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Insurance bargaining under ambiguity

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HIGHLIGHTS

- We examine both cooperative and non-cooperative insurance bargaining games.
- In the presence of ambiguity, full coverage is optimal.
- The optimal premium is higher in the presence than in the absence of ambiguity.
- The optimal premium will increase with the degree of ambiguity aversion.
- The optimal premium will increase with an increase in ambiguity.

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ABSTRACT

This paper investigates the effects of an increase in ambiguity aversion and an increase in ambiguity in an insurance bargaining game with a risk-and-ambiguity-neutral insurer and a risk-and-ambiguity-averse client. Both a cooperative and a non-cooperative bargaining game are examined. We show that, in both games, full coverage is optimal in the presence of ambiguity, and that the optimal premium is higher in the presence of ambiguity than in the absence of it. Furthermore, the optimal premium will increase with both the degree of ambiguity aversion and an increase in ambiguity.

1. Introduction

Both cooperative and non-cooperative bargaining between insurance companies and clients are commonly observed in reality. One case for cooperative bargaining is that 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. The insurance companies and their clients negotiate over the terms of the insurance and seek to draw up contracts which can benefit both parties. Another case for non-cooperative bargaining is that the insurance company could settle the property and casualty insurance contract with a large corporation, or the unemployment insurance with a union through bargaining. Therefore, analysis under a bargaining context is important and deserves attention in insurance.

Kihlstrom and Roth (1982) were the first to analyze the Nash equilibrium of a cooperative bargaining game between a risk-neutral insurance company and a risk-averse client. They found that the optimal insurance contract is a full-coverage one. In addition, they found that the more risk-averse the client is, the higher the premium that he/she will pay.[1] Schlesinger (1984) further generalized Kihlstrom and Roth's (1982) model and obtained similar results. Recently, Viaene et al. (2002) proposed a sequential

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[1] Some papers have obtained different results under different frameworks. For example, Safra and Zilcha (1993) found that this result does not necessarily hold under non-expected utility preferences such as the rank-dependent utility preference and the weighted utility preference. Volij and Winter (2002) arrived at an opposite result by using Yaari's dual theory.

bargaining game and found that the insurance company obtains a higher premium when the client has a lower discount factor.[2] Quiggin and Chambers (2009) studied the interaction between bargaining power and the efficiency of insurance contracts, and found that an increase in the bargaining power of the clients will increase social welfare.

In this paper, we extend this line of the literature by considering the impact of ambiguity and ambiguity aversion in insurance bargaining games. Ambiguity describes a case where a decision maker is uncertain about the payoff probability which affects his/her decisions, and ambiguity aversion is an aversion to such an uncertainty. The literature has demonstrated that ambiguity and ambiguity aversion could have significant effects on individuals' decisions under risk.[3] Regarding insurance, the demand for insurance and the design of insurance contracts will be different in the presence of ambiguity from in the absence of it. For example, Snow (2011) proved that the demands for both self-insurance and self-protection increase with ambiguity aversion.[4] Although the above literature has provided many fruitful findings, these papers all focus on a non-bargaining-based context. To the best of our knowledge, our paper is the first to examine insurance bargaining under ambiguity.

Specifically, we respectively investigate the effects on the negotiation outcomes of an increase in ambiguity aversion and an increase in ambiguity in two-player cooperative and non-cooperative insurance bargaining games. For the cooperative bargaining game, we follow the framework of Kihlstrom and Roth (1982). For the non-cooperative bargaining game, we consider sequential bargaining games as modeled in Rubinstein (1982) and White (2008).[5] In both games, we analyze the case where the insurance company and the client negotiate on the insurance coverage and the premium.

As in Alary et al. (2013) and Gollier (2013), we assume that the insurance company is risk and ambiguity neutral. The client is assumed to be not only risk averse, but also ambiguity averse. To model ambiguity aversion, the literature has provided several approaches.[6] In this paper, we employ Klibanoff et al.'s (2005) smooth model of ambiguity aversion.[7] Their model can separate the ambiguity preferences and the ambiguous beliefs, and thus help us to discuss the effects of an increase in ambiguity aversion and an increase in ambiguity on the bargaining outcome.

In cooperative and non-cooperative bargaining games, we find that full coverage is optimal. This result shows that the optimal full coverage first found by Kihlstrom and Roth (1982) is robust in the presence of ambiguity. Moreover, the optimal premium is found to be higher in the presence of ambiguity than in the absence of ambiguity. We further find that the impacts on the premium of an increase in ambiguity aversion and an increase in ambiguity are robust in both types of bargaining game: (1) an increase in the client's degree of ambiguity aversion increases the optimal premium; (2) the optimal premium becomes higher when an increase in ambiguity occurs.

The rest of the paper is organized as follows. Section 2 first studies a cooperative insurance bargaining game under ambiguity, and then examines the impact on the bargaining outcomes of an increase in ambiguity aversion and an increase in ambiguity. Section 3 examines identical questions, but uses a non-cooperative insurance bargaining model. Finally, Section 4 concludes the paper, and appendices provide proofs of lemmas.

2. A cooperative insurance bargaining game

This section consists of two subsections. In the first subsection, a cooperative insurance bargaining model is introduced to investigate what the optimal insurance contract will be in the presence of ambiguity. In the subsequent subsection, we respectively examine the effects on the optimal insurance contract of an increase in ambiguity aversion and an increase in ambiguity.

2.1. The presence of ambiguity

The model setting and the notation are as follows. Suppose that there are two agents in an economy. One is a risk-and-ambiguity-neutral insurance company endowed with ω_I and the other is a risk-and-ambiguity-averse client endowed with ω_C. The client has a potential loss L, and its probability of occurrence is $1-\pi \in (0, 1)$. On π, the client has a subjective belief following an F distribution. This is common knowledge between the client and the insurance company. To isolatedly evaluate the effect of the presence of ambiguity, for simplicity, it is assumed that the insurance company prices the contract by the unbiased ambiguous belief, i.e.,

$$\alpha = \int_0^1 \pi \, dF(\pi). \quad (1)$$

To hedge the risk, the client negotiates with the insurance company. The negotiation could turn out to be successful or it could break down. If it is 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 negotiation breaks down, no insurance contract will be agreed upon.

To model the decision making under ambiguity, we adopt the smooth model of ambiguity aversion proposed by Klibanoff et al. (2005). Under their model, the expected utility of a decision maker facing ambiguity in the insurance bargaining game can be obtained in two steps. The first step is to compute all the expected utilities under a specific belief of the loss probability. The second step is to obtain the expected utility under ambiguity by

2 Viaene et al. (2002) described the effect of a lower discount factor as the effect of more risk aversion or more impatience.

3 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 a more ambiguity-averse agent will demand fewer ambiguous assets when the distribution of a risky asset's return is uncertain. He further demonstrated that an increase in ambiguity aversion raises equity premiums when the distribution of states is uncertain.

4 Alary et al. (2013), who considered more than two states of Nature, investigated the effect of ambiguity aversion on self-insurance and self-protection. They showed that, under certain conditions, ambiguity aversion increases the demand for self-insurance but decreases the demand for self-protection. Gollier (2013) studied the effect of ambiguity aversion on the optimal insurance contract and found that, under different ambiguity structures, ambiguity aversion results in different optimal insurance contracts. Huang (2012) examined the impact of ambiguity aversion on effort when either the target wealth distribution or the initial wealth distribution is ambiguous. She found that a decision maker with greater ambiguity aversion will make more effort when the target distribution is ambiguous, but may make less effort when the starting distribution is ambiguous.

5 Our model is similar to that in Viaene et al. (2002), but it differs in two ways. First, they did not consider the effect of ambiguity. Second, they assumed that both parties only bargain on the premium rate, whereas we assume that both parties can bargain on the premium and the coverage.

6 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).

7 Klibanoff et al. (2005) set up a two-stage model in which they decomposed the decision process 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 related to ambiguity aversion and the distribution of ambiguous beliefs captures ambiguity.