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Disclosure in insurance law: a comparative analysis

Kevin Li · Yulan Wang · Owen Tang · Jie Ming

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ABSTRACT

Disclosure or non-disclosure is one of the key issues in insurance contract. This paper compares laws on remedy for no-disclosures in European and other major jurisdictions. It concludes there are generally two different approaches on remedy for non-disclosure – 1) the strict disproportionate approach; and 2) the proportionate approach. The paper introduces an asymmetric information model to elaborate on the ongoing debates over the various normative issues of fairness with respect to the two different approaches. It confirms that the proportionate approach serves better the goal of fairness, in particular for the insured who acts honestly but carelessly provides bad information to the insurer. The model provides a statistical tool for a correct range of remedy on non-disclosure.

Keywords: insurance, information disclosure, utmost good faith, fairness, remedy, regulation

K.X. Li
College of Business & Economics, Chung-Ang University, Republic of Korea
Email: kxli@cau.ac.kr

Yulan Wang
Institute of Textiles and Clothing, The Hong Kong Polytechnic University, China

Owen Tang
Faculty of Business, The Hong Kong Polytechnic University, China

J. Ming
Faculty of Business, The Hong Kong Polytechnic University, China

1 Introduction

The social function of insurance is to help an individual to conduct his affairs with prudence by giving him a choice – a choice of transferring away his risk of loss from an uncertain event by paying a known amount of premium to an insurer. In another words, insurance is intended to be a risk-transfer mechanism that brings the peace of mind to the policyholders. This exchange performs a valuable function by enabling members of society to plan their personal and business affairs prudently. If the insurer avoids the policy, such exchange fails, and the peace of mind a policyholder expects to enjoy would become illusory.

Accordingly, for the sake of fairness, a good legal system should protect a policyholder's legitimate and reasonable expectation of coverage. At the same time, to facilitate transactions in the insurance market, the insurers need to rely on a well designed legal system to obtain good information from the policyholders so as to assess the related risks properly, and then to make the following two decisions: (a) whether to accept the deal; and (b) if yes, how much the premium should be.

In order to smooth the progress of the insurance market, a well designed legal system should encourage both insurers and policyholders to engage in adequate information exchange during the pre-contractual stage so that the insurers can assess the risks properly, which in some jurisdictions is governed by the principle of utmost good faith. There are two major remedy approaches for non-disclosure or violation of utmost good faith: 1) the strict disproportionate approach; and 2) the proportionate approach.

1.1 The strict disproportionate approach

The strict disproportionate approach works on the assumption that a policyholder knows more about the risks of his affairs than does the insurer.

To guard against insurance policy applicants withholding true information from or supplying false information[1] to the insurers, the strict disproportionate approach uses legal tools such as non-disclosure, misrepresentation and warranties to regulate a policyholder's information disclosure behavior, and such tools were incorporated into the 1906 British Marine Insurance Act[2]. The strict disproportionate approach leans towards the side of protecting insurers,[3] and in some cases, even towards over-compensating the insurers.[4] Such a judicial mindset can be best summarized by Lord Steyn's opinion as stated in *Smith New Court Securities Ltd v Citibank*[5] that

> 'a generous measure of damages is appropriate where the misrepresenter has behaved in a morally reprehensible way. This shows society's disapproval of the behavior, and discourages the wrongdoing. Similarly, where a policyholder is morally blameworthy, the insurer should be permitted to avoid the contract from the start. This is true even if, had the insurer been given the correct information, it might still have accepted the risk with only a slight increase in premium.'[6]

The UK Law Commission[7] reviewed the insurance contract law in England and Scotland, and one of their observations was that the application of a strict disproportionate approach could operate as a trap for those policyholders who have acted honestly and reasonably during the

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[1] The 1906 British Marine Insurance Act [hereinafter called the 1906 Act], 6 Edw. 7, ch. 41, requires the policyholder to provide the material facts correctly. The test of materiality is set out in section 20(2): A representation is material when it would influence the judgment of a prudent insurer in fixing the premium, or determining whether he will take the risk.

[2] 1906 Act, § 18(1). Although, strictly speaking, the 1906 Act is concerned only with marine insurance, many of its provisions are presumed to be equally applicable to other types of insurance.

[3] In the landmark English case of *Pan Atlantic Insurance Co Ltd v Pine Top Insurance Co Ltd* ([1995] AC 501), the House of Lords decided that: If a policyholder makes a statement which is deemed to be a warranty and that statement is not correct, the law states that the insurer is entitled to be discharged from liability. This is the case even if the statement does not influence the judgment of a prudent insurer in fixing the premium or in determining whether or not he will take the risk. The effect is that the law will allow a policy to be avoided for the smallest inaccuracy, if that statement is deemed to be a warranty.

[4] Under the UK legal principle of restitution, where a contract is avoided, it would normally require the parties to restore their positions to the time prior to the contract being made. In other words, if the general restitution law applies, the policyholder may demand the return of the premium paid.

[5] [1997] AC 254.

[6] Id at 280.

[7] The UK Law Commission published its Consultation Paper No 182 on Insurance Contract Law: Misrepresentation, Non-disclosure and Breach of Warranty by the Insured. The overall objective of the law reform is to find a fairer balance between the rights of insurers and of those insured.

information exchange. In short, the strict approach is quite biased against the interests of policyholders, and its applications to the case decisions often defeat policyholders' reasonable expectations.

1.2 The Proportionate remedies approach

Many of the incorrect statements provided by insurance policy applicants during the information exchanges could be made honestly but negligently. For example, an insurance policy applicant may fail to understand what the insurer exactly wants to know in the application form, or he may fail to check the facts correctly. It makes sense to have a legal framework that allows the insurers to claim for a remedy, but it would be unfair to grant them a right to avoid the contract if that right goes further than what is necessary. If the insurers would have underwritten the risk with only a small increase in premium, then avoidance would impose a disproportionate penalty on the policyholder. Most European countries, such as Norway, Sweden, France and Germany, adopt the proportionate approach by requiring the insurer to pay a proportion of the claim for negligent misrepresentation.[8] Under the proportionate approach, if the insurer would have insured the applicant had he known the true facts, but at a higher premium or on different terms, then the insurer has to pay the claim proportionately or in accordance with the different terms.

By adopting a proportionate approach, a judge will investigate what the insurer would have done had it been aware of all the facts, and will try to put the insurer into that position. Under the proportionate approach, the only scenario in which an insurer can avoid the claim is where he can show that he would not have accepted the deal in the first place.[9] If the insurer would have

[8] Norway, Insurance Contracts Act 1989, s 4-2; Sweden, Insurance Contracts Act 2005 Chapter 4 s 2 para 2. The French Code des Assurances, Art L 113-9 allows a proportionate remedy for non-negligent and negligent misrepresentation. Under the current approach of the European Restatement Group, in cases of negligent misrepresentation, the outcome would depend on what the insurer would have done if it had been given the correct information.

[9] Norway, Insurance Contracts1989 Act § 4-2 (no remedy unless blame "more than merely slight"); Sweden, Insurance Contracts Act 2005, Chapter 4 s 2; and under the proposed scheme of the European Restatement Group, the

accepted the deal but with an exception, the judge will investigate whether such an exception would have covered the claim. If the insurer would have accepted the deal with a higher premium, the insurer must pay the claim with the reduction of the difference between the higher premium and the contractual premium. In the UK, the Financial Ombudsman Service (FOS) has a mandate to make decisions on the basis of being "fair and reasonable" in handling dispute resolutions regarding consumers and small businesses, and it adopts the proportionate rather than the strict approach. Let us consider how a proportionate approach works out in an insurance dispute case reported in the *UK Ombudsman News,* which can be summarized as follows:

> The husband and the wife held a critical illness insurance policy. When the husband arranged the policy, he failed to disclose the hearing problems that the wife had suffered. Subsequently, the wife was diagnosed with leukemia, which was wholly unrelated to her hearing problems. The insurer avoided the policy on the grounds of misrepresentation, and refused to pay the substantial claim for leukemia. Under the strict approach, the insurer was entitled to do this. [10]

The ombudsman started by investigating what the insurer would have done had it been aware of the true position. The ombudsman faced the following four alternatives:

Alternative 1: The insurer would have excluded a particular type of claim.

Alternative 2: The insurer would have added additional terms, such as an excess in the policy.

Alternative 3: The insurer would have declined the risk altogether.

Alternative 4: The insurer would have charged more.

We can summarize the alternatives and the corresponding remedies in Table 1.

[Insert Table 1 here]

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insurer will be permitted to terminate for the future if it would not have concluded the contract had it known of the information concerned.

[10] Financial Ombudsman Service, *Ombudsman News,* (April 2003), Issue 27.

The ombudsman found out that if the insurer had known about the wife's hearing problem, it would merely impose an exclusion relating to the wife's hearing problem (Alternative 1). Therefore, the ombudsman held that it was unfair and disproportionate for the insurer to avoid the entire policy. The ombudsman ruled that, as the misrepresentation was merely inadvertent, the insurer should only reject any claim related to the hearing exclusion, but should pay the leukemia claim.

The proportionate approach imposes on the insurance policy applicant a duty to be honest in ensuring that the statements they volunteer are accurate and complete, and if the policyholder has acted both honestly and carefully (that is, without negligence) in giving pre-contractual information, the insurer may not avoid the policy on the grounds of misrepresentation.

Many of the continental systems even apply the proportionate approach to business insurances. For example, marine insurance laws in Norway[11] and Sweden[12] require insurers to pay when business policyholders gave incorrect information but acted in good faith and without negligence. The French law also gives the insurer a proportionate remedy in such a case.[13] Some European countries even make the proportionate remedy a default rule; that is, the proportionate approach applies, unless the parties have agreed otherwise.[14]

1.3 Theory and methodology

The phenomena of asymmetric information in insurance markets have been detected by previous studies (Chiappori and Salanie, 2000; Finkelstein and McGarry, 2006). Some went a further step by comparing welfare in an asymmetric information equilibrium to what would have

[11] Norwegian Marine Insurance Plan 2007 (http://www.norwegianplan.no/eng/index.htm) arts 4.4 and 4.7
[12] Swedish Marine Insurance Plan 2006 (http://www.sjoass.se/orgvillpdf/SPL/SPLeng.ver.pdf) art 4.6; Swedish Insurance Contracts Act 2005.
[13] Code des assurances, art 113-9.
[14] Swedish Insurance Contracts Act 2005, ch 8 s 9. In Germany, the proportionate approach is mandatory in business insurance.

been achieved under a well designed regulatory framework (Einav, Finkelstein and Schrimpt, 2007).

When describing the nature of insurance dealings as an exclusive property rights, some prior researchers conduct their analysis by extending Ronald Coase's concept of transaction costs. For example, Eggertson and Barzel regard transaction costs as the transfer, capture, and protection of exclusive property rights (Barzel, 1997; Eggertson, 1990). Although Coase originally use the transaction cost concept to explain the cost of discovering the relevant prices and of negotiating and contracting (Coase, 1937), researchers such as Marneffe *et al*. (2011), from the aspects of regulatory liability, treated insurance premiums as part of the operational compliance costs.

In theory, the assumptions which form the basis of the proportionate approach are consistent with those on costly state verification (CSV) and costly state falsification (CSF) theories. The CSV theory was evolved from Akerlof's 1970 article on the examination of the market for lemons. Researchers after Akerlof shifted their research focus to informational asymmetry situations in insurance contracts, in which the policyholder holds private information concerning the actual magnitude of economic loss. Those researches were divided into two distinct lines of inquiry, the CSV and CSF theories, respectively.

Townsend (1979) formulated his CSV theory by referring to a debt contract situation in which the borrower has private information that the lender can discover with certainty by bearing a fixed monitoring cost. Kaplow (1994) and Crocker (1998) examined the CSV theory in an insurance setting. The generic environment considered in these studies is the one in which only the insured knows the actual magnitude of a loss suffered, and the insurer can observe that loss only by incurring a fixed monitoring cost. Thus, in a setting with CSV, the insurer can choose to eliminate the informational advantage of the insured by incurring some resource cost. The economic problem encountered in this environment is to design an agreement that utilizes the costly monitoring technology in an efficient fashion.

As for CSF, researchers argue that there is no effective monitoring technology available to the insurer for alleviating the informational asymmetry. Central to this line of inquiry, which was initiated by Lacker and Weinberg (1989) and extended by Crocker and Morgan (1998), is the assumption that the insured's private information on the magnitude of the actual loss is immutable. The CSF occurs because the policyholder is able to manufacture an insurance claim that exceeds the loss actually suffered. To form a good contract in such an environment must downsize the incentives for making falsified claims.

Both the CSV and the CSF agree that disclosure (or verification) of information related to contract contents is costly, and a monitoring cost has to be incorporated into administering the contract. The central idea of the CSV approach is that it is generally optimal to commit to at least a partial disclosure rule. Townsend (1979) has shown that as long as a debt obligation is honored, disclosure of information about the debtor's performance may not be needed; however, full information disclosure (verification) is needed in case of default.[15]

The proportionate approach in this paper can also be mirror imaged to that of the CSV in the financial contract scenario. In a financial contract setup, there are two parties involved, an entrepreneur with an investment project and a wealthy investor with available capital. The entrepreneur has private information about the cash flow from the project, but it can convincingly disclose it to the investor by incurring certain costs, and such disclosed information has a strong correlation with the interest rate determination. The CSV approach assumes that, with no audit, the entrepreneur would never be able to raise any money from the investor. Its argument is that a rational investor would anticipate the entrepreneur lying about the realized profit in order to avoid paying it back to the investor. However, the supporters of the CSV approach realize that mandatory disclosure of the entrepreneurial performance has two drawbacks: (a) It is inefficient and (b) it imposes excessive disclosure costs. Therefore, the CSV model gives the money lender a

[15] Townsend, R.M., 1979. Optimal Contracts and Competitive Markets with Costly State Verification, *Journal of Economic Theory* 22: 265–293.

right to charge a fixed bankruptcy cost on the assets of the investment project – the cost expected to be incurred in order to collect the proceeds. In our proportionate remedies model, the amount the insurer would be entitled to the reasonable coverage proportionate to the actual risks known to the policyholder at the policy's inception.

In an insurance contract scenario, the two parties are the policyholder and the insurer. The policyholder with an unknown event to be insured has private information about the likelihood of risks relevant to such unknown event, and such information determines how much the premium will be.[16] How to evaluate the risk of an unknown event has been the focus of insurance fraud literature. Watt R. (2003) shows there is a negatively sloped sharing rule in case of revealed fraud, then the underwriter can take advantage of the trade-off between the probability of fraud detection and the policyholder's decision to commit fraud to reduce fraud to zero.

This paper builds on the existing legal research about the aforementioned two approaches, and aims to find out which one is better from the view point of fairness. The rest parts of the paper are organized as follows. Section 2 describes the basic assumptions that will be used in the model. In Section 3 we develop a model of the pre-contractual information exchange for an insurance transaction, from which we derive the effects of the fairness of both approaches. Section 4 discusses the optimal strategies for the insurance policy applicant, the insurer and the court, respectively. Section 5 concludes that the proportionate approach achieves a fairer result.

2. Basic assumptions

2.1 Utility function

The utility of the insurer is determined by the premium payments received from the policyholder. The utility of the policyholder is measured by the coverage provided by the insurer.

[16] Crocker, Keith J. and Tennyson, Sharon (1999). *"Costly State Falsification or Verification? Theory and Evidence from Bodily Injury Liability Claims"*. Automobile Insurance: Road Safety, New Drivers, Risks, Insurance Fraud and Regulation. Dionne, Georges and Laberge-Nadeau, Claire, Eds., Kluwer Academic Publishers, 119-131.

In mathematical presentation, the insurer has a concave utility function U, where $U' > 0$ and $U'' < 0$; whereas the policyholder has another concave utility function W, where $W' > 0$ and $W'' < 0$. Both the policyholder and the insurer maximize their individual utilities. Thus, a good legal framework should encourage both parties to disclose all material information truthfully and completely; at the same time, it should ensure the fairness of the insurance contract during its implementation. Whether the court's formula should involve fairness (a moral concern) has long been a subject for investigations by legal philosophers. There are certain situations where some issues can and other issues cannot be fully understood under the law. This presents a problematical question as to whether the best law or the best man should rule.[17] Aristotle did not believe that having "moral fairness" should be a legitimate state concern.[18] The writings of utilitarian philosophers, such as Mill[19] and Bentham,[20] also indicate that the court should not be used as a mechanism for promoting the public morality of fairness; the court should be limited to the use of its judicial power only in preventing harm from one social member to another. Our model considers the application of fairness both in an economic setting and in a practical manner. This approach is consistent with the modern view that law and economics is a field extremely close to policy frontiers (Veetil, 2011). The application of our findings may help in preventing judicial administrators' personal ideological preferences and predispositions entering into their decision making process when confronted with the issue of fairness in insurance claim settings. For example, one suggestion from our model is to assign an arbitrage free constraint on both the policyholder and the insurer, so that neither side may make an unjust profit from the other side. In other words, our model can prevent judicial decision makers from taking a step down the road towards the rule of men rather than the rule of law.

[17] The familiar concept that the courts should strive for the "rule of law" rather than the "rule of man" is attributed to Aristotle. Aristotle, Politics, in Great Books of the Western World vol. 9, 485-486 (Robert Maynard Hutchins ed., Benjamin Jowet trans., William Benton 1952).
[18] Aristotle, Nicomachean Ethic (H. Tredennick ed. & J.A.K. Thomson, trans., Penguin Classics 2003) (circa 350 B.C.E.).
[19] John Stuart Mill, On Liberty 97 (C. Shields ed., 1956).
[20] Jeremy Bentham, Principles of Morals and Legislation (Prometheus Books 1988) (1843).

2.2 Risk state and information disclosure

Our model sorts policyholders in terms of their risk states. We use the symbol *S* to denote the set of the existing *N* types of risk states that a policyholder may hold, that is, $S = \{S_j, j = 1,2, \dots, N\}$, where S_j denotes the j^{th} type risk state. S_j contains the information about an insured subject that is material for an insurer to make his risk evaluation. Suppose that there are *m* aspects of material information. Then, S_j can be expressed by a vector of the material information, $S_j = (x_{j1}, x_{j2}, \dots, x_{jm}) \in R^m$, where x_{jk} denote the k^{th} aspect of material information of an insured subject with the j^{th} type risk state.

An insurer cannot enter into contracts with all *N* type policyholders. Suppose that it would contract with those belonging to a subset of *S*, $S_u = \{S_i, i = 1,2, \dots, n; n < N\} \in S$. If $S_j \in S_u$, the insurer offers an insurance contract. Conversely, if the insurer confronts an $S_j \notin S_u$ situation, which indicates that the members have high risk characteristics, he would not have economic incentives to offer a contract. The high risk propensities under $S_j \notin S_u$ would make the premium rate extremely high. In our model, this rate is approximately close to infinity.

Below, we use the superscript *a* to denote the actual risk state, S_j^a, and the superscript *b* to denote the distorted risk state, S_j^b. Then, we can divide the policyholders into two subsets: $\{S_j^a \in S_u, S_j^b \in S_u\}$ and $\{S_j^a \notin S_u, S_j^b \in S_u\}$.

2.3 Random loss and premium pricing

In a free market, the price (premium) of insurance protection is determined by free negotiations, and if one system is fairer than another, theoretically, the additional value of fairness should be captured in the market price. The contractual parties would formulate their negotiation strategies based upon their perceptions on the chance of the random loss of the insured subject. If

the underwriter perceives that there is a strong likelihood of information distortion, and would negotiate for a higher premium as a margin of safety. For example, a typical marine insurance contract normally involves a ship owner (policyholder) and an insurer. Suppose that the occurrence of an accident follows a Poisson process (Li and Wonham, 1999). We use the symbol λ to denote the arrival rate of the occurrence of an accident, and the symbol *L* to denote the random loss of the insured subject. The random loss follows an actual probability distribution with a cumulative density function (c.d.f) $F^a(\ell)$, and a probability density function (p.d.f)$f^a(\ell)$. The distorted information provided by the policyholder will distort the estimations of the random loss distribution and claimed arrival rate. Let the estimated distribution based on the distorted information be expressed by the c.d.f, $F^b(\ell)$, and the p.d.f, $f^b(\ell)$.

We use the symbol *q* to denote the insurance premium in a unit time interval. Then the premium would take the following form:

$$q = (1+\eta)\cdot\lambda\cdot E(L),$$

where η represents the constant risk loading rate (Taksar, 2000). The insurer determines the premium according to the disclosed information, and we have the following contract pricing formula:

$$q(S_j) = (1+\eta)\cdot\lambda(S_j)\cdot E(L|S_j) = \begin{cases} (1+\eta)\cdot\lambda(S_j^a)\cdot E(L|S_j^a), & S_j = S_j^a \in S_u, \\ \text{extremely high}, & S_j = S_j^a \notin S_u, \\ (1+\eta)\cdot\lambda(S_j^b)\cdot E(L|S_j^b), & S_j = S_j^b \in S_u. \end{cases}$$

As to the estimation of the random loss with respect to the true and distorted information, we have the following statements:

a. The expected loss and the loss arrival rates are higher under the actual risk state than those under the distorted risk state, that is $E(L|S_j^a) \geq E(L|S_j^b)$ and $\lambda(S_j^a) \geq \lambda(S_j^b)$.

b. Suppose that policyholder A is in the i^{th} risk state S_i^a, and policyholder B is in the *jth* risk state S_j^a. *(1)* If $E(L|S_i^a) > E(L|S_j^a)$, policyholder A is of higher risk than policyholder B. (2) If $S_i^a \notin S_u$, *and* $S_j^a \in S_u$, then $E(L|S_i^a) \gg E(L|S_j^a)$.

Consequently, the premium rates have the following relationship:

$$q(S_j^b|S_j^b \in S_u) \leq q(S_j^a|S_j^a \in S_u) \ll q(S_j^a|S_j^a \notin S_u),$$

which illustrates two types of information distortion. In general, the information disclosed in $S_j^a \notin S_u$ is distorted more severely than that in $S_j^a \in S_u$. Unlike our proportionate model, the disproportionate approach fails to take this difference into consideration.

2.4 Term structure of insurance policy

Consider that a policyholder purchases a *T*-year-term insurance for the insured subject. At time *t*, a certain type of risk state, $S_{j,t}$, is observed. The insurer then offers a time- and risk state-dependent insurance premium rate $q(t, S_{j,t})$,

$$q(t, S_{j,t}) = (1 + \eta)\lambda(S_{j,t})E(L|S_{j,t}).$$

Suppose that the risk state changes at time *d*, where $0 \leq d \leq T$. If the policyholder does not realize such change, then the information is distorted at this moment *unintentionally*. However, if the policyholder has already discovered such change but fails to disclose it, the information is distorted *intentionally*. When an accident occurs and the amount of claim severely exceeds the expectation of the insurer, the insurer will start an investigation of the accident to see if there exists a lack of proper disclosure on the side of the policyholder.

Let *D* denote the time of the occurrence of the claim and $d \leq D \leq T$. Then the time *D* can be defined as

$$D = \inf\{t: L_t > \text{the tolerable level of the insurer}; 0 \leq t \leq T\},$$

where L_t is the actual loss of the accident at time t. The tolerable level of the insurer will be discussed in the next subsection.

Under the situation $\{S_{j,d}^a \notin S_u, S_{j,d}^b \in S_u\}$, the insurer would not offer a contract to the policyholder under the truthfully disclosed information. This implies that the premium rate would tend to reach an extremely high level. However, under the situation $\{S_{j,d}^a \in S_u, S_{j,d}^b \in S_u\}$, the insurer would conclude the insurance contract based on the truthfully disclosed information at time *d*. In a situation where a policyholder unintentionally distorts the risk state, the premium rate would not change at time *d* even if the risk state changes. Based on the ways the information is disclosed, we have the following four scenarios:

Scenario I

During the time interval $[0, d]$, the policyholder provides the true information and obtains the contract at a premium rate $q(0, S_{j,0}^a)$. The policyholder fails to realize the change of risk state at time *d*. So the premium rate remains at the original level until time *D* (the solid line A in Figure 1). It is assumed that neither the policyholder nor the insurer can predict time *d* and *D*.

[Insert Figure 1 here]

Scenario II

This is an extreme situation, in which there is no change of risk state during the time interval $[0, D]$. The policyholder can distort information during the pre-contractual period to obtain a lower premium rate, that is, $d = 0$ (see Figure 2).

[Insert Figure 2 here]

The dotted line indicates the premium rate under the true information, while the solid one corresponds to that under the distorted information.

Scenario III

The policyholder does nothing, although he knows about the change of risk state at time *d*. This is similar to the situation of the unintentional distortion in scenario 1, but the policyholder in this scenario is intentional about the distortion.

[Insert Figure 3 here]

Based on the true information, the premium should be adjusted at time *d* to a new higher rate (dotted line). The policyholder does not report the change, so the premium remains at the original rate (solid line A).

Scenario IV

Figure 4 shows based on the true information, the premium should be adjusted at time *d* to a new higher rate (dotted line). The policyholder, however, distorts the information so as to obtain a lower premium (solid line A or line B), which is no less than the premium before time *d* (solid line B).

[Insert Figure 4 here]

According to Taksar (2000), the premium collection under the distorted information is

$$Q\left(S_{j,0}^{a}, S_{j,d}^{b}, d, D\right) = q\left(0, S_{j,0}^{a}\right) \cdot d + q\left(d, S_{j,d}^{b}\right) \cdot (D - d). \quad (1a)$$

And if the information is disclosed truthfully, the premium collected shall be

$$Q\left(S_{j,0}^{a}, S_{j,d}^{a}, d, D\right) = q\left(0, S_{j,0}^{a}\right) \cdot d + q\left(d, S_{j,d}^{a}\right) \cdot (D - d). \quad (1b)$$

Consequently, at time *D*, the loss of income for the insurer is

$$\Delta Q\left(S_{j,d}^{a}, S_{j,d}^{b}, d, D\right) = Q\left(S_{j,0}^{a}, S_{j,d}^{a}, d, D\right) - Q\left(S_{j,0}^{a}, S_{j,d}^{b}, d, D\right)$$
$$= \left[q\left(d, S_{j,d}^{a}\right) - q\left(d, S_{j,d}^{b}\right)\right] \cdot (D - d). \quad (1c)$$

This income loss depends on both the degree of underestimation of the premium rate, $\left[q\left(d, S_{j,d}^{a}\right) - q\left(d, S_{j,d}^{b}\right)\right]$, and the duration of information distortion, $D - d$. Our model indicates that the longer the period of information distortion, the higher the amount of income loss for the insurer.

2.5 Game structure

The policyholder and the insurer are now each adopting their individual game strategies so as to slant the benefits and liabilities in their own favor. The court intervenes when the policyholder and the insurer fail to settle their differences by themselves. We assume that each party has the knowledge of the whole game structure and knows the objective function of the other party. However, they may not necessarily have the knowledge of the actions inside the game.

The policyholder can influence the premium price by disclosing the material information $S_{j,t}$, which affects the estimation of the loss arrival rate λ and the loss distribution $F(\ell)$.

Define γ as the insurer's risk attitude towards the loss. The smaller λ , the more likely the insurer is to investigate the accident. Denote the loss at time *D* as L_D where $D = \inf\{t: L_t \geq \gamma \cdot E(L|S_{j,t})\}$. If $L_D \geq \gamma \cdot E(L|S_{j,d})$, the insurer would settle the case at cost *C*, but if $L_D < \gamma \cdot E(L|S_{j,d})$, then the insurer would pay the claim without any hesitation.

The court makes the ruling decision from a fairness perspective. The policyholder can then recover the claim partially as a proportion of the whole loss value. Denote such coverage proportion as α, where $0 \leq \alpha \leq 1$. In order to calculate α objectively, this research develops a method that is independent of the psychological impact ("moral concerns") of the judge and the other two parties.

3 Basic model

We let $P\left(S_{j,d}^{b}\right)$ and $I(\gamma)$ denote the expected utilities of the policyholder and the insurer, respectively. The focus of this analysis is the possibility of the insurer filing the case at court.

3.1 The choice of the policyholder

As for the policyholder, if the insurer does not file the case at court, the expenditure of the policyholder is $Q\left(S_{j,0}^{a}, S_{j,d}^{b}, d, D\right)$; otherwise, the insurer's investigation will reveal the distorted information, and only a part of the loss, $\alpha \cdot \ell$, will be recovered. Under the strict disproportionate remedy, $\alpha \equiv 0$, while under the proportionate remedy, $0 \leq \alpha \leq 1$. Thus, if the insurer files the case at court, the expenditure of the policyholder is $Q\left(S_{j,0}^{a}, S_{j,d}^{b}, d, D\right) + (1-\alpha) \cdot \ell$. Therefore, the expected utility of the policyholder is

$$P\left(S_{j,d}^{b}\right) = \max_{S_{j,d}^{b}} \left[W\left(-Q\left(S_{j,0}^{a}, S_{j,d}^{b}, d, D\right)\right) \cdot F^{a}\left(\gamma \cdot E\left(L \middle| S_{j,d}^{b}\right)\right) + \int_{\gamma \cdot E\left(L \middle| S_{j,d}^{b}\right)}^{\infty} W\left(-Q\left(S_{j,0}^{a}, S_{j,d}^{b}, d, D\right) - (1-\alpha) \cdot \ell\right) dF^{a}(\ell) \right]. \quad (2a)$$

The distorted risk state, $S_{j,d}^{b}$, directly impacts the insurer's estimations of $E\left(L \middle| S_{j,d}^{b}\right)$ and $\lambda\left(S_{j,d}^{b}\right)$. Let $x = E\left(L \middle| S_{j,d}^{b}\right)$. Then we have

$$P(x) = \max_{x,\lambda} \left[W\left(-Q(x, \lambda, d, D)\right) \cdot F^{a}(\gamma \cdot x) + \int_{\gamma \cdot x}^{\infty} W(-Q(x, \lambda, d, D) - (1-\alpha) \cdot \ell) dF^{a}(\ell) \right]. \quad (2b)$$

3.2 The choice of the insurer

At time *D*, the accident loss L_D occurs. The insurer either pays the claim without litigation, or investigates with a cost *C* and pays the policyholder partially. The action of the insurer depends on his risk attitude γ. The insurer chooses the optimal value γ so that

$$I(\gamma) = \max_{\gamma}\left[\int_{0}^{\gamma\cdot E\left(L\middle|S_{j,d}^{b}\right)} U(-\ell)dF^{b}(\ell) + \int_{\gamma\cdot E\left(L\middle|S_{j,d}^{b}\right)}^{\infty} U(-\alpha\cdot\ell - C)dF^{b}(\ell)\right]. \quad (2c)$$

3.3 The choice of the court

We assume that the primary objective of the court is to see justice done, that is, to allocate the liabilities fairly between the insurer and the policyholder. There exist two scenarios.

Scenario I $S_{j,d}^{a} \in S_u$, $S_{j,d}^{b} \in S_u$

Under the truthfully disclosed information, the premium gap is $\Delta Q\left(S_{j,d}^{a}, S_{j,d}^{b}, d, D\right)$. The court determines the coverage proportion rate, α, so that the policyholder has to bear a portion of the loss, $(1-\alpha)\cdot\ell$, by himself. This is the liability of the policyholder.

The premium gap should be expectedly equal to the liability of the policyholder. The following equation ensures the ruling of the court be arbitrage free, that is, both the policyholder and the insurer cannot make an unjust profit from each other:

$$\Delta Q\left(S_{j,d}^{a}, S_{j,d}^{b}, d, D\right) - \int_{\gamma\cdot E\left(L\middle|S_{j,d}^{b}\right)}^{\infty}(1-\alpha)\cdot\ell dF^{a}(\ell) = 0 \quad (3)$$

Scenario II $S_{j,d}^{a} \notin S_u$, $S_{j,d}^{b} \in S_u$

In this scenario, an insurance contract would not exist if the truthful information had been disclosed. When the loss actually occurs, the insurer has no liability to cover the loss. Thus $\alpha = 0$.

4 The optimal proportionate remedy

4.1 Optimal strategy of the policyholder

In an economic game setting, the policyholder will design his strategy according to the strategy taken by the insurer. The policyholder will distort the information whenever the insurer does not suspect the accuracy of the information. When the first-order derivatives of the policyholder's expected utility with respect to the expected loss *x* and the arrival rate λ satisfy $\frac{dP}{dx} > 0$ and $\frac{dP}{d\lambda} > 0$, the policyholder will disclose the information that is closer to the truth. If $\frac{dP}{dx} < 0$ and $\frac{dP}{d\lambda} < 0$, the policyholder will further distort the information to obtain a lower premium rate. In particular, if $\frac{dP}{dx} < 0$, $\frac{dP}{d\lambda} < 0$ and $S_{j,d}^{a} \notin S_u$, the policyholder will choose to disclose the distorted information $S_{j,d}^{b} \in S_u$, where the true expected loss is surely larger than any estimation based on the information in S_u.

4.2 Optimal strategy of the insurer

An insurer has to decide whether or not to file his case at court when the actual loss at time *D* exceeds the tolerable level of the insurer. When $L_D < \gamma \cdot E\left(L \middle| S_{j,d}^{b}\right)$, the insurer will cover the loss directly. When$L_D \geq \gamma \cdot E\left(L \middle| S_{j,d}^{b}\right)$, the insurer will file his case at court with a cost *C* and will cover the loss partially based on the judgment of the court.

Proposition 1 Given the rule of the court, $\alpha < 1$*, the distorted information,* $S_{j,d}^{b}$*, and the investigation cost, C, the optimal control variable of the insurer, that is, his risk attitude towards the loss, is*

$$\gamma = \frac{C}{(1-\alpha) \cdot E\left(L \middle| S_{j,d}^{b}\right)}. \tag{4}$$

When $\gamma < \frac{C}{(1-\alpha) \cdot E\left(L \middle| S_{j,d}^{b}\right)}$*, the utility of the policyholder increases with* γ*; when* $\gamma > \frac{C}{(1-\alpha) \cdot E\left(L \middle| S_{j,d}^{b}\right)}$*, the utility of the policyholder decreases with* γ*.*

When the investigation cost *C* decreases, the insurer will file more cases at court. Under the current marine insurance law, if the policyholder distorts the material information, the insurer has

the right to terminate the contract, that is, $\alpha = 0$. If the investigation cost is minimal, the insurers have strong incentives to investigate all cases.

4.3 Fairness target

Rawls (1971) built up a hypothetical societal framework to assess the nature of laws, and his framework is based on two basic tenets: (1) all individuals, in a state of nature, are initially identical with regard to physical strength, financial security, religion, race, etc;[21] and (2) these individuals have no concrete idea about what future events will happen to them.[22] Given these two basic tenets, Rawls claimed that the rules people intend to establish would be fair because no one can skew these rules to benefit himself in a given individual circumstance.[23]

Our model of analysis adopts the idea of Rawls (1971) on fairness. Corresponding to the scenario $S_{j,d}^{a} \in S_u$, the coverage proportion rate, α, can be solved by simplifying the constraint (3).

Proposition 2 *Given* $\Delta Q\left(S_{j,d}^{a}, S_{j,d}^{b}, d, D\right)$*, we find that for any given* $S_{j,d}^{a}, S_{j,d}^{b} \in S_u$

$$\alpha = 1 - \frac{(1+\eta)\cdot(D-d)\cdot\left[\lambda\left(S_{j,d}^{a}\right)\cdot E\left(L\middle|S_{j,d}^{a}\right) - \lambda\left(S_{j,d}^{b}\right)\cdot E\left(L\middle|S_{j,d}^{b}\right)\right]}{\int_{\frac{C}{(1-\alpha)}}^{\infty} \ell dF^{a}(\ell)} \qquad (5)$$

From equation (5), we find that the optimal coverage proportion, α, is independent of the "moral concerns" of the judge, and of the risk attitudes of the policyholder and the insurer. Next we *show the existence of* α.

Proposition 3 *There exists an optimal coverage proportion* α.

[Insert Figure 5 here]

[21] John Rawls, *A Theory of Justice* 136 (1971).
[22] Id.
[23] Id.

Figure 5 illustrates Proposition 3. However, it is difficult to obtain the exact explicit form of α as it depends on the specific loss distribution function. Figure 6 illustrates the variation of the coverage proportion with respect to the extent of information distortion. For $S_{j,d}^{b} \in S_u$, the maximal coverage percentage is 1, when $S_{j,d}^{b} = S_{j,d}^{a}$.

[Insert Figure 6]

4.4 Shortcomings of a strict approach

As shown in Figure 7, the strict approach (line AB) differs significantly from that of the proportionate method (curve AC) when $S_{j,d}^{a} \in S_u$. Supporters of the strict remedy argue that for any distorted information, the coverage proportion should be zero, and the premium should not be refunded. Such a position presents a problem of procedural unfairness. For example, in *Roselodge Ltd v Castle*[24], the judge opined that there exists a strong tendency for the expert witnesses to anxiously "defeat the claim if it could be legitimately defeated".

Policyholders are often at a considerable disadvantage in finding expert witnesses to challenge the expert evidence provided by the insurers.[25] Also, it depends on the judge to challenge the validity of the insurer's evidence. For example, in *Reynolds v Phoenix Assurance Co*,[26] the judge challenged the assertion of the insurer's expert witness in classifying a previous conviction as material information. The judge reasoned that such evidence is readily available to the insurers, and is thus not private information available only to the policyholder.

[Insert Figure 7 here]

[24] [1966] 2 Lloyd's Rep 113, at p 132.
[25] See J Birds and N Hind, Birds Modern Insurance Law (6th ed, 2004), p 116.
[26] [1978] 2 Lloyd's Rep 440, at p 460.

The strict approach defeats the reasonable expectations of policyholders in using the insurance as a mechanism to transfer risk. It creates an unduly harsh legal burden on the side of the policyholders. As a result, it makes the risk transfer mechanism an illusory protection for those honest but unwary policyholders.

A strict approach may even cause unfairness to a third party. For example, a driver fails to disclose all material information to the insurer when applying for the liability insurance. The driver subsequently hits and injures a victim during his driving. Under a strict remedy approach, the victim's ability to recover from the car driver (policyholder) could be adversely affected by the driver's non-disclosure to the insurer.

In this research, we suggest the following amendments to the current rules, as shown in Figure 8. Basically, we should take into consideration: (1) whether or not it is an intentional distortion of the information, and (2) the severity of the distortion (i.e. the impact on the income loss of an insurer). Thus, the following suggestions are recommended for different situations.

[Insert Figure 8 here]

Severe information distortion

A severe information distortion is indicated in our model as $S_{j,d}^{a} \notin S_u$, and the treatment is subdivided according to the nature of the distortion.

- For the intentional distortion, the insurer can refuse to cover the loss (line 0C) and also refuse to refund the premium;
- For the unintentional distortion, the insurer has the right to refuse to cover the loss (line 0C), but has to refund the premium.

Less severe information distortion

In the case of less severe information distortion, that is $S_{j,d}^{a} \in S_u$ if the coverage proportion derived from equation (6) is greater than zero, the insurer should provide a proportionate remedy for the loss at the rate α (curve AB in Figure 8). The less distorted the information is, the greater should be the coverage proportion.

Our model can help the courts to make judgments in a more objective manner, by referring to the resulting coverage proportion. If it is less than zero, the insurer can refuse to cover the loss (line 0A in Figure 8), but he must refund the premium.

5 Conclusion

In this paper we have examined the two legal approaches that judicial regulators tend to use in regulating pre-contractual information exchanges between an insurance policy applicant and the insurer in an insurance transaction. The strict disproportionate approach tends to create results that favor the insurers to an unnecessary extent. The strict approach places an unfavorable burden on the insurance policy applicant in the pre-contract information exchanges, albeit with the hope of keeping sufficient insurers in the market to provide insurance functions, even if this is detrimental to those policyholders who act honestly but fail to provide the correct information.

Our model has illustrated that the proportionate approach likely provides a fairer result. The model we have developed may help judicial decision makers to gain a better insight into common situations where conflicting evidence is presented that makes it difficult to calculate the proportional coverage. For example, commentators admit that there are many cases where the court is unable to put an accurate percentage on the reduction, and the decision has "an element of arbitrariness".[27] Even faced with the uncertainty of coming up with a precise value, our analysis has shown that the proportionate approach is still a fairer way when compared with the strict approach. This commonsense reasoning is simple: it is better to work imprecisely within the

[27]Lambert-Faivre, *Droit des Assurances* (11th ed), Dalloz, at p197.

correct range of values than to apply a method that is clearly wrong. Using fairer legal practices, the courts can always employ statistical tools to keep the level of imprecision within acceptable limits.

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Appendix: Proofs

Proof of Proposition 1. Calculating the first-order derivative of $I(\gamma)$ with respect to γ yields

$$\frac{dI}{d\gamma} = \left[U\left(-\gamma \cdot E\left(L\middle|S_{j,d}^{b}\right)\right) - U\left(-\alpha \cdot \gamma \cdot E\left(L\middle|S_{j,d}^{b}\right) - C\right)\right] \cdot f^{b}\left(\gamma \cdot E\left(L\middle|S_{j,d}^{b}\right)\right) \cdot E\left(L\middle|S_{j,d}^{b}\right)$$

Let $\frac{dI}{d\gamma} = 0$, then equation (4) is obtained. □

Proof of Proposition 2. From constraint (3), we can derive that

$$\alpha = 1 - \frac{\Delta Q\left(S_{j,d}^{a}, S_{j,d}^{b}, d, D\right)}{\int_{\gamma \cdot E\left(L\middle|S_{j,d}^{b}\right)}^{\infty} \ell dF^{a}(\ell)} = 1 - \frac{(1+\eta)\cdot(D-d)\cdot\left[\lambda\left(S_{j,d}^{a}\right)\cdot E\left(L\middle|S_{j,d}^{a}\right) - \lambda\left(S_{j,d}^{b}\right)\cdot E\left(L\middle|S_{j,d}^{b}\right)\right]}{\int_{\gamma \cdot E\left(L\middle|S_{j,d}^{b}\right)}^{\infty} \ell dF^{a}(\ell)}.$$

Substituting $\gamma = \frac{C}{(1-\alpha)\cdot E\left(L\middle|S_{j,d}^{b}\right)}$ into the above equation, we obtain that for $S_{j,d}^{a} \in S_u$,

$$\alpha = 1 - \frac{(1+\eta)\cdot(D-d)\cdot\left[\lambda\left(S_{j,d}^{a}\right)\cdot E\left(L\middle|S_{j,d}^{a}\right) - \lambda\left(S_{j,d}^{b}\right)\cdot E\left(L\middle|S_{j,d}^{b}\right)\right]}{\int_{\frac{C}{(1-\alpha)}}^{\infty} \ell dF^{a}(\ell)}.$$

Proof of Proposition 3. Let $y = \frac{1}{1-\alpha}$. Then the equation (5) can be rewritten as

$$\int_{C\cdot y}^{\infty} \ell dF^{a}(\ell) = (1+\eta)\cdot(D-d)\cdot\left[\lambda\left(S_{j,d}^{a}\right)\cdot E\left(L\middle|S_{j,d}^{a}\right) - \lambda\left(S_{j,d}^{b}\right)\cdot E\left(L\middle|S_{j,d}^{b}\right)\right]\cdot y.$$

Define $H(y) = (1+\eta)\cdot(D-d)\cdot\left[\lambda\left(S_{j,d}^{a}\right)\cdot E\left(L\middle|S_{j,d}^{a}\right) - \lambda\left(S_{j,d}^{b}\right)\cdot E\left(L\middle|S_{j,d}^{b}\right)\right]\cdot y$ and $G(y) = \int_{C\cdot y}^{\infty} \ell dF^{a}(\ell)$. Then $G(y)$ decreases in *y* and $G(0) = E\left(L\middle|S_{j,d}^{a}\right)$; $G(\infty) = 0$. As $\lambda\left(S_{j,d}^{a}\right)\cdot E\left(L\middle|S_{j,d}^{a}\right) > \lambda\left(S_{j,d}^{b}\right)\cdot E\left(L\middle|S_{j,d}^{b}\right)$ for any $S_{j,d}^{a} \in S_u$, $H(y)$ is greater than zero and increases in *y*. Thus, there must exist a solution of α (see Figure 5).

Table 1: Alternative of Remedy

Alternatives	Remedies
Alternative 1	The insurer need not pay for a claim covered by the exclusion, but the insurer cannot avoid the entire policy.
Alternative 2	The policy is deemed to contain those additional terms.
Alternative 3	The insurer can avoid the claim.
Alternative 4	The claim should be reduced proportionately to the under-payment of premium.

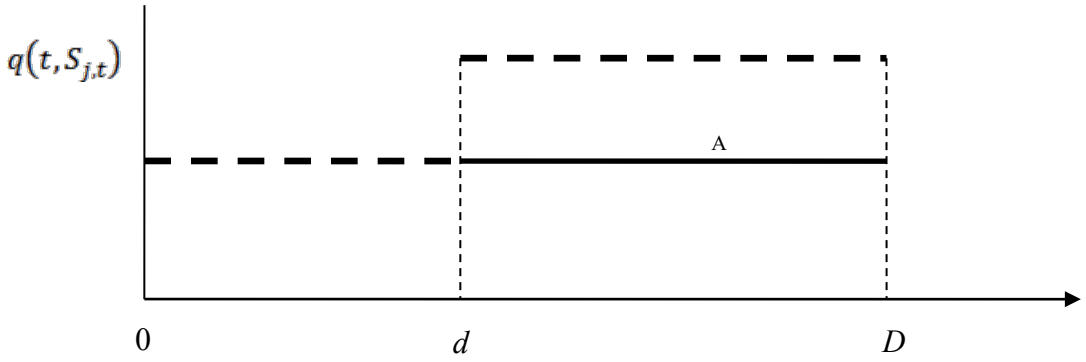

Figure 1: Premium rate under unintentional distortion

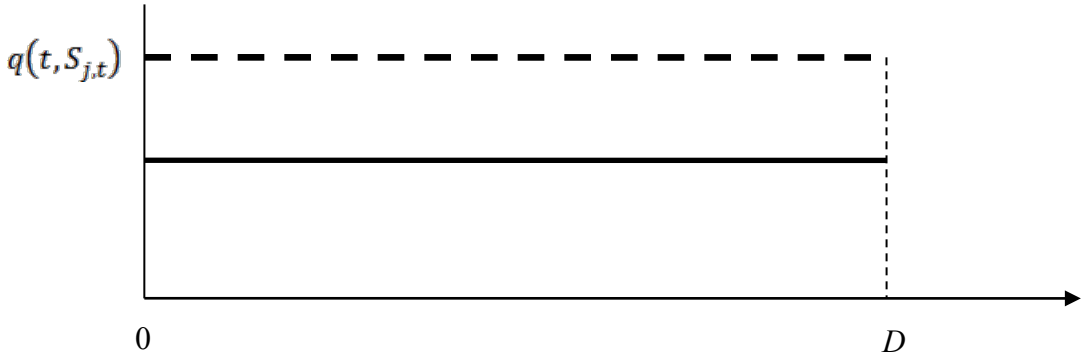

Figure 2: Premium rate with distorted information from time 0

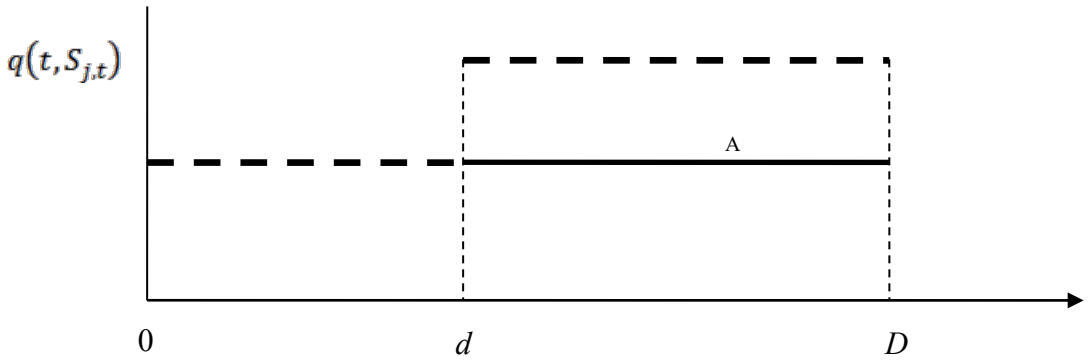

Figure 3: Premium rate with distorted information from time d (not reported)

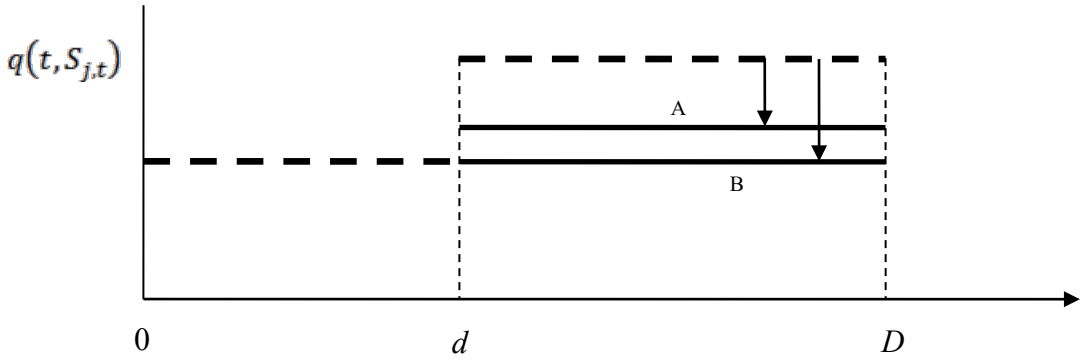

Figure 4: Premium rate under distorted information from time d

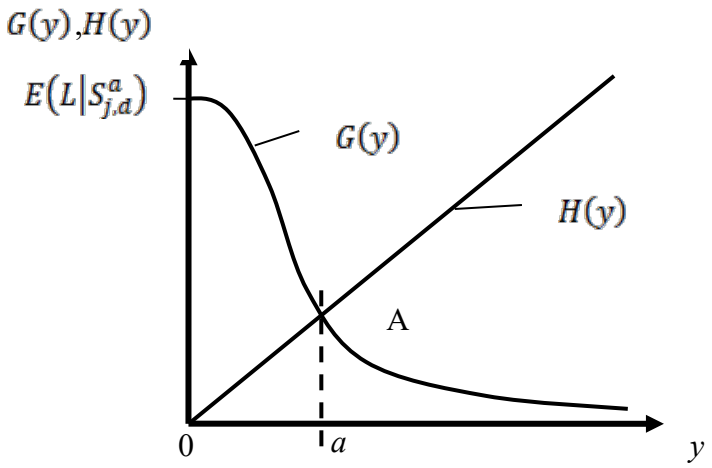

Figure 5: The solution of the coverage proportion α

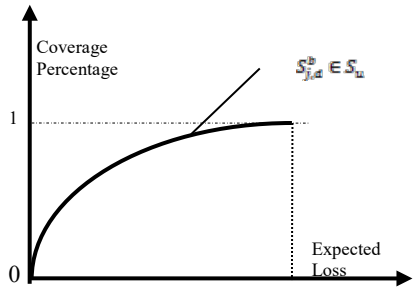

Figure 6: The coverage proportion and the distorted expected loss

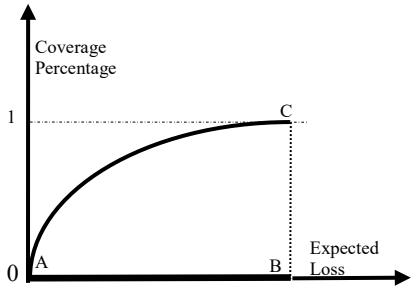

Figure 7: The optimal coverage proportion

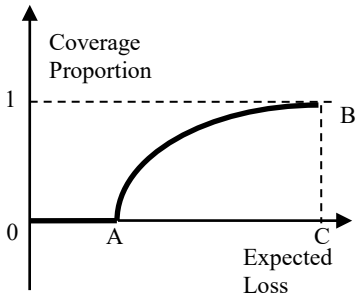

Figure 8: Suggested Proportionate Remedy