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MODELING THE UTILITY OF INSURANCE PILLARS RISK MANAGEMENT USING THE GAME THEORY

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ABSTRACT

Insurance and being insured is itself a risk. Risk management is one of the challenges by which the insurance industry is now faced. Failure to the correct, logical and timely risk management causes serious problems for insurance industry such as price fluctuations and differences. Usually, the policyholder and insurer, each of them, impose the law and the rules themselves for more profit which means the disturbance in the relevant market for consumer use. The purpose of this paper is demonstrating the utility of risk management by each insurance pillar in a cooperative and non-cooperative manner with the Stackelberg strategic game (conflict situations). The data were analyzed in a semi-experimental manner based on expert opinion and with the goal of applied development in the form of mathematical relations. Since the suggested model has one insurer and one policyholder, the results showed that the insurer has gained more profit in exchange for the risk incurred than the policyholder for the risk incurred in the non-cooperative approach and in the cooperative approach compared with the aggregation of the utility of him and insurer, therefore, the risk is not always the criterion for more profit. It seems that there is a need for mechanisms for the unification of services in the community for the acceptance of all kinds of people.

Keywords: Utility, Risk Management, Policyholder, Insurer, Insurance Industry, Stackelberg Game.

INTRODUCTION

One of the most important methods of insurance and facilities that has been more considered today is the risk management style. Risk means uncertainty about incidence of an event in the future. Whatever this uncertainty is high, the amount of risk will be more (Zaboli, 2007). Managers are faced a number of challenges because of the uncertainty surrounding the organization and the intensity of their competition. Modern management approaches are recommended for effective management of these challenges (Babaie & Zanjani, 2005). Risk management such as other disciplines of management knowledge and its application takes advantage of special knowledge, standards, criteria, principles and guidelines to achieve predetermined predictions and goals (Mazloomi, 2007). Today, in business world, the growth and development of the capital market as one of the important sectors of the economy of each country requires an efficient risk management system. The necessity of an integrated risk management and risk-based investment analysis system for capital market development and progress has become increasingly important (Saadat Joy Ordeklu & Rahimi, 2014).

Risk management functions like a forward radar and searches for an uncertain future to identify and avoid things that may cause a significant risk or an important opportunity is discovered. It may be impossible to identify the latest details of any uncertain future, but the risk process targets

the disclosure of certain uncertain environments and determines the best path to continue. One of the simplest definitions of risk is that the risk is the problem which has been arisen itself (Cerone, 2006). Companies usually use risk management to decrease the desirable effects of unfavorable conditions and thus reduce the behavioral impact of these conditions on the performance and function of companies (poor Zamani & Karimi, 2010). Regarding the economic system and continuous changes in environmental factors, the issue of risk management in the way of managing of financial and service organizations has been very importance. Changes in the business environment have changed the attitude toward the risk management from a component-oriented perspective to a holistic and systematic approach (Husseini et al, 2013). The possibility of causing loss, uncertainty, and dispersion of actual results from expected results and the chance of loss or damage or the difference between the actual and expected returns on investment is risk (Amini Pajoooh, 2017). Risk or danger is defined as possibility of failure to realize future forecast. In other words, it means the possibility of a loss and damage whether financial or non-financial as a result of an activity (Saralah, 2005).

In our country, insurance is one of the most important factors in capital maintenance and guarantee (Jafari Samimi & Moradi, 2008). The duty of the insurance industry, as a financial entity, is demonstrating its strength and power in providing the capital supply and formation and strengthening the economic investment power of the community (Sheibani Far, 2014). The insurance industry in Iran is over 70 years old and its range of activities has been gradually expanded in different parts of the country and in various sectors of the economy (Vatan Khah, 2008). The necessity of security has been one of the most important human needs which according to passage of time, its simple definition has been expanded as security in property, investment, and so on. At first, a variety of tools were used in order to eliminate such a need until the insurance system was modernized (Asgari & Azim Zadeh Arani, 2014). Advanced countries such as the United States, Japan, and developed European countries have tried to reduce or control the risk of damage. According to available statistics, more than half of the damage from natural hazards in advanced countries is compensated by insurance coverage (Karimi, 2013). In line with the issues raised, it is attempted to describe the utility (profit) of risks of the policyholder and insurer in a cooperative and non-cooperative manner using the Stackelberg game (competitive decision-making model) in the insurance industry in general and in the form of numerical example.

RESEARCH HISTORY

Several researches have been carried out in the country and abroad regarding risk management and insurance that we refer to some cases in order to differentiate them with the present research. In a research, Safari (2011) studied risk management in Iran insurance company. He investigated the legal control and supervision of risk management in country insurance companies. The results showed that the state of market insurance and also the study of the financial position of the country's insurance companies indicate an increase in risk in the insurance companies of the country. Farzin et al. (2012) investigated the role of insurance on income and risk management of farmers as case study of Cotton Suppliers in Darab City. The results of the calculation of income premiums were analyzed with two assumptions including direct and indirect implementation of the relationship between price and function. Finally, it was specified that due to the negative correlation coefficient between price and performance,



the direct implementation of the price relationship and Functional performance reduces the amount of income premiums when compared to the situation in which this relationship is indirect.

Solati Dige Sarayi (2015) presented an article entitled "strategies for risk management in reinsurance". The results showed that currently, the issuance of securities is a more common alternative to reinsurance risks in the traditional way. It allows insurers to reduce their risk and transfer the company's risk and also the cost of risk following an accident to the investor. Cardgar and Ahrari (2015) investigated an analysis of the institutional aspects of risk management in the insurance industry based on the economics of exchange cost approach. The results showed that the structure of risk management could be organized in insurance based on the approach of economics of exchange cost and paying attention to the hidden angles caused by moral hazard along with the standard risk assessment systems. The incomplete and asymmetric information in assessing the transactions of insurer and insured plays a role in creation of transaction costs due to unfavorable selection and moral hazards. Therefore, the role of insurance companies in covering uncertainties in the context of legal contracts is crystallized.

Momeni Rad and Maddahin Nasab (2016) conducted a research on the risks of existing risks in oil projects. The risks of existing oil industry projects were first studied and classified in this research. Then, insurability and insurance coverage in the cases capable to be insured and their position in the oil industry, as well as contractor obligations, were explained. The hazards in these projects are threatening both of them, so the existence of identification of existing risk and insurance capabilities is necessary. Mohammad Pour et al. (2017) identified and ranked the factors affecting supplementary health insurance risks using network analysis technique in insurance companies of Khorasan Razavi province. According to the findings of the research, four factors including insurers, policyholder, state and the environment were as factors influencing the insurance risk of treatment identified by a number of sub-criteria and options. The results showed that the insurer's criterion was considered as the most important factor and the insurance agents, the state and the environment were at the next ranks.

Beck et al (2010) presented a research entitled "risk adjustment in health insurance and its long-lasting impact". The results showed that the need for risk adjustment in relation to health status in insurance markets with a comprehensive ranking and considering the horizon of profit insurers' plan is fixed and demographic risk is very high. Being & Qui (2011) conducted a research on risk reduction in engineering management for a range of social security insurance through financial engineer and ethical privileges. They found that a permanent and low-risk mechanism to reduce the cost of risk management by increasing the leadership of the ethical government and regulating collection policies would increase the amount of social insurance premiums.

Barrieu & Louberge (2013) investigated the risks of reinsurance and life insurance securities and the impact of regulatory constraints. By differentiating between reinsurance and securities according to the effects on reverse needs, they focused on the regulatory effects on risk transfer. The results showed that different regulatory rules in terms of global risk distribution would result in very different outcomes. It also investigated the optimal strategy for risk sharing and risk transfer between the three agents (policyholder, reinsurer, investor), considering the importance of pricing principles in insurance and the financial sector in a single unit. Li Hu & Eyu (2014) investigated risk management in life insurance companies as some evidences from Taiwan. They



reported two models including 2SQR and 2SLS in USA. They found that there is a positive relationship between capital and risk. There is also a reverse relationship between investment and capital. This discount was made between 2004 and 2009 in Taiwan.

Bohnert et al (2015) conducted a research entitled "Life insurance company risk management by choosing product mix strategy, investment strategy and surplus allocation plans". The results showed that the effectiveness of management decisions regarding risk reduction strongly depends on the allocation of surplus to the customer and its impact on guaranteed benefits payments which consequently provide an important control variable for the insurer. Eckert et al (2016) conducted a study entitled "Risk evaluation and assessment of company life insurance in the presence of credit risk. The results showed that paying attention to bond related credit risk, even in higher bonds risk conditions, has a significant impact on fair assessment and risk measurement in the field of health insurance contracts.

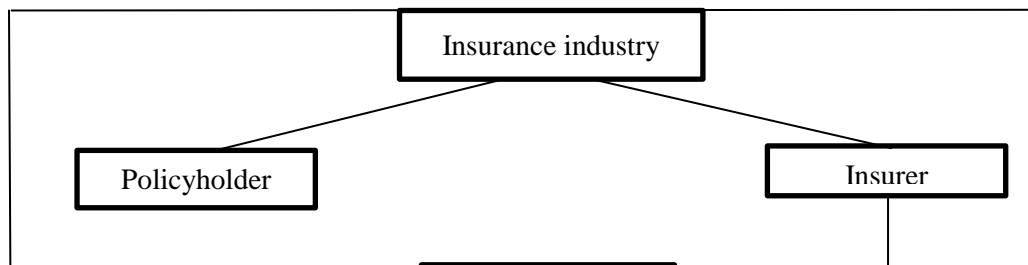
Yang et al (2017) conducted a research entitle "Insurance as a market mechanism in environmental risk management and regional safety". They found the strength of the insurance company at average level and it forms permanent triangular. They also found that liability insurance for the protection of the environment and the safety of new insurance is an important complement to prevention and the control of the immune system and the environment has already been developed. As we have seen and investigated, there has been a lot of research in the field of risk and insurance within the country and abroad. But innovation of the present research is due to the use of conflict situations to distinguish risk-taking and risk aversion based on parameters in which there may be no definite knowledge and understanding for the decision making of insurance corporations.

DESCRIBING THE ISSUE

In this study, a research was conducted about insurance industry including one policyholder and insurer. The manner of insurance progress in this industry is such that the policyholder offers its service plans in the form of a variety of insurance at lower prices, more risk and less supply. The insurer offers its service plans in the form of a variety of insurance at a higher price, lower risk and higher supply. There are two main modes in the research foundations. 1) When the policyholder and the insurer have a common risk utility that in this case, collaborative functions are created. 2) When the policyholder and the insurer have the uncommon risk utility (profit) that in this case, non-collaborative functions are created. The proposed model includes the following notions:

- The policyholder and insurer are considered as one entity in cooperative mode and they are considered as two separate entities in non-cooperative mode.
- Customers (people) provide their insurance needs through the insurer.
- The risk level of the insurance pillars (insurer and insurer) is possibility or phasic in term of size.
- Risk utility is a degree of risk taking and risk aversion of the policyholder and insurer in exchange for profit earned.

The overall view of the issue is shown in figure 1.



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Figure 1: Researcher-made conceptual model of study

FINDINGS

Research Modeling

we will implement the model in the two cooperative and non-cooperative modes.

A. Cooperative conduct:

In this case, the Stackelberg game is dominant. In other words, the policyholder will manage the price, risk and supply and the insurer should follow it. The earned profits or benefits are obtained and calculated simultaneously. Relation 1 indicates this issue:

$$\pi_t = p_i(d_i - q_i) - C_{qi} \quad (1)$$

In this relation, p_i is insurance price of insurer, d_i is insurance offer, q_i is level of risk incurred by policyholder and insurer, C_{qi} is the cost of insurance risk incurred in cooperative mode and π_t is utility (profit) of common risk.

B. Non-cooperative conduct

Policyholder and insurer do not cooperate with each other and the profit and utility of each other are individually calculated:

Relations 1 and 2 show this issue:

$$\pi_{bz} = p_{bz}(d_{bz} - q_{bz}) - C_{qbz} \quad (2)$$

In relation 2, p_{bz} is insurance price of policy holder, d_{bz} is insurance supply of policyholder, q_{bz} is the level of risk incurred by policyholder, C_{qbz} is the cost of insurance risk incurred by policyholder and π_{bz} is utility (profit) of policyholder's risk:

$$\Pi_{bg} = p_{bg}(d_{bg} - q_{bg}) - C_{qbg} \quad (3)$$

In relation 3, p_{bg} is insurance price of insurer, d_{bg} is insurance supply of insurer, q_{bg} is the level of risk incurred by insurer, C_{qbg} is the cost of insurance risk incurred by insurer and π_{bg} is utility (profit) of insurer's risk.

Numerical example

Consider an insurance industry. The policyholder puts into place insurance pillars. These pillars can be many factors. But the price, amount of supply and the risk incurred are ones of very popular issues that can form the basis of insurance. If the policyholder is considered as the



highest member of insurance, he naturally has members under his control and these are the same insurers.

Insurers have a representative status because of their affiliation to the policyholders. But in this paper, we examine them as cooperative (policyholder and insurer of a single entity) and non-cooperative (policyholder and insurer of two separate entities) they take. We describe the proposed model in a numerical example with the empirical information and according to experts on insurance affairs; the following table summarizes the information gathered by the experts. It should be noted that the risk incurred for all situations is equal 35000 toman.

Table 1: Numerical example information

Parameter	Numerical value, potency	parameter	Numerical value, potency	parameter	Numerical value, potency
Pi	95000	Pbz	80000	pbg	110000
Di	650000	Dbz	500000	dbg	800000
Qi	50%	Qbz	80%	qbg	20%
Cqi	35000	Cqbz	35000	cqbg	35000
İlt	?	İlbz	?	İlbz	?

According to relation (1),

$$\pi_t = 95000 \times (65000_50\%)_35000 = 61749917500$$

Profit value (common utility of risk-taking of the policyholder and the insurer in one fiscal year):

$$\pi_t = 61749917500 \text{ toman.}$$

According to relation 2,

$$\pi_{bz} = 80000 \times (500000_80\%)_35000 = 3999990100$$

Profit value (common utility of risk-taking of the policyholder and the insurer in one fiscal year):

$$\pi_{bz} = 3999990100 \text{ toman.}$$

According to relation 3,

$$\pi_{bg} = 110000 \times (800000_20\%)_35000 = 87999943000$$

Profit value (common utility of risk-taking of the policyholder and the insurer in one fiscal year):

$$\pi_{bg} = 8799994300 \text{ toman.}$$

So, we can say that:

$$\begin{aligned} [(d_i_q_i) < \pi_t, q_i=1/2] \\ [(d_{bz}_q_{bz}) < \pi_{bz}, q_{bz}=4/5] \\ [(d_{bg}_q_{bg}) < \pi_{bg}, q_{bg}=1/5] \end{aligned}$$

Then, according to the highest degree of risk incurred, they have the following priority:

$$\{q_{bz} >> q_i >> q_{bg}\}$$

It is also true:

- ✓ Decrease in q_{bg} =increase in π_{bg}
- ✓ Decrease in π_{bz} = increase in q_{bz}

CONCLUSION

Insurance and community security issues are inevitable. Today, in the modern world, there is no group, school or sect that cannot be found without dichotomy. Conflict is a mental contradiction that comes from collision of motives, impulse or opposite demands and drives. The economic, strategic, and competitive model that illustrates the contradictions, conflicts and modifications of the members of an industry is the Stackelberg game. This game, which is one of the theories of the game theory, can clarify the strategic conditions and provide the possibility of evaluating organizational relationships with internal and external factors to obtain the optimal result through analyzing decisions and interactions with the industry. Undoubtedly, the risk and its management are strategic. Assessment the level of risk utility in insurance industry helps us to enjoy functional knowledge in job creation and entrepreneurship action as well as claiming and requiring insurance for the use of services.

In the economy, people include two general categories: 1- risky people, 2- risk-aversion ones. If we want to measure the degree of risk in each one of them, it is noteworthy that we should measure and assess the utility or profit due to level of that risk. In this paper, the risk of the policyholder and the insurer in the insurance industry using the Stackelberg game was analyzed in form of numerical example. The study of the proposed model in the form of cooperation between the insurer and the policyholder realized a profit equal to 61.749.917.500 toman, a profit equal to 39.999.901.000 toman in the form of non-cooperation and utility of policyholder and a profit equal to 87.99.943.000 in the case of non-cooperation and utility of insurer. According to the results of this applied assumption, insurers have the highest utility (profit) due to their risk and it has also been found that more risk does not generate more profits. In this regard, it is recommended to use special, organic and seasonal discounts mechanism for the stabilization of insurance prices. The proposed model can be compared in two insurance models. It seems that the existence of the law and the supervisory authority in the implementation of policyholder and insurance in the form of draft resolutions of the Islamic Consultative Assembly and the sixth and seventh development plans are essential. Competitiveness in business communities is a spiritual and unreasonable element. If we do not understand it and do not know about it, we will not have a position in the economy.



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