Incentive of Risk Control, Tort Law and Liability Insurance for the Public Premises

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Abstract

The public policy maker plans to implement the compulsory liability insurance with strict liability principle to provide the compensation for the injured in the public premises and to enhance the safety care taken by the firm. However, the availability and affordability of private liability insurance has been a serious problem in the insurance market since 1980's. The fundamental solution of public safety is to improve the risk control activities by the firms.

This paper provides theoretical analysis of the effect of legal system (negligence rule vs. strict liability) and compulsory liability insurance on the incentive of safety care. The major findings of this study are:(1)the incentive of safety care of the firm is decided by the relative expected cost of risk control program to the expected benefit of damage reduction, instead of the liability rule of tort law; (2)the intervention of compulsory liability insurance will not encourage the incentive of safety care unless the premium rate is structured unfairly to make extra penalty on the high-risk insured; (3)when there is uncertainty in causation and/or claim settlement, strict liability law will not encourage the safety care but discourage the firm from attending the business, while the safety care is increased under negligence rule and the expected utility of attending business may be unchanged, increased, or decreased depending on the cost of risk control activities.

Keywords: negligence rule, strict liability principle, liability insurance of public premises, incentive of safety care, uncertainty in loss settlement.

I. Introduction

The disastrous accidents in the public premises have cost numerous lives and huge economic losses during the past decay. Although the attribution varies from case to case, the results are quite the same---deep grief for the death/injured and huge financial loss for the society. These unexpected accidents will remain and even more drastic as the development and advancement in new technology continues. To maintain the safety and quality of living space is one of the most important responsibility for all the public as well as the government.

The causes of accidents may be attributed to natural force or human negligence or the mix of both. The natural force is no way to blame, but the human negligence must be controlled or punished in order to reduce the accidents and the losses. In every society there are some kinds of laws, e.g., tort law, to protect the injured and/or punish the negligent party. The original function of tort law is to maintain the social justice which attributes liability to the party causing injury. Under the tort law, the negligent injurer must compensate the loss of the victim. For example, the speeding driver in a car accident must pay the loss of bodily injury and property damage to the injured pedestrian. However, the emphasis on fairness and social justice of the law has somewhat changed with the economic environment in the past century (see Mercuro and Medema (1997) for a review of the evolution of the law). Economic efficiency becomes an important consideration in the tort law and public policy in addition to the social justice.

To attribute the fault or negligence of an injury may involve the litigation cost. To provide the full compensation for the victim(s) must depend on the financial ability of the injurer. The huge cost and lengthy process of litigation, as shown in table 1, have encouraged the adoption of no-fault or strict liability law in the past twenty years, ranging from the car accidents to the product liability. On the other hand, the financial responsibility for the injury has increased the business of liability insurance dramatically

during the past two decays. Liability insurance becomes a major source to compensate the injury in the developed countries such as the U.S. and western Europe.

As the disastrous accidents continue to occur and the damages of loss become larger and larger, the public-policy maker plans to adopt compulsory liability insurance with strict liability principle to expedite the compensation for the injured. There are questions about the incentive of risk control which must be seriously considered when the public policies are dominated by the expedience of compensation because damage prevention is more important than the ex post monetary compensation. The purpose of this study is to investigate whether the public policy of compulsory liability insurance with strict liability principle has an adverse impact on the incentive of safety care for the public premises.

The paper is organized as follows. Section II describes the ambiguity in causation of an accident and the law of liability rule. Section III develops the basic model for the decision of risk control. The comparison of optimal safety care levels under strict liability and negligence rule is shown in section IV. The effect of liability insurance on the incentive of risk control is analyzed in section V. Section VI extends the discussion of safety care and liability insurance to the situation with uncertainty in causation and claim settlement. The concluding remarks are provided in section VII.

Table 1 Costs and Compensation Paid in Tort Litigation

	average cost per case ($)	total cost ($ billion)	% of total (w/o time cost)	expenditure (w/ time cost)
plaintiff's cost				
legal cost	$ 9383	$ 3.8	22%	20%
time and other cost	1850	0.7	---	4
total cost	11233	4.5	22	24
defendant's cost				
legal cost	8500	3.6	21	18
unallocated claim cost	916	0.4	2	2
time and other cost	5863	2.2	---	12
total cost	15329	6.2	23	32
expenses of the court	741	0.3	2	2
total litigation cost	27303	11.0	47	57
compensation obtained				
total compensation	31358	12.7	---	---
net compensation after deducting plaintiff's legal cost	21728	8.8	53	---
net compensation after deducting plaintiff's total cost	20247	8.2	---	43
total expenditures on litigation and comensation				
not incl. time cost of litigation	41975	17.0	100	---
			---	
including time cost of litigation	48148	19.5		100

Data Source:J.kakalik and N.Pace, "Costs And Compensation Paid In Tort Litigation." The Rand Corporation, R-3391-ICJ.1986

Section II. Uncertainty in Causation and the Law of Liability

The fundamental issue after an accident is to decide who must be liable for the injury. The judgement is not always easy or obvious. An accident might be caused by the natural force (e.g., flood), or by the negligent human parties (e.g., an industrial firm), or by the mix of both (e.g., poor-built house damaged by flood). The negligent parties may be unilateral (i.e., the victim has no negligence), or bilateral (i.e, the victim also contributes some negligence). For example, the case that a customer gets injured by the fire in a restaurant usually is regarded as unilaterally negligent because the customer is no way to improve the safety condition of the restaurant. On the other hand, the injured drivers in a car accident may involve some kind of negligence and thus it is a bilateral case. The accidents caused completely by the natural force (e.g., the houses destroyed by volcanic explosion) are ignored in this paper because they are not related to human liability and the victims are usually compensated by the public funds instead of through lawsuits. This paper concentrates the discussion of liability on the cases which are caused partly or completely by human party (parties).

The disastrous accidents in the public premises, such as fire or gas explosion in a restaurant, are usually attributed to the negligence of the owner or manager of the public premises because the owner or manager is the only person who has the right to improve the safety condition of the public premises. However, in some cases the fire of the restaurant may be resulted from an arson such that the owner is also a victim. Furthermore, it is also possible that the natural force partly contributes to the accident, e.g., the lightning ignites the impaired electric cord and causes fire. To determine the liability of an injury incurred in the public premises sometimes is not an easy job.

Under the present legal system there are two major forms to determine the liability of injury: negligence rule and strict liability. The negligence rule requires a party who

causes the loss to pay the damage of an accident only if he is negligent. The strict liability law requires a party who causes the loss to pay the damage no matter he is negligent or not. Due to the huge cost and lengthy delay in the litigation process, and due to the protection of consumers, the strict liability principle becomes more and more popular in the modern society, for example, the product liability (see CED, 1989).

As described in the example of the fire in a restaurant, there might be several factors involved in the accident. The legal system adopted may has an impact on the owner's or manager's decision to attend the business or take the safety care. Shavell (1985) has analyzed the uncertainty of causation and incentive of care under different rule of liability determination for the cases of (1) natural force and one human party and (2) multiple human parties. He compares the threshold liability and proportional liability and suggests the later is preferred.

However, the threshold or proportional liability still involve the judgement by the court and hence the compensation settlement may be delayed. The regulation planned to be applied for the liability of injury in the public premises is no-fault approach, i.e., 100% liability for the owner or manager of the premises no matter he is negligent or not, which implies the possible liability of natural force and/or other parties are ignored. To guarantee the affordability of compensation, the public policy maker intends to adopt compulsory liability insurance. It is interesting to know whether such regulatory restriction will result in depressing the incentive of doing business or taking safety care by the owner or manager because part of the accident is not controllable by him.

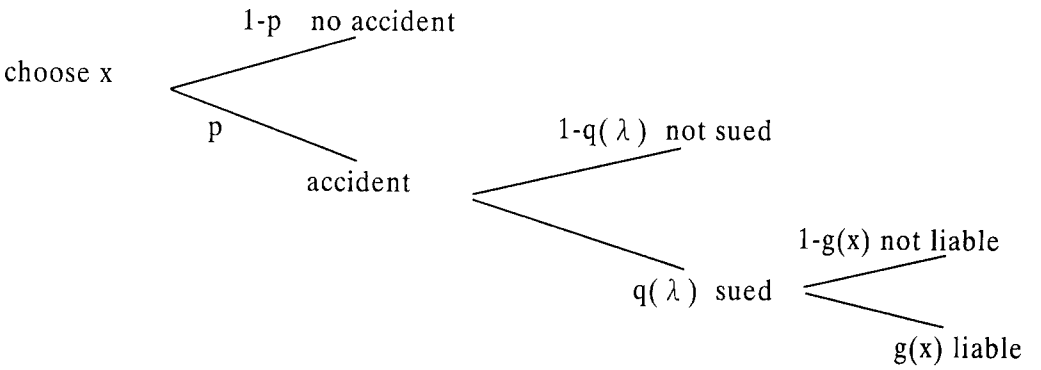
In the following text, this paper focuses the analysis on the profit-oriented private enterprise although in practice the public premises may be owned by other types of organizations. Thus we just call the owner or manager of the public premises "the firm" to simplify the description.

Section III. The Model for the Decision of Safety Care

Since the occurrence of an accident is uncertain and the safety care requires extra cost, the decision for a firm to conduct risk control activities must take into consideration of probability of loss and the cost of safety care as indicated in Brander and Spencer (1989). Most economic literature about safety care constructs the model on the effect of reduction in loss frequency, e.g., Kleindorfer and Kunreuther (1987) and Miceli (1997). However, the occurrence of an accident in the public premises is usually unexpected and difficult to prevent by the firm, most of the risk control techniques for the public premises are designed to reduce the loss severity once the accident occurs (Head, 1989). For example, the installment of fire hydrant or sprinkler system may reduce the loss amount but can not prevent the occurrence of fire. Therefore, the risk control program defined in this paper is the action which can reduce the loss severity instead of frequency.

The legal system which adopts strictly liability or negligence rule has an impact on the expected payoff of compensation for the damages. A firm causing an accident is not necessarily to pay the damages unless it is sued. A firm being sued must pay the damages if under the strict liability system, but will not pay the damages under the negligence rule unless it is negligent. Therefore the probability of legal liability is also a factor in the risk control decision. The decision of safety care for the firm can be described by the following diagram.

Figure 1 The Decision of Safety Care



The definitions of variables are provided as follows.

x =the level (cost) of safety care chosen by the firm, e.g., no. of fire hydrant;

p =probability of accident;

L(x) =loss amount of accident when safety care is x, $L'(x)<0$, $L''(x)>0$;

k =cost per unit of safety care;

λ =litigation cost of the victim;

$q(\lambda)$ =probability for the firm being sued when litigation cost is, $q(0)=1$, $q'<0$;

g(x) =probability of the firm being liable when safety care level is x.

It is assumed that in a competitive market the price of product is constant, but the quantity sold will increase with the quality of product which is represented by the level of safety care. Thus the incentive for a firm to take safety care is that its revenue R(x) will increase with the safety care level, $R'(x) >0$.

The firm is assumed to be risk neutral, and its objective is to maximize the expected profit when the safety care is considered. It is assumed that in case of full responsibility[1]

[1] In this paper, full responsibility means there is no intervention of legal system in the judgement of an accident and the firm has enough asset to pay the damage. Thus the firm will always pay for the total damage and g(x) =1 in this case.

and no litigation cost for the victim,[2] the firm must pay the damage once the accident occurred. Since the cost of safety care is spent ex ante, the expected utility function of the firm can be expressed by equation (1).

$$\begin{aligned} U &= p\{R(x) - kx - L(x)\} + (1-p)\{R(x) - kx\} \\ &= R(x) - kx - pL(x) \end{aligned} \tag{1}$$

The objective of the firm is to take a safety care level x such that the expected utility is maximized. That is,

$$\max_x \; U = R(x) - kx - pL(x) \tag{2}$$

According to the first order condition (F.O.C.) of equation (2), the sufficient condition for the optimal solution is:

$$k - R'(x) = -pL'(x) \tag{3}$$

Equation (3) implies that under the optimal condition, the marginal cost of safety care (left-hand side) must equal the marginal benefit due to safety improvement (right-hand side). This result shows unit cost of risk control program is offset by the marginal revenue of sales due to the improvement of safety. Since $L' < 0$, it implies marginal revenue R' must be less than unit cost k. If the optimal solution of safety care under this full responsibility case is x^*, then

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[2] Litigation cost may deter the incentive to sue because the victim may give up to sue when the damages are relative small to the litigation cost. We assume the victim will always request the compensation when there is no litigation cost.

$$x^* = -L'^{-1}(k-R'/p)$$
$$= x^*(k, R', p) \qquad (4)$$

Let $x^*(k, R', p)$ be called the first-best optimal solution because it is the solution under the situation of full responsibility and without litigation cost, i.e., no intervention of legal system. According to the properties of L(x), we can find $\partial x^*/\partial k < 0$, $\partial x^*/\partial R' > 0$, and $\partial x^*/\partial p > 0$. The optimal safety care level decreases with the unit cost k, but increases with the marginal revenue and probability of accident. This result is reasonable because the firm will not perform high standard of safety care if they must pay a high unit cost and it will take more safety care if the accident probability or the marginal revenue is large.

Section IV. Comparison of Safety Care under Strict Liability and Negligence Rule

In practice whether a firm must pay the damages after an accident is depending on the law. Usually the firm will not automatically pay the damage unless the victim sues. Under strict liability a firm which has made injury must compensate the loss no matter it is negligent or not, but under negligence rule the firm will compensate the damages only if it is negligent. Whether the victim will sue the firm depends on the relative scale of the litigation cost and the expected compensation of damages.

The model for strict liability is very similar to the basic model except for the probability of litigation $q(\lambda)$ where λ is the litigation cost, $q'<0$. The probability for the firm being liable g(x) is equal to one under strict liability no matter what level of safety care the firm takes[3]. Once the victim sued, the firm must compensate the damages.

[3] In fact, such case is better to be called absolute liability instead of strict liability because there is still a little chance to defense in the latter case (see Smith et al, 1988). However, the name of strict

The victim may not sue when the compensation is small relative to the litigation cost. The expected utility of the firm becomes $U = R(x) - kx - pq(\lambda)L(x)$. The optimal safety care which the firm will take under strict liability x_S^* is:

$$x_S^* = -L'^{-1}(k - R'/pq) \qquad (5)$$
$$= x_S^*(k, R', p, q)$$

Since $q(\lambda)$ is less than one when λ is positive, the optimal safety care under strict liability x_S^* is somewhat less than the first-best solution x^* according to the property of loss function $L(x)$. The optimal safety care x_S^* will decrease as the litigation cost λ increases because $q' < 0$. When the litigation cost is high for the victim, the incentive of safety care by the firm decreases because the probability of the firm being sued is reduced and the expected liability is lower.

Under the negligence rule the victim is not so sure whether he can win the lawsuit because the safety care is not observable to the consumers. If the litigation cost is relatively high as compared to the damages, the victim may not sue. Thus the probability for the firm being sued $q(\lambda)$ is less than one. Even if the firm is sued, under the negligence rule it is not necessarily liable unless it is negligent, so $g(x) < 1$. It is assumed $g' < 0$ because the more safety care taken by the firm, the less chance it being liable. The expected utility function for the firm can be rewritten as $U = R(x) - kx - pq(\lambda)g(x)L(x)$, and the optimal safety care level under negligence rule x_N^* is:

$$x_N^* = -L'^{-1}\{[(k - R')/pqg] + [g'L/g]\} \qquad (6)$$
$$= x_N^*(k, R', p, q, g)$$

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liability is more popular in the economic literature, e.g., Shavell (1982) and thus is adopted in this paper.

The impact of p and q on x_N^* is the same as previous case. The higher probability of accident or being sued, the more safety care is taken by the firm. The firm will also take more risk control program when the probability of being liable is higher. However, the safety care level under negligence rule is not necessarily lower than that under strict liability. The firm may release its liability completely under negligence rule if it takes enough safety care. Because the marginal probability of being liable is decreasing with safety care, g' in equation (6) is negative which will increase the safety care incentive of the firm. On the other hand the firm is always liable under strict liability no matter how much safety care was taken. It is possible that the strict liability may discourage the firm from taking safety care. The comparison of equations (5) and (6) shows that the firm will take more safety care under negligence rule if

$$(1-g)[k - R'] < -pqg'L \qquad (7)$$

The left-hand side of equation (7) is the expected net marginal cost (i.e., the unit cost of safety care minus the marginal sale revenue) when not liable, the right-hand side is the expected marginal benefit of reducing liability when accident occurs.

This result is important for the public policy because most people prefer the strict liability and think intuitively it provides more protection to the victims. From the viewpoint of compensation, it may be true because strict liability enhance the liability of the firm for the incurred losses. However, the strict liability says nothing about the safety care in the business operation. The firm may save cost in risk control program and then claim bankruptcy to avoid the compensation in case of injury. The effect of firm size and bankruptcy on the incentive of safety care has been extensively discussed in the previous literature such as Shavell (1986) and Larson (1996). The insufficient asset of the firm will mitigate its incentive of safety care. That is, strict liability can not guarantee the protection or compensation to the consumers. The modern risk management should

emphasize more on risk control than risk financing. To prevent or reduce the injury is more important than to obtain the monetary compensation. Therefore, how to encourage the incentive of safety care must be emphasized in the public policy.

Section V. Liability Insurance and Incentive of Safety Care

According to the previous literature, the incentive of safety care is related to the asset size of the firm. It implies that an effective way to increase the safety is through the increase of minimum asset/capital requirement. However, high level of capital requirement is an entry barrier for the freely competitive market. The public policy maker usually prefers to take other alternatives. To avoid the unavailability of compensation due to the bankruptcy of the firm, liability insurance is one of the most popular approaches used to indemnify the victim. Based on the same concept of workers compensation and automobile liability insurance, the government intends to pass compulsory liability insurance law to protect the injured in the public premises.

The major function of insurance is to compensate the damages rather than to prevent or reduce the losses. The impact of insurance on the safety care incentive is controversial. Shavell (1982) suggests liability insurance does not reduce the incentive to avoid accidents, but Sarath (1991) argues that restricting the availability of liability insurance will increase economic efficiency when there is uncertainty in the legal standards. In this section, a brief analysis is introduced to see the impact liability insurance on the incentive of safety care of the firm.

Under the assumptions of full responsibility and zero litigation cost, the utility function of the firm can be presented as follows.

$$U = p\{R(x) - kx - \pi(x) - L(x) + I(x)\} + (1-p)\{R(x) - kx - \pi(x)\}$$
$$= R(x) - kx - \pi(x) - pL(x) + pI(x) \qquad (8)$$

In equation (8), I(x) is the redemption from the insurer and $\pi(x)$ is the insurance premium. $I(x) \leq L(x)$ because the indemnity principle of insurance, $I'(x) < 0$. Insurance premium $\pi(x)$ is a function of safety care level x to reflect the risk characteristic of the insured firm, $\pi'(x) < 0$. The optimal safety care with insurance x_I^* is:

$$x_I^* = -L'^{-1}[(k - R' + \pi' - pI') / p] \qquad (9)$$

Whether the liability insurance will discourage the incentive of safety care must depend on the relative slopes of the insurance premium and coverage. If $\pi' - pI' = 0$, then $x_I^* = x^*$, i.e., liability insurance has no impact on the incentive of risk control. The optimal safety care with insurance is the same as the first best solution. On the other hand, liability insurance may encourage (discourage) the safety care because x_I^* is greater (less) than x^* if $\pi' - pI' < 0$ (> 0).

$\pi' - pI' = 0$ means marginal premium is equal to expected marginal coverage which implies premium is charged on the fair rate. In such case liability insurance will not reduce the incentive of safety care. In practice the insurance premium rate always greater than the fair rate even if it is operated by the government because of the administration expense, that is, $\pi' > pI'$. Therefore the implement of compulsory liability insurance for the public premises may somewhat reduce the incentive of safety care. If the public policy maker hopes liability insurance to encourage the risk control as described in regulatory plan, the insurance premium must be restructured to have $\pi' < pI'$.

The above analysis is based the assumption that insurance premium is a function of safety care x so that the level of safety care might be not reduced by the liability insurance. However, the risk-based rating is somewhat difficult to be applied in the

liability insurance of public premises if the safety care is not observable by the insurer at the moment of selling insurance. In other types of insurance the insurer can charge the premium rates according to the previous loss experience of the firm, but it is not the case for the public premises. The firm usually closes the business after the accident since the premises may be also destroyed in the disaster (e.g., fire). When the firm re-opens with another name, it is a new insured with "clean" record of claims since a firm is a legal person instead of natural person. Therefore, the firm is always charged at beginner-rate. In practice the compulsory liability insurance usually charges a flat rate for the new insured at first time since no claim record, for example, the compulsory automobile liability insurance. In such case, the model can be revised as:

$$U = R(x) - kx - \pi - pL(x) + pI(x) \qquad (10)$$

In equation (10), I(x) is the redemption from the insurer which is still based on the loss amount and thus is related to safety care, but the insurance premium π is not calculated based on the risk characteristics of the insured any more due to the unobservability of safety care or the social policy of cross-subsidization in compulsory insurance. The optimal safety care in such case x_{CI}^* is:

$$x_{CI}^* = -L'^{-1}[(k - R' - pI') / p] \qquad (11)$$

It is obvious that $x_{CI}^* < x^*$ since $I' < 0$, which implies the incentive of risk control is reduced by liability insurance due to the cross-subsidization effect in the flat premium charges. In the voluntary insurance, the consumer can reject to buy insurance in case of adverse selection. Rothschild and Stiglitz (1976) have shown that there is no pooling equilibrium when the risk characteristics of the insured are heterogeneous. The firm, however, cannot reject the compulsory insurance since it is prescribed by law unless the

firm withdraws the business. It is obvious that a profit-oriented firm will reduce its expense on risk control program to offset the cost of insurance premium if it wants to stay in the business.

The insurance premium charged to the firm is related to the legal system because the insurance coverage is provided for the compensation of its legal liability of the damages. Different legal systems may result in difference in insurance premium. When insurance system is applied with strict liability law, the optimal safety care for the firm becomes

$$x_{IS}^{*} = -L'^{-1}[(k- R' + \pi' - pqI') / pq] \qquad (12)$$

The optimal safety care taken by the firm is depending on the structure of insurance premium. If $\pi' = pqI'$ (i.e., fair rate), then $x_{IS}^{*} = x_S^{*}$. The optimal safety care in such case is the same as the case without insurance. When the marginal premium rate π' is greater than the marginal expected coverage pqI' as usually seen in practice due to expense loading, the optimal safety care is reduced to offset the insurance cost, that is, $x_{IS}^{*} < x_S^{*}$. If the premium is a flat amount not based on the safety care, i.e, $\pi' = 0$, then x_{IS}^{*} always less than x_S^{*} since pqI' is negative.

By the same token, the optimal safety care level with insurance under negligence rule x_{IN}^{*} is:

$$x_{IN}^{*} = -L'^{-1}\{[(k - R' + pqg'L)/pqg] + (\pi' - pqg'I - pqgI')/pqg \} \qquad (13)$$

Compared with equation (6) where there is no intervention of liability insurance, whether x_{IN}^{*} is greater than x_N^{*} depends on the value of the second bracket in equation (13). If $\pi' > pqg'I + pqgI'$, i.e., the marginal premium rate is greater than the marginal expected coverage, then x_{IN}^{*} is less than x_N^{*}. Otherwise, x_{IN}^{*} is equal to or greater than

x_N^*. In case of flat premium, the intervention of liability insurance will always reduce the incentive of safety care since $x_{IN}^* < x_N^*$ for $\pi' = 0$.

Section VI. Uncertainty in Causation and Claim Settlement

In certain accidents it is sometimes not easy to attribute the liability to certain party (parties) because the disaster may occur unexpectedly, suddenly and its origin of causation ambiguous. The victim may also involve certain negligence. Furthermore, the natural force (environmental risk) may have an impact on the frequency and/or the severity of loss, for example, dry weather increases fire accidents. Shavell (1985) has analyzed the effect of different liability principles on the social desirability for the firm to attend risky activities when there is ambiguity in the causation of an accident. Although Shavell suggests that proportional liability principle is social desirable for the case with ambiguity in causation, the proportional liability encounter some problems in practice because the probability of ambiguity may not be separable, otherwise there is no ambiguity.

In addition to the ambiguity in causation, the judgement of the court may also involve uncertainty in observation when deciding the liability, which has an impact on the incentive of safety care when liability insurance is applied for compensation as indicated by Sarah (1991). A serious problem in liability claim settlement is the so-called "social inflation" where the compensation for pain and suffering is subjective and the intervention of attorney may exacerbate the damage payoff. The Survey by ISO (1996) shows that the claim payments of commercial general liability insurance are affected by legal representation involved in the settlement (see table 2). Therefore, the potential loss amount is not completely related to the safety care or controllable by the firm.

Table 2 LAE[1] Ratios by Type of Legal Representation of the Insured

representation of the insured	severity of injury	number of claims	average paid loss	average LAE	ratio of LAE/paid loss
no counsel	minor	44	$115,110	$ 523	0.005
	major	86	164,189	870	0.005
in-house counsel only	minor	118	146,994	14,576	0.099
	major	271	204,560	18,441	0.090
outside counsel only	minor	265	173,932	31,502	0.181
	major	615	291,349	51,771	0.178
both in-house and outside counsel	minor	17	130,349	32,380	0.248
	major	70	293,572	66,963	0.228

Data Source:ISO,"Closed Claim Survey for Commercial General Liability :Survey Results 1995," Insurance Service Office, 1996,NY.

Note 1:LAE = Loss Adjustment Expense.

In this section, the effect of tort law and liability insurance on risk control incentive is analyzed for the case with ambiguity in causation and uncertainty in claim settlement. If the total loss of the damage is not completely dependent on the safety care of the firm but also affected by the natural force or the third party, then

$$L(x, \alpha) = L(x) + \alpha \qquad (14)$$

In equation (14), $L(x, \alpha)$ is the total loss of the damage and α is the portion of loss caused by the nature force and/or the third party such as social inflation which is not

controllable by the firm, $\alpha > 0$.[4] The assumption of ambiguity in causation and claim settlement implies that the court cannot distinguish the components of the damage. In such case the expected utility of the firm under strict liability can be revised as follows:

$$\begin{aligned} U &= p\{R(x) - kx - q(\lambda)L(x, \alpha)\} + (1-p)\{R(x) - kx\} \\ &= R(x) - kx - pq(\lambda)[L(x) + \alpha] \end{aligned} \tag{15}$$

The optimal safety care which the firm will take under strict liability with uncertainty in total loss $x_{S\alpha}^*$ is:

$$x_{S\alpha}^* = -L'^{-1}(k - R'/pq) \tag{16}$$

Equation (16) shows that the incentive of safety care under uncertainty case is the same as the case without uncertainty x_S^* because the firm has no way to control the damages caused by the nature force or the third party. The expected utility in such case is reduced by $pq\alpha$ due to the uncertainty.[5] Since a rational firm will attend the business only if the expected utility is nonnegative, there will be less firms to enter the market when the strict liability law is applied for the damage with ambiguity in causation and/or claim settlement.

By the same token, the expected utility and optimal safety care for the firm with uncertain loss under the negligence rule are shown in the following.

$$U = R(x) - kx - pq(\lambda)g(x)[L(x) + \alpha] \tag{17}$$

$$x_{N\alpha}^* = -L'^{-1}\{[(k - R')/pqg] + [g'(L+\alpha)/g]\} \tag{18}$$

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[4] This portion of loss amount is foreseeable although it is not controllable by the firm. It is not a random forecasting error and thus its expected value is not zero.

[5] $U(x_{S\alpha}^*) - U(x_S^*) = -pq\alpha$ since $x_{S\alpha}^*$ is equal to x_S^*.

Compared with equation (6), the optimal safety care under negligence rule is increased due to the uncontrollable loss since $g'\alpha$ is negative, that is, $x_{N\alpha}^{*} > x_N^{*}$. This result is consistent with the study by Png(1987) who compares several approaches to increase the safety care and concludes that only the increase in damage award will raise the safety care. The expected utility with optimal safety care in such case, $U(x_{N\alpha}^{*})$, may be not less than $U(x_N^{*})$ as long as the unit cost of safety care is not too high because

$$U(x_{N\alpha}^{*}) - U(x_N^{*}) = [R(x_{N\alpha}^{*}) - R(x_N^{*})] - k[x_{N\alpha}^{*} - x_N^{*}] + pq(\lambda)\{g(x_N^{*})L(x_N^{*}) - g(x_{N\alpha}^{*})[L(x_{N\alpha}^{*}) + \alpha]\} \quad (19)$$

The first item in equation (19) is the increase of revenue which is positive. The second term is the cost of additional safety care which is negative. The third term is the difference of the expected losses which may be positive or negative. If the expected losses of damage are assumed equal for the two cases, the difference in expected utility will depend on the relative scale of increase in revenue and increase of safety cost. When the revenue can offset the safety cost, the expected utility is unchanged. Thus the willingness of the firm to attend the business is not necessarily discouraged by negligence rule even if there is ambiguity in causation and/or claim settlements.

Whether the safety care level taken by the firm under negligence rule is less than that under strict liability must depend on relative cost and benefit of liability reduction. If the expected net marginal cost for not liable is less than the expected marginal benefit of liability reduction as shown in equation (20), then the firm will take more safety care under negligence rule.

$$(1-g)[k - R'] < -pqg'(L+\alpha) \quad (20)$$

The effect of the intervention of compulsory liability insurance depends on the insurance premium structure. Supposed the premium is related to safety care instead of flat amount, the expected utility for the firm under strict liability

$$U = R(x) - kx - [\pi(x) + \pi(\alpha)] - pq[L(x) + \alpha] + pq[I(x) + \alpha] \quad (21)$$

The firm may purchase more insurance coverage to compensate the extra damage caused by the natural force or the third party because under strict liability the firm is liable for all of the damage in an accident. Thus the total insurance premium is increased by $\pi(\alpha)$ for the extra coverage. The optimal safety care in such case is :

$$x_{IS\alpha}^{*} = -L'^{-1}[(k - R' + \pi' - pqI') / pq] \quad (22)$$

Equation (22) is identical to equations (12), i.e., $x_{IS\alpha}^{*} = x_{IS}^{*}$, thus the uncertainty in causation and judgement does not affect the incentive of safety care because insurance can release the cost of indemnity. The effect of insurance premium structure on the safety care $x_{IS\alpha}^{*}$ is exactly the same as previous section and thus the discussion is omitted here. In case $\pi' = pqI'$, then $x_{IS\alpha}^{*} = x_{IS}^{*} = x_{S\alpha}^{*} = x_{S}^{*}$. Although the optimal safety care is unchanged for each case when the insurance premium is calculated based on fair rate principle, the expected utility in those situations may be different. The expected utility of the firm with insurance is further reduced in the uncertainty case because of the increase in insurance cost for the extra coverage, which is shown as follows.

$$U(x_{IS\alpha}^{*}) - U(x_{IS}^{*}) = -\pi(\alpha) \quad (23)$$

$$U(x_{IS\alpha}^{*}) - U(x_{S\alpha}^{*}) = -[\pi(x_{S}^{*}) + \pi(\alpha)] + pq[I(x_{S}^{*}) + \alpha] \quad (24)$$

Since premium $\pi(\alpha)$ is positive, equation (23) is negative which implies the expected utility of the firm is reduced by the extra insurance premium to cover the uncontrollable loss. The right-hand side of equation (24) is the difference between gross premium and expected coverage, i.e., the expense loading which is nonnegative. In practice the expense loading may be as high as 30% of gross premium for liability insurance (see Best's Aggregate and Average, 1997) and never equal to zero as usually ignored in economic literature. Therefore, equation (24) is negative which implies the intervention of insurance under strict liability will reduce the expected utility of the firm even if insurance premium is based on fair rate. At least, we can conclude that compulsory liability insurance neither increase the incentive of safety care nor increase the expected utility of the firm.

The discussion of safety care under negligence rule with insurance is analogical to the above case. The expected utility and the optimal safety care for the firm are shown in the following.

$$U = R(x) - kx - [\pi(x) + \pi(\alpha)] - pqg(x)[L(x) + \alpha] + pqg(x)[I(x) + \alpha] \quad (25)$$

$$x_{IN\alpha}^{*} = -L'^{-1}\{[(k - R' + pqg'L)/pqg] + (\pi' - pqg'I - pqgI')/pqg\} \quad (26)$$

Since the effect of uncertainty in causation or claim settlement is completely covered by the insurance, the optimal safety care $x_{IN\alpha}^{*}$ is exactly the same as x_{IN}^{*}. In case the insurance premium is based on fair rate principle, i.e, $\pi' = pqg'I + pqgI'$, then $x_{IN\alpha}^{*} = x_{IN}^{*} = x_{N}^{*} < x_{N\alpha}^{*}$. Thus the incentive of additional safety care for the portion of uncontrollable damages is removed by insurance, which is consistent with the study by Sarath (1991). Although the safety care $x_{IN\alpha}^{*} = x_{IN}^{*}$, the expected utility with uncertainty is reduced due to the increase of premium charge. That is,

$$U(x_{IN\alpha}^{*}) - U(x_{IN}^{*}) = -\pi(\alpha) \quad (27)$$

The effect of insurance on the expected utility with uncertainty is undetermined as shown in the following.

$$\begin{aligned} U(x_{IN\alpha}^{*}) - U(x_{N\alpha}^{*}) = {} & \{R(x_{IN\alpha}^{*}) - R(x_{N\alpha}^{*})\} + \{k(x_{N\alpha}^{*} - x_{IN\alpha}^{*})\} \\ & + \{pqg(x_{N\alpha}^{*})L(x_{N\alpha}^{*}) - pqg(x_{IN\alpha}^{*})L(x_{IN\alpha}^{*})\} \\ & + \{\alpha[pqg(x_{N\alpha}^{*}) - pqg(x_{IN\alpha}^{*})]\} \\ & + \{pqg(x_{IN\alpha}^{*})[I(x_{IN\alpha}^{*}) + \alpha] - [\pi(x_{IN\alpha}^{*}) + \pi(\alpha)]\} \quad (28) \end{aligned}$$

All the items in equation (28) are negative(or nonpositive) except the second bracket $\{k(x_{N\alpha}^{*} - x_{IN\alpha}^{*})\}$ which is the difference in the cost spending on safety care. The total effect is ambiguous. However, unless the safety cost is large enough to dominate all the other costs such as reduction in sale revenue, increase in loss payment, and insurance expense loading, i.e., the other four items in equation (28), the difference in expected utility $U(x_{IN\alpha}^{*}) - U(x_{N\alpha}^{*})$ is more possible to be negative which implies the expected utility is reduced by insurance. Otherwise, the expected utility of the firm under negligence rule may be increased by insurance.

VII. Concluding Remarks

Protection and compensation for the victims in the injury of public premises become an important issue in the society after some disasters occur in recent years. The public policy maker plans to implement the compulsory liability insurance to provide the compensation, which requires all the owners or managers of the public premises such as restaurant and department store to buy private liability insurance. Besides, the public policy maker intends to adopt strict liability law for the damage to enhance the incentive of safety care.

The availability and affordability of private liability insurance has been a critical problem in the insurance market since 1980's. The social inflation of loss payments of liability claims has driven some insurers out of the market. Most of the insurers have excluded the coverage of certain catastrophic risks from liability insurance policies in recent years. Therefore, relying on private liability insurance as the way to provide protection to the public is costly and unrealistic because the insurer may withdraw from the market when there is no profit. The fundamental solution of public safety is to improve the risk control activities by the firms.

This paper provides theoretical analysis of the effect of law system (negligence rule vs. strict liability) and compulsory liability insurance on safety care. It also discusses the problem of ambiguity in causation or claim settlement of an accident which is the major reason for insurance crisis but not received enough attention in the insurance literature. The major findings of this study are listed as follows.

(1)The incentive of safety care of the firm is decided by the relative expected cost of risk control program to the expected benefit of damage reduction, instead of the liability rule of tort law. The optimal safety care level under strict liability is not necessarily higher than that under negligence rule.

(2)The intervention of liability insurance will not encourage the incentive of safety care unless the premium rate is structured unfairly to make extra penalty on the high-risk insured.

(3)When there is uncertainty in causation and/or claim settlement, strict liability law will not encourage the safety care but discourage the firm to attend the business; on the other hand, the safety care is increased under negligence rule and the expected utility of attending business may be unchanged, increased, or decreased depending on the cost of risk control activities.

The findings suggest that relying on compulsory liability insurance with strict liability law as the approach to provide the compensation for the injured without taking

account of the safety cost is incomplete and risky because it may discourage the safety care of the firm. Besides, how to control the soaring claim payments of liability insurance in the future is also an important decision factor for the public policy maker to implement compulsory liability insurance, which will be studied in the future research.

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Incentive of Risk Control, Tort Law and Liability Insurance for the Public Premises

侵權法與責任保險對於公共場所損害防阻意願之影響

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摘　要

由於近年來公共場所意外災害頻傳，政府有意實施公共場所強制責任保險，並採用無過失主義，以加強業者對於公共安全之重視。然而民營責任保險之供給與價格，自從1980年代起即已是市場上之一大難題，仰賴責任保險以減少意外事故，其效果乃值得商榷。本文藉由法律經濟學與保險理論之分析方法，探討侵權法之過失責任原則與責任保險，二者對於損害防阻意願之影響，並且納入事故肇因或損害賠償不確定因素之介入效果。研究結果認為（一）業者對於場所安全之改善意願，乃決定於損害防阻工作之淨效益而非法律制度，無過失主義並不必然能提高業者之意願；（二）強制責任保險並未能提高損害防阻意願，多數情況是降低其意願，除非費率結構特別設計加重處罰高風險被保人，才可能提高業者之安全改善意願；（三）當有事故肇因或損害賠償不確定因素介入時，無過失主義不會增加業者損害防阻意願，責任保險保費負擔只會促使其退出市場，然而過失主義卻會增加業者損害防阻意願，責任保險保費負擔不必然會影響其經營事業之意願。

關鍵字：過失主義、無過失主義、公共場所責任保險、損害防阻、損害不確定性