A Note of the New Regulatory Economics for Property-Liability Insurance Rate Regulation

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摘要

本文之目的在於探討資訊限制對於保險費率之影響。資訊之不對稱性不僅存在於被保人與保險人之間，亦可能發生於保險人與監理機關之間，以往之保險文獻偏重探討被保人與保險人間之資訊不對稱，但事實上監理機關無法充分獲得保險人資訊之限制，亦是保險市場未能健全運作之重要原因。

由於傳統經濟學之完全資訊假設，無法符合實務上若干受監理產業之行爲模式，因此近十年來法規經濟理論重新思考資訊限制對於政府決策之影響。這些新理論已應用於水電公共事業與公共工程承包價格之規範，並且受到廣泛重視，然而尚未直接應用於保險監理。因此本文之主要內容，即在於說明新法規經濟模型如何應用於產險費率規章。撰寫方式則偏重於文獻之比較分析，藉由重新詮釋現有經濟模型之變數，說明其與保險人經營行爲之關連性，分析監理機關在資訊限制下，如何規範產險費率。

根據法規經濟模型之分析，本文結論認爲在資訊不對稱之限制下，監理機關必須容許保險人有較高之利潤率與附加保費，以引導保險人呈報眞實之損失準備金資料，倘若一味要求保險人制定低水準費率，反而容易導致呈報不實財務資料，增加失去清償能力之機會。

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I. Introduction

Because of the concern for the public interest, insurance is usually a highly regulated industry in most of the countries. Numerous studies have investigated the impact of rate regulation on the insurance price. Witt and Miller (1981) and Harrington (1984) conduct empirical analyses to study the impact of rate regulation on the price level of automobile insurance. Tanneyson (1993) indicates that there exists regulatory lag on the reviewing process of the insurance rates. The effect of rate regulation on insurance price is always a major subject in the insurance research. However, most of the previous studies for insurance rate regulation did not take into consideration of informational constraints to the insurance commissioner. Since the theory of regulatory economics has been renovated during the past decays, it of course will make the insurance ratemaking decision be remodeled. Therefore, the new rationale for insurance rate regulation must be developed.

The purpose of this paper is to provide a review of insurance pricing model under different stages of the regulatory economics in order to understand the impact of research trend in regulatory economics on the insurance pricing model. Besides, this paper tries to suggest a rationale for insurance price based on the new economic theory of regulation. Due to the effect of informational asymmetry between the insurer and the regulator, the underlying rationale for insurance premium ratemaking must be revised to incorporate the potential problem of moral hazard of the insurer. By redefining the variables in the general economics model to meet the specific characteristics of the insurance market, we can provide a new direction for the insurance commissioner to develop the rate regulation.

The structure of this paper is organized as follows. Section II reviews the characteristics of the traditional regulatory economics and the corresponding insurance price formula under that theoretical background. Section III describes the main features of the new theory of regulatory economics primarily based on the book of Laffont and Tirole (1993) and then suggests the underlying rationale for the insurance commissioner to develop the insurance rate regulation. The theoretical model for insurance rate regulation and the results based on the new rationale are provided in section IV. The final section makes concluding ramarks on the potential influence of new regulatory economics for the future research of insurance price.

II. Traditional Regulatory Economics and Insurance Ratemaking Model

Based on the comments by Laffont (1994), the economics of regulation before 1980's were developed primarily under two approaches: (1) cost of service regulation, and (2) Ramsey-Boiteux regulation. By reviewing the main features of the two approaches, we consider that insurance rate regulation is similar to the first one, cost of service regulaiton. The characteristics of this type of regulation include the following key points (Laffont, 1994, P508):

(1) price is determined based on the average costs;

(2) price remains fixed before the next revision of rates;

(3) the conflicts on price between the firm and the consumers are arbitrated by the regulator through the regulatory review process;

(4) a guaranteed fair rate of return.

By inspecting the traditional fair rate principle in the insurance literature, we can find that insurance pure premium rate is set equal to the present value of expected losses. Since the estimation of expected losses in practice usually is based on the loss ratios of the accounting reports (see Brown, 1993), it implies that insurance price is determined based the average costs. The process of regulatory intervention in insurance industry is obviously close to the description of the second and third points in the above. In most of the states the modification of premium rates must be approved by the regulator before introduced to the market. The insurance policy is an adhesive contract for which the consumers cannot bargain the price by themselves. Any conflicts or complaints about the insurance policy are arbitrated by the insurance commissioner. A guaranteed rate-of return for the insurer is provided through the profit loading to the premium rate. In practice the profit loading usually is a fixed percentage of pure premium, but there lacks a theoretical foundation to determine the percentage.

How to reflect a fair rate of return in insurance price has been a controversial topic in insurance research. Before 1970's the pricing model in most of insurance literature primarily followed the actuarial fair rate principle, therefore the discount rate applied in insurance ratemaking decision was simply an interest rate for which the treasury bill rate usually served as a proxy. The significant progress in the financial economics during 1970's provoked the remodelling for insurance price. Fairley (1979) provided the theory and empirical test for the investment income and profit margins in property-liability insurance industry. The argument of including investment income in the pricing formula is new for property-liability insurance because the traditional acturarial view of insurance price is only concerned with the expected losses (underwriting income).

The application of Capital Asset Pricing Model (CAPM) was another typical example for remodeling insurance price. The concept of "underwriting beta" was popular in insurance literature during the 1980's. Myers and Cohn (1985) brought the underwriting beta into the discount factor and developed a discounted cash-flow approach to property-liability insurance price. The interest in CAPM was found not only in the theoretical model but also in the empirical studies. Cummins and Harrington (1985) conducted an empirical testing of underwriting beta based on quarterly data for property-liability insurance industry. Because the overall results of the empirical analyses of CAPM for insurance industry were not significant and the criticism of the applicability of CAPM theory itself, it is not popular for insurance premium rate any more.

Another field of the application of financial theory to insurance price can be represented with the study by Doherty and Garven (1986), which considered a contingent-claim approach and applied the theory of option to determine the insurance premium rate. The contingent claim approach involves complicated mathematics and may be difficult to apply in practice, however, it provides solid theoretical foundation. The applicability of contingent claim approach is better for the reinsurance market than the regular insurance because the responsibility of the insurer to the insured is a duty instead of an option.

The cost of service regulation has suffered from harsh criticism which included the slowly and costly regulatory review process, no incentive for provision of quality and controlling cost, difficulty in allocating the fixed costs, and so forth. On the other hand, there exist advantages for using the cost of service regulation. It recognizes the need for regulation and provides a feasible procedure to avoid the risk of bankruptcy (see Laffont, 1994). In fact, the debates for insurance rate regulation are quite similar to the above arguments. The lengthy regulatory lag in the process of prior-approval for insurance premium rates causes the delayed responses between claim costs and insurance price, which may be a reason for underwriting cycles (Cummins and Outreville, 1987) and may raise the incentive of manipulation on loss reserves (Chen, 1995). How to control the soaring cost and price level of automobile insurance becomes an important issue in the public policy. Although free competition may be a good way to reduce price in most commodity markets; however, due to the complexity of insurance products, it may be too risky to eliminate the rate regulation completely which possibly results in the underpricing and insolvency of the insurer.

The traditional studies of regulatory economics emphasized the impact of regulatory intervention on the industry, which were usually achieved through empirical analysis. For example, Grabowski et al (1989) compared the price levels in the regulated states and deregulated states and studied the impact of rate regulation on the tradeoffs between price and availability of automobile insurance. Most of the previous studies only provided empirical evidences for the existing problems in the insurance industry, however, there lacks a normative theory to lead the direction for rate regulation.

III. Main Features of New Regulatory Economics for Insurance Market

The preliminary disadvantage of the traditional economic theory of regulation is that it ignores the incentive issues of the firm as pointed by Laffont and Tirole (1993). The constraint of information availability was frequently omitted in the studies of traditional regulatory economics. In the insurance literature (e.g., Dionne and Doherty, 1994), although the problems of adverse selection and moral hazard have been important subjects, they emphasized informatinoal asymmetry on the relationship between the insured and the insurer. In fact, there also exists the problem of informational asymmetry between the insurer and the regulator. The insurance policies and premium rates must be approved the insurance commissioner before they are introduced to the market. The premium rate is calculated based on the incurred losses on the financial statement. Since incurred losses largely rely on the forecast of future claim costs, it is difficult for the commissioner to investigate the truthfulness of financial reports due to the complexity of insurance claim costs.

Most of the previous studies, e.g., Harrington (1984) and Taynneson (1993) suggested that the existence of rate regulation did have an impact on the price level, but they did not offer the explanation for that phenomenon. We think one of the possible factors may be referred to the information constraint of the regulator. To prevent the moral hazard of manipulating claim costs by the insurer, the regulator incurs additional auditing costs and time lag to review the premium rates, which in turn affects the price level in the market.

As indicated in the studies by Weiss (1985) and Grace (1990), the loss reserve errors are not random and may be subject to manipulation by the insurer in order to achieve certain financial purposes. Due to the loss settlement process of property-liability insurance, a large proportion of the incurred losses are not finished at the end of the year which must be record as loss reserves, the most important item of liability for an insurance company. The incurred losses which consist of loss reserves are the most important bases for caculating the premium rates. Each year the regulator reviews the loss ratio (i.e., incurred losses/premiums earned) and determines whether to modify the premium rates (Webb, et al, 1984). Therefore, the truthful reporting of loss reserves is crucial for the regulator to determine the rate modification. Unfortunately, it is not easy for the insurance commissioner to judge the reported information because the estimation of loss reserves involves lots of complicated actuarial techniques.

The major contribution of new theory of regulatory economics is the concern with the problem of information availability to the regulator. As described in the book by Laffont and Tirole (1993), the sources of regulatory constraints which prevent the regulator from implementing his preferred policies are (1) informational constraints, (2) transactional constraints, and (3) administrative and political constraints. The administrative and political constraints are ignored in the new regulatory economics because they are not exogenous but driven by the informational and transactional constraints.

The information constraints refer to the informational asymmetry between the regulator and the firm. For example, the regulator may be not able to observe the moral hazard or the effort incurred by the firm; besides, the firm may have more information than the regulator about some exogenous variables. According to the above description, it is obvious to see that there exist informational constraints in the insurance industry. The insurance commissioner is not able to observe the loss control effort of the insurer and does not have so much information about the claim costs as the insurer. Because of these constraints, the insurance commissioner must conduct regulatory intervention and spent time and costs in auditing the reported data by the insurer. Since the premium rates in most of the states are required to be approved by the regulator, the insurer may consider the role of the regulator as well as the consumers when setting the price. Therefore, the problem of informational asymmetry between the regulator and the insurer must be taken into account in the discussion of insurance ratemaking decision.

Transactional constraints indicate that the costs to write a contract would be higher when the contingencies are harder to predict and formulate. Several types of transactional constraints are discussed by Williamson (1975). We may suggest that the insurance contract presents transactional constraints between the insurer and the insured. These constraints may serve as the reasons for explaining the differences of expense and profit loading in different insurance lines. The more uncertainty of the claim costs (e.g., the commercial liability insurance), the higher expense and profit loading charged to the insured. Althougth the transactional constraints are an important issue for the government in dealing with procurement contracts and may be related to the insurance contracts for the policyholders, we think they are not so relevant in the relationship between the insurer and the regulator. Therefore, in the following discussion of this paper we emphasize the informational constraints and ignore the problem of transactional constraints for the insurance commissioner.

The key point in the methodology for the new regulatory economics is the application of the agency theory to explicitly discuss the incentive issue between the firm and the regulator, which is more rigorous and realistic than the traditional approach. Instead of applying the principal-agent theory to the relationship between the shareholder and the manager, the new regulatory economics treats the regulator as the principal and the firm as the agent. The model usually must include the description of (1) the objectives of the firm and the regulator, and (2) the information structure which reflects the reality of observational and contractual costs.

The insurance premium rates in most of the states are subject to certain level of regulatory restriction. The principle of insurance rate regulation is that the rate should be adequate, not excessive and not unfairly discriminatory in order to protect the interest of the policyholders. On the other hand, the objective of the insurer who accepts the risks transferred from the insured is to pursue the profits. The insurer will not offer the insurance policies to the consumers if there are no financial gains in the transaction. Because insurance is an important risk management tool for the individuals and the business, the unavailability of insurance is a serious problem in the public policy. Therefore, the insurance commissioner must consider both the consumer surplus and the insurer surplus in order to achieve the goal of social welfare maximization.

As pointed out in the paper by Laffont (1994), whatever the objectives, the regulator is constrained by the lack of information on the firm that he is regulating.

Therefore, we must stress the role of informational asymmetry to formulate the model and take into consideration of incentive issue. A canonical model and its interpretation are provided in the paper by Laffont. However, the insurance contract is somewhat different from the public utility and procurement contract. The application and interpretation of the model must be modified to fit the characteristics of the insurance market. To develop a model based on the agency theory for the insurance commissioner under asymmetric information setting, we need a set of functions discussed as follows.

(1) Claim Cost Function of the Insurer

The major costs for an insurance company are the incurred losses of the claims together with some marketing and operating expenses. The items of expenses are similar to general accounting accounts which are clear-cut cash payments and do not involve with the complicated problems of estimation. On the other hand, the incurred losses include the loss payments and the loss reserves. The loss reserves are the estimated claim costs which incur during the year but will be paid in the futrue. The forecast of future payments require special actuarial techniques and the judgement about the economic and social environments. To control or smooth the fluctuation of the realizerd claim costs, the insurer must put into some smoothing or manipulation efforts on the financial statements. Therefore, we may write the claim cost function of the insurer as equation (1)

$$C = L(\beta,\theta) + \varepsilon \qquad (1)$$

In equation (1) C is the claim costs of the insurer. L is the incurred losses which is a function of loss severity parameter β and parameter of manipulation effort (moral hazard) θ. ε is the random error or unanticipated inflation for the losses since the claim costs are uncertain. The function of losses L can be simply expressed as equation (2) if we omit the number of claims.[1]

$$L(\beta,\theta) = \beta - \theta \qquad (2)$$

(2) The Disutility Function of the insurer for the Manipulation Effort

Once the insurer smooths or manipulates the loss reserve, there exists a disutility for the insurer. The value of the manipulation effort parameter θ may be positive or negative. The insurer in practice usually understates the loss reserves so that the total incurred losses may be lower than the true amount in order to have a competitive premium rate, that is, θ is positive in this case. On the otherhand, the manipulation effort θ can be negative if the insurer overstates the loss reserves and thus the reported losses are higher than the actual losses.[2] Since underreserving of losses is a more popular situation and a crucial factor for insolvency in property-liability insurance industry (Cummins, et al, 1995), we will assume θ is positive in this paper without loss of generality (see Laffont and Tirole, 1993).

Because the understatement of loss reserves will reduce the loss ratio and the consequent premium rate, there is a risk for the insurer that the underwriting income is reduced while the investment income is not high enough to compensate the difference.[3] Thus there is a disutility for the insurer due to the manipulation. Another explanation for the disutility is that the underreserving of losses may result in higher risk of insolvency for the insurer. We may also think that the the insurer has a risk to be charged a penalty by the regulator because of the manipulation on the financial statement. However, the manipulation effort is known only to the insurer but not observable by the regulator at the beginning of the period due the informational asymmetry.

The disutility function is defined as $\psi(\theta)$. $\psi'(\theta)>0$ because the effort is costly. The more manipulation effort put into, the higher risk of insolvency or penalty, thus the more disutility for the insurer. Furthermore, the marginal cost of effort is increasing, that is, $\psi(\theta)$ is a convex function of θ and $\psi''(\theta)>0$.

(3) The Distribution Function of β

The severity of claim costs usually is not a constant number but a random variable. As indicated in the risk theory (Beard, et al, 1984), the severity of losses follows certain probability distribution such as lognormal or gamma distribution depending on the types of insurance lines. Therefore, the parameter of loss severity β is assumed to follow a distribution function $F(\beta)$ on the support $[0, \infty]$. $F(0)=0$, and $F(\infty)=1$ according to the general probability rules. If the $f(\beta)$ is the p.d.f. of β, we assume $d[F(\beta)/f(\beta)]/d\beta>0$ to avoid bunching, which means different value of β will not be treated equally. Furthermore, it is assumed that the distribution function F is a common knowledge to the regulator as well as the insurer although the specific value of β is not observable by the regulator. These assumptions are not unusual or unrealistic for the insurance market because the distribution of loss severity are well known to the public actuaries and the insurance commissioner. Most of the loss distribution functions (e.g., Normal, Lognormal, Gamma) satisfy the requirement of not bunching.

(4) The Utility Function of the Insurer

The insurer sells the insurance products and earn a underwriting profit margin which is so-called profit loading. The profit loading uaually is a constant proportion of the gross premium such as 5%. Besides, the insurer may earn investment profits from the investment activities. Supposed the total (underwriting and Investment) profits earned by the insurer is equal to $t(\beta)$, which is a function of loss severity because the underwriting profit and investment profit are related to the incurred losses. The insurer's utility function U_I is equal to the expected total profits minus the disutility as shown by equation (3) because the risk of insolvency or penalty will reduce the insurer's utility.

$$U_1 = t(\beta) - \psi(\theta) \tag{3}$$

Usually it is assumed that the insurer is risk neutral with respect to income. The assumption of risk aversion only complicate the analysis but the results are similar (see Laffont and Tirole, 1993).

(5) The Consumer's Surplus Function

The consumer transfers his risk to the insurer and relieves the worry of uncertainty of the potential losses, thus he gets a utility S. However, the consumer must pay premiums to compensate the insurer. The gross premium which the policyholder should pay includes the expected claim cost, the insurer's expected profits, and the underwriting expenses. Since in practice the expense charges are a proportion of the expected claim costs which are usually based on the incurred losses, we may express the gross premium as $(1+\rho)(L+t)$[4]. Therefore, the consumer surplus U_2 is presented by equation (4).

$$U_2 = S - (1+\rho)(L+t) \tag{4}$$

(6) The Social Welfare Function of the Regulator

Since insurance is one of the most important risk management tools, the risk transfer function through insurance should not be neglected. The premium rates must be set with adequate returns to the insurer to compensate their contribution to transfer the risks. Therefore, instead of only concerned with the consumer surplus, the objective of the insurance commissioner is to maximize the welfare of the society W which is composed of the consumer's surplus and the insurer's utility (surplus). That is,

$$\begin{aligned} W &= U_2 + U_1 \\ &= S - (1+\rho)(L+t) + t - \psi(\theta) \\ &= S - (1+\rho)[\beta - \theta + \psi(\theta)] - \rho U_1 \end{aligned} \tag{5}$$

(7) The Constraints for the Regulator

The insurance commissioner must consider ac couple of constraints when he makes the rate regulation for the insurance market. First, the insurer's expected utility U_1 must be $\geqq 0$, which is called "individual rationality" because the insurer can refuse to sell the insurance policies if those contracts do not generate a minimum level of expected utility. As we have seen the insurance crisis of the liability insurance market during the 1980's when the insurer rejects to offer insurance policies to the market because of the substantial underwriting losses.

Second, since there is informational asymmetry between the regulator and the insurer, the insurance commissioner cannot observe the insurer's manipulation of incurred losses directly. Based on the revelation principle (Myerson, 1979), any regulation method which can induce truthful reporting of information is the mechanism under which the firm has no incentive to misreport the information. It is also called "incentive compatibility". Therefore, the insurance rate regulation must provide incentives to the insurer so that the information of incurred losses will be truly reported without manipulation. The rate regulation will induce true reporting if and only if it maximize the insurer's utility U_1. That is,[5]

$$\beta \in \underset{\beta}{\mathrm{Argmax}} \{ t(\beta) - \psi(\beta - L) \} \tag{6}$$

Based on equation (6), we know that the first order and second order conditions for the optimal value of β are as follows.

$$t'(\beta) + \psi'(\beta - L)L' = 0 \tag{7}$$
$$L' \geqq 0 \tag{8}$$

IV. The Model and The Results

Based on the set of functions indicated in the previous section, we can write the model for the optimal rate regulation of insurance market. By applying the agency theory to the insurance rate regulation, the principal-agent relationship in the model is that the principal is the insurance commissioner and the insurer is the agent. The objective function for the principal (regulator) is the maximization of the expected social welfare EW, subject to the constraint functions of incentive compatibility and individual rationality. That is,[6]

$$\max_{\theta, u_1} EW = \int_0^{\infty} \{S - (1+\rho)[\beta - \theta(\beta) + \psi(\theta(\text{^`})] - \rho U_1(\beta)\} dF(\beta) \tag{9}$$
$$\text{s.t.} \quad U_1'(\beta) = -\psi'(\theta(\quad , \qquad \forall \beta \tag{10}$$
$$U_1(\beta) \geqq 0, \quad \forall \beta \tag{11}$$

In order to find the optimal solution of the above model, we will employ the optimal control techniques (Kamien and Schwartz, 1981). By taking U_1 as the state variable and θ as the control variable, we can write the Hamiltonian H as equation (12).

$$H = \{S - (1+\rho)[\beta - \theta(\beta) + \psi(\theta(\beta))] - \rho U_1(\beta)\} f(\beta) - \lambda(\beta)\psi'(\theta(\beta)) \tag{12}$$

where, $\lambda(\beta)$ is the Hamiltonian multiplier.

The first order conditions of the Hamiltonian w.r.t. θ and U_1 can be shown as follows.

$$\partial H / \partial \theta = (1+\rho)[1 - \psi'(\theta(\beta))] f(\beta) - \lambda(\beta)\psi''(\theta(\beta)) = 0 \tag{13}$$
$$-\partial H / \partial U_1 = \rho f(\beta) = \lambda'(\beta) \tag{14}$$

By integrating equation (14), we obtain

$$\lambda(\beta) = \rho F(\beta) \tag{15}$$

Since the Hamiltonian multiplier represents the marginal valuation in the optimal program of the state variable at the value of β. Equation (15) shows that the marginal valuation to the expected social welfare through the insurer's utility is zero if the severity parameter β is at the lowest level (zero) since $F(0)=0$. With any increment in the insurer's utility, the increment in the total value of social welfare will be at the rate of $\lambda(\beta)$ which is equal to the loading percentage times the cumulative probability of severity.

Then we replace λ in equation (13) with equation (15), the optimal solution for the disutility function of the insurer must satisfy the following condition:

$$\psi'(\theta(\beta)) = 1-\{[\rho/(1+\rho)]\,[F(\beta)/f(\beta)]\psi''(\theta(\beta))\} \qquad (16)$$

Equation (16) shows the increment of the insurer's disutility due to the risk of insolvency or penalty is related to the loading and the probability of loss severity.

Suppose the $\theta^*(\beta)$ is the optimal solution for equation (16), then we integrating equation (10) to obtain the insurer's utility function U_1 as follows.

$$U_1^*(\beta) = \int_0^{x} \psi'(\theta^*(\beta))d\beta \qquad (17)$$

The optimal regulatory policy for the insurance commissioner can be indicated by the following results. Based on equation (3) for the relationship between U_1, t, and ψ, we can find that the optimal level of profits t^* allowed for the insurer to earn will equal to the disutility plus the utility. The optimal level of the incurred losses allowed for reporting to the commissioner is the loss severity minus the optimal manipulation level. The optimal solution is presented by the following equations.

$$t^*(\beta) = \psi(\theta^*(\beta))+U_1^*(\beta) \qquad (18)$$

$$L^*(\beta) = \beta-\theta^*(\beta) \qquad (19)$$

Compared to the case of complete information where the incentive compatibility constraint is not required for the model any more, the optimal solution is that $U_1^*=0$, $\theta \equiv \theta^*$, $t^*=\psi(\theta^*)$, $\psi'(\theta^*)=1$, and $L^*=\beta-\theta^*$ (see Laffont and Tirole, 1993). That is, the optimal profit t^* allowed for the insurer must be higher when there is informational asymmetry between the regulator and the insurer. The extra cost for the consumer to pay under incomplete information situation is equal to U_1^*. According to equation (17), the optimal utility U_1^* of asymmetric information case is increasing with the manipulation level $\theta^*(\beta)$ because ψ is assumed a convex function of θ. Therefore the higher level of informational asymmetry, the higher profit loading must be paid to the insurer in order to induce the truthful reporting to prevent the understatement of loss reserves and consequent risk of insolvency.

V. Concluding Remarks

Insurance is an intangible and complicated product which requires utmost good faith from the consumer. In the previous research we always emphasize the informational asymmetry on the consumers who may cause the adverse selection and moral hazard problem. Although the informational asymmetry between the consumer and the insurer is a serious problem in the insurance market, it is also an important issue between the regulator and the insurer; however, it has been ignored in the previous insurance literature.

The new theory of regulatory economics provides a normative approach for the public policy which is different from the traditional research by emphasizing the informational constraints of the regulator. Asymmetric information between the regulator and the firm is a very fact in the real world but was ignored in the previous academic research. It is almost impossible for the regulator to know the production efficiency of a specific firm. For a perfect competitive market where the consumer and the firm both have full information about the products and the prices, there is no need for the regulatory intervention and thus it is trivial to discuss the problem of informational asymmetry between the regulator and the firm. However, for a highly regulated market as insurance industry, the regulatory intervention of products and prices has a significant impact on the business transaction. In such case the sufficiency of information for the regulator becomes an important issue in making a public policy.

Due to the special characteristics of claim costs and the accounting procedures of loss reserves, the insurer has much more advantage on controlling the claim cost information than the regulator. Loss reserves are the largest item of liability for an insurance company. The accuracy of loss reserves is important not for the rate regulation but also for the solvency regulation. How to induce the insurer to report the true information is one of the most important work for the commissioner. The model and discussion in this paper provide a preliminary step of the new regulatory economics for insurance market. This study is to highlight the application of the new regulatory theory to the insurance market by translating the original model and redefining the variables into the specific conditions of insurance.

The finding of this paper is that the higher level of informational asymmetry, the higher profit loading must be paid to the insurer in order to induce the truthful reporting to prevent the understatement of loss reserves and consequent risk of insolvency. This result provides a theoretical foundation for the insurance practice that the profit loading or risk premium for the more upredictable lines (e.g., malpractice and general liability) must be higher in order to maintain the market. If the profit loading is not high enough for these risky lines, the insurer may reject to provide insurance products to the market.

In addition the property-liability insurance, we may also apply the model to the case of national health insurance by setting the government (insurer) as the principal and the physician as the agent. The results will be similar that the higher level of the effort is controlled by the physician, the higher rent for the asymmetric information the government should pay. The future studies may extend the preliminary model provided in this paper to the other problems such as the insolvency of property-liability insurers or other fields of insurance.

Note :

1. If the number of claims or the frequency is included, we just revise the equation (2) as $L=(\beta-\theta)Q$, where Q is the quantity. Since this variable does not have an impact on the model, we may simply treat Q as one or think β as the severity of total losses.
2. The concept of manipulation effort is very close to the loss reserve error (see Weiss, 1985). We may consider the loss reserve error is the result of the manipulation effort. Therefore, we may measure the effort which is not observable directly (Laffont and Tirole, 1993) by way of the loss reserve error.
3. In practice the insurer sometimes lowers down the underwriting standard and sacrifices the underwriting income to pursue the investment income when the investment market is promising. However, the significant fluctuation in the investment market may not generate the anticipated returns.
4. In risk theory we frequently assume the expense and profit loading is proportion of pure premium (expected losses). Since this paper considers not only the underwriting profit but also the investment profit, the formula of gross premium is somewhat revised to match with the following mathematics of the agency theory.
5. $\psi(\theta)=\psi(L-\beta)$ because $L=\beta-\theta$.
6. It is not necessary to put the second order condition (eq.(8)) of incentive comparability in the model because the incurred losses are always an increasing function of the severity parameter. The first order condition of incentive comparability (eq. (7)) is rewritten by replacing $t'(\beta)$ with $U_1'(\beta)$ and $\psi'(\beta-L)L'$ with $\psi'(\theta(\beta))$.

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