denotes statistical significance at the 0.10 level, ** denotes statistical significance at the 0.05 level, and *** denotes statistical significance at the 0.01 level.

Variable	Premium initially offered		Premium finally paid	
	Coefficient	T Statistic	Coefficient	T Statistic
Intercept	1586.1961	55.5500***	1319.3777	53.7100***
Insurance	3.4780	0.7300	-5.2923	-1.2900
Past claim	544.4095	115.5500***	441.9090	109.0300***
Male	212.4250	50.7900***	168.3475	46.7800***
Marriage	-195.1670	-27.4900***	-159.5258	-26.1200***
Insured age 20	1267.2366	7.5100***	942.1024	6.4900***
Insured age 2040	-61.8924	-2.9300***	-74.9492	-4.1200***
Insured age 4070	-142.3399	-6.7500***	-131.6730	-7.2600***
North	-14.2658	-0.8600	-18.9334	-1.3300
Midland	-21.0339	-1.2600	-12.2303	-0.8500
South	-25.5054	-1.5400	-2.7650	-0.1900
City	-0.7458	-0.1700	-14.6697	-3.8100***
Displacement 1.6	24.5282	3.2900***	22.5673	3.5100***
Displacement 1.6-2.4	2.4425	0.3600	1.6731	0.2800
Import	-10.2745	-2.0000**	-12.0705	-2.7300***
Car age 1	-20.1963	-2.8500***	-56.3273	-9.2300***
Car age 1-5	92.1709	19.1900***	60.6277	14.6700***
Year 2005	76.7368	15.3600***	47.3199	11.0100***
Year 2006	45.0004	9.0300***	24.9566	5.8200***
Recession	-11.8363	-2.9400***	-3.6878	-1.0600
R^2	0.5972		0.5601	
Adjusted R^2	0.5966		0.5595	
Sample size	14185.0000		14185.0000	

Table 4: Results of the Tobit Regression on Expected Claim Amounts

The dependent variable is the claim amount. * denotes statistical significance at the 0.10 level, ** denotes statistical significance at the 0.05 level, and *** denotes statistical significance at the 0.01 level.

Variable	Coefficient	Chi-square Statistic
Intercept	-47787.9000	0.3300
Insurance	-2060.8600	0.3300
Past claim	-13916.5000	16.8900***
Male	786.4868	0.0600
Marriage	3715.2390	0.5200
Insured age 20	-77796.0000	1.5500
Insured age 2040	8858.7210	0.3700
Insured age 4070	7157.7790	0.2500
North	-8506.4000	0.4300
Midland	-530.7550	0.0000
South	-3401.8800	0.0700
City	-1123.0800	0.1200
Displacement 1.6	-1518.3000	0.0800
Displacement 1.6-2.4	2720.0080	0.2800
Import	1668.8290	0.1900
Car age 1	12666.3100	5.4100**
Car age 1-5	892.8617	0.0600
Oil price	-500.3520	0.0800
Year 2005	-321.0850	0.0000
Year 2006	-424.3190	0.0000
Log-Likelihood	-7823.5024	
Sample size	14185.0000	

Table 5: Results of the Tobit Regression on Premium Discount Ratios

The dependent variable is the premium discount ratio. * denotes statistical significance at the 0.10 level, ** denotes statistical significance at the 0.05 level, and *** denotes statistical significance at the 0.01 level.

Variable	Coefficient	Chi-square Statistic
Intercept	2.1189	53.8400***
Predicted expected claim amount	-0.0001	46.3300***
Insurance	-0.0306	143.9800***
Past claim	-0.0548	30.3000***
Male	0.0055	8.0200***
Marriage	0.0068	2.8100*
Insured age 20	-1.8050	44.6000***
Insured age 2040	0.0167	2.0800
Insured age 4070	0.0281	6.5500**
North	-0.0183	4.1300**
Midland	0.0191	6.6100***
South	0.0038	0.2500
City	-0.0501	551.4400***
Displacement 1.6	-0.0117	11.2000***
Displacement 1.6-2.4	0.0037	1.0600
Import	-0.0002	0.0000
Car age 1	0.0106	1.4200
Car age 1-5	-0.0049	4.5800**
Year 2005	-0.0032	1.3100
Year 2006	0.0019	0.5500
Recession	0.0068	14.0700***
Log-Likelihood	6374.6999	
Sample size	14185.0000	