

# The Expected Utility Maximization Framework And The Demand And Supply For Retroactive Liability Insurance

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## Abstract

*The paper uses the expected utility of wealth maximization principle to establish the economic boundaries under which a market for retroactive liability insurance will develop. It is shown that the economic feasibility for the backdated insurance coverage is affected by the income tax rates, and the levels of risk aversion of the potential insurer and insured and by the time to settlement. However, the potential insurer's tax rate is more relevant than the other parameters.*

## Introduction

Retroactive liability insurance is backdated insurance that provides coverage for a loss that has already occurred. This type of coverage is not new to the insurance industry. Indeed, retroactive policies have been around for a long time, with some Ocean Marine forms dating as far back as 1613 (1). In addition, backdated insurance has been designed to cover losses arising from very different kinds of liability such as pollution liability, product liability, workers' compensation, and medical malpractice (2). However, retroactive liability insurance became highly visible to the insurance industry, consumers, regulatory authorities and scholars only in 1981. In that year, MGM Grand Hotels, Inc., startled the insurance business by purchasing retroactive liability insurance to cover losses from a fire in November 1980 of its Nevada Hotel at Las Vegas (3).

The fact that retroactive policies are currently more popular is not surprising. Indeed, this kind of coverage seems essential to a majority of businesses today given the present tendency towards litigation, the substantial settlement dollar amounts, and the lengthy duration of most law suits (4). An insurance product that covers liability losses after they have occurred is a simple solution to many business problems (5), including: businesses that bought inadequate amount of insurance; and, businesses with insufficient insurance coverage resulting from merger or acquisition of an inadequately insured firm (6).

Traditionally insurance has been considered a mechanism for transferring the uncertainty associated with potential "future" losses from the insured to the insurer.

If the loss has already taken place there is no uncertainty about its occurrence. Retroactive coverage is bought after the loss has occurred; then, the obvious question is whether retroactive liability is a legitimate insurance product. The answer is yes because retroactive liability implies the transfer of financial responsibility for loss from risk, where the principal factor of risk is the uncertainty about the dollar amount of loss. In effect, the ultimate amount of loss to be paid to the victims or their beneficiaries is unknown to both the insured and insurer (7,8).

The legitimacy of retroactive liability as an insurance product has important tax, accounting, and financial implications. The benefits to the potential insured of retroactive liability insurance include: the cost of the premium is tax deductible in the year the policy is purchased (9), the coverage may allow the insured to avoid a qualified financial statement; the purchase of insurance may minimize the impact of the loss in the stock price (10). The main benefits to the potential insurer are: the loss is tax deductible at the date the policy is written (11), and the potential increase of its investment income by investing the premium proceeds.

This paper uses the expected utility of wealth maximization principle to determine the economic boundaries under which a market for retroactive liability coverage will develop. It is established that the economic feasibility of backdated insurance depends on the several parameters in the financial model. In general, the market for retroactive liability is an increasing function of the insurer's tax rate and the insurer's level of risk

aversion, and an increasing function of the time to settlement. The insurer's tax rate is the most relevant parameter because it allows for tax arbitrage opportunities that increase the economic feasibility of the retroactive liability insurance coverage.

The paper is organized as follows: Sections one and two formulate the economic conditions under which the potential insured and insurer are willing to buy and sell the retroactive liability insurance coverage, respectively. Section three, contains the derivation of the financial model for the demand and supply of retroactive insurance. Finally, section four contains a brief summary and presents the papers main conclusions.

### The Insurer's Demand Of Retroactive Liability Insurance

The formulas that follow make use of two important features of the current tax code: 1) the insurance premium paid by the insured is tax deductible the year the policy is purchased; and 2) the retained losses can be deducted only when they are actually paid.

For the potential insured the utility of final wealth associated with the purchase of retroactive liability insurance can be expressed as follows:

$$U[W-P(1-t_1)] \tag{1}$$

Where:

- W = Insured's Initial Wealth,
- P = Insurance premium,
- t<sub>1</sub> = Insured's income tax rate,
- U [ ] = Utility operator.

On the other hand, the expected utility of final wealth associated with the retention of the loss and subsequent payment n years since the loss occurred corresponds to the following (12):

$$\frac{E\{U [W-L(1-t_1)]\}}{(1+r_f)^n} \tag{2}$$

Where:

- L = Uncertain ultimate dollar amount of loss,
  - r<sub>f</sub> = Risk-free discount rate (13),
  - n = Time to settlement (14)
  - E [ ] = Expectation operator
- And the other terms are as defined before.

Clearly, the potential insured will be willing to purchase retroactive liability insurance if the following inequality holds:

$$U[W-P(1-t_1)] > E\{U [W- \frac{L(1-t_1)}{(1+r_f)^n} ]\} \tag{3}$$

thus, the insurance policy is attractive to the potential insured if the insured's utility of final wealth resulting from the purchase of the coverage is larger than the insured's expected utility of final wealth resulting from the retention of the loss.

### The Insurer's Supply Of Retroactive Liability Insurance

The potential insurer's expected utility of final wealth associated with the sale of retroactive liability insurance is given by the following expression:

$$E\{U[W^* + (P-C)(1-t_2) - \frac{L}{(1+r_f)^n} + Lt_2]\} \quad (4)$$

Where:

$W^*$  = Insurer's Initial Wealth

$C$  = Commissions and other administrative expenses incurred by the insurer (15)

$t_2$  = Insurer's income tax rate,

and the other terms are as defined before.

Formula (4) points out a significant difference between the tax rules applied to the potential insured and insurer. The loss payment of the insured, as it was already indicated, is tax deductible only at the time that is actually paid; that is,  $n$  years hence. The loss payment made by the insurer, on the other hand, can be deducted at the time the policy is issued. In other words, current income tax laws allow the potential insurer to recognize the loss at an earlier date than the potential insured could. As it is shown later in the paper, this preferential tax treatment of the potential insurer plays a important role in the economic feasibility for retroactive liability insurance (16).

The potential insurer will write the retroactive insurance coverage if the following inequality is satisfied:

$$E\{U[W^* + (P-C)(1-t_2) - \frac{L}{(1+r_f)^n} + Lt_2]\} > U[W^*] \quad (5)$$

That is, the potential insurer will be willing to issue the insurance policy if the operations of selling the coverage and paying the loss increase the insurer's expected utility of wealth.

### Market Feasibility Boundaries for Retroactive Liability Insurance

Retroactive liability insurance is designed to cover a loss that has already occurred, which requires an unknown ultimate loss payment of  $L$  dollars  $n$  years after the insurance policy is issued. In this situation, the potential insured will demand retroactive liability insurance if the following inequality holds:

$$U[W - P(1-t_1)] > \int LU[W - \frac{L(1-t_1)}{(1+r_f)^n}] f(L) dL \quad (6)$$

The potential insurer, on the other hand, will supply the retroactive insurance coverage if the following inequality is satisfied:

$$\int LU[W^* + (P-C)(1-t_2) - \frac{L}{(1+r_f)^n} + Lt_2] f(L) dL > U[W^*] \quad (7)$$

By combining inequalities (6) and (7) it is possible to establish the economic boundaries under which a market for retroactive liability insurance will develop. Furthermore, additional insights can be obtained by making specific assumptions about the utility and loss distribution functions. Assuming the preferences of the potential insured and insurer are governed by an exponential utility function, we have (17).

$$U(X) = -e^{-aX} \quad (8)$$

Using (8) inequality (6) becomes:

$$-e^{-a[W-P(1-t_1)]} > - \int Le^{\frac{-a[W - L(1-t_1)]}{(1+r_f)^n}} f(L) dL \quad (9)$$

Rearranging, taking logarithms of both sides and solving for P we get:

$$P < \frac{1}{a(t-t_1)} \ln \int Le^{\frac{-a(1-t_1)L}{(1+r_f)^n}} f(L) dL \quad (10)$$

Next, assume the loss distribution is of the form (18):

$$F(L) = \lambda e^{-\lambda L} \quad (11)$$

Substituting the above expression in inequality (10) integrating and rearranging we come up with the following inequality:

$$P < \frac{1}{a(1-t_1)} \ln \left[ \frac{\lambda}{\lambda - a(1-t_1)} \frac{1}{(1+r_f)^n} \right] \quad (12)$$

Inequality (12) represents an upper bound on the insurance premium acceptable to the potential insured.

For the potential insurer we have that the following inequality must hold, under the assumption of exponential utility:

$$- \int Le^{-\beta[W^* + (P-C)(1-t_2) - \frac{L}{(1+r_f)^n} + Lt_2]} f(L) dL > -e^{-\beta W^*} \quad (13)$$

Rearranging, taking logarithms of both sides and solving for P, we get:

$$P > C + \frac{1}{\beta(1-t_2)} \ln \int Le^{-\beta \left[ \frac{-1}{(1+r_f)^n} + t_2 \right] L} f(L) dL \quad (14)$$

Combining (11) and (14), integrating and rearranging we finally have:

$$P > C + \frac{1}{\beta(1-t_2)} \ln \left[ \frac{\lambda}{\lambda + \beta t_2 - \beta} \right] \frac{1}{(1+r_f)^n} \quad (15)$$

Inequality (15) represents a lower bound for the insurance premium to be acceptable to the potential insurer.

By combining inequalities (12) and (15) we can establish the economic boundaries between which a market for retroactive liability insurance will be feasible:

$$C + \frac{1}{\beta(1-t_2)} \ln \left[ \frac{\lambda}{\lambda + \beta t_2 - \beta} \right] \frac{1}{(1+r_f)^n} < P < \frac{1}{a(1-t_1)} \ln \left[ \frac{\lambda}{\lambda - a(1-t_1)} \right] \frac{1}{(1+r_f)^n} \quad (16)$$

Comparative statics analysis of inequalities (7) and (15) reveals that the higher  $\beta$  and  $t_2$  and the longer  $n$ , the higher the potential insurer's utility of final wealth associated with the sale of retroactive liability insurance, and the smaller the premium the potential insurer is willing to charge. Comparative statics of the inequalities (6) and (12), on the other hand, shows that the lower  $a$  and  $t_1$  and the shorter  $n$ , the higher the potential insured's utility of final wealth arising from the purchase of the retroactive insurance coverage, and the higher the premium the potential insured is willing to pay.

Clearly, a market for retroactive liability insurance is economically feasible and is a function of the tax rates and levels of risk aversion of the potential insured and insurer and the time to settlement. However, potential incentives conflicts can also arise. In effect, the potential insured has incentive to negotiate an earlier settlement because doing so would increase its utility (19). The potential insurer, on the other hand, will benefit by delaying the time to settlement because doing so would reduce the loss of utility associated with the present value of the loss payment (20).

The comparative statics analysis also show that the insurer's income tax rate is more important than the other parameters because of the tax savings enjoyed by the potential insurer under the current tax rules. This tax arbitrage increases the market feasibility for retroactive liability insurance because it allows the insurer to transfer part of the income tax deduction to the insured in the form of a smaller premium. The tax arbitrage factor becomes more influential the higher the discount rate of the potential insurer and the longer the time to settlement.

### Summary and Conclusions

The paper establishes the economic conditions for the demand and supply of retroactive liability insurance. The potential insured and insurer are assumed to be risk averters and expected utility maximizers. In general, the development of a market for retroactive liability insurance depends on the levels of risk aversion and income tax rates of the potential insurer and insured and the time to settlement. A market for retroactive insurance becomes more feasible the higher the potential insurer's income tax rate because of the tax arbitrage opportunities arising from the tax advantages enjoyed by the potential insurer under current tax laws.

### Footnotes

1. More about the evolution of retroactive liability insurance can be found in McAlear (1982)
2. A more detailed account of the different kinds of retroactive liability insurance is given in McIntyre (1981) and Mahoney (1982).
3. In this fire 85 people died and more than 500 were injured. On the date of the fire, November 1980, MGM

- had only \$30 million in liability insurance in force. However, insurance experts had estimated approximately 700 lawsuits for about \$1 billion. MGM was able to get additional protection backdated 20 days before the loss by buying an extra \$170 million in liability coverage at an estimated premium of \$37.5 million. The retroactive coverage was written in four layers. It was placed with more than 70 insurers and reinsurers, including General Reinsurance, American International Group, and Lloyd's of London. For more details about the retroactive liability contract purchased by the MGM Grand Hotels, Inc., the interested reader is remitted to Oliphant (1982), Smith and Witt (1983), and Smith and Witt (1984).
4. All these factors increase the uncertainty associated with the number of losses, dollar amounts of loss, and timing of payments. The higher the uncertainty the harder it is for the insured to estimate in advance the amount of adequate protection to be bought under a conventional insurance coverage.
  5. For more information about the several applications of retroactive liability insurance see, i.e., Hallett (1983)
  6. Retroactive liability is expected to become the predominant insurance form in the mergers and acquisition area. This kind of insurance is attempted to cover the legal costs of the buyer incurred in fighting an unfriendly takeover, provided the fight proves victorious; or to provide more insurance when the seller is underinsured. A few examples are indicated in Brenner (1982). The issue is not that retroactive insurance is preferable to conventional insurance. So far, backdated insurance has mainly been used as a supplement when the outstanding insurance policy has provided insufficient coverage.
  7. Another important type of insurance that involves no uncertainty about the occurrence of loss is life insurance - it is certain that everybody will die. A good defense of the legitimacy of retroactive liability insurance is given by Hedges (1981). See also Hendershott and Koch (1980)
  8. The model developed in this paper assumes the time to settlement is known with certainty. Indeed, the time to settlement is also unknown. This assumption, however, simplifies the mathematics without affecting the main conclusions of the paper.
  9. The purchase of retroactive insurance represents a clear advantage over self-insurance. In effect, the insurance premiums are considered ordinary expenses and are deductible for federal tax purposes when the policy is bought. The self-insurance reserves, on the other hand, are not tax deductible and the firm can only deduct the losses when they are actually paid.
  10. Retroactive insurance is also a device to get auditors to remove the qualifications they often cite in corporate financial statements when they are unsure of the size of the prospective liabilities. In this way, the retroactive coverage helps to keep larger reserves off the balance sheet which helps to maintain investors' confidence, and minimize the depression in the stock price.
  11. The immediate tax deduction of the loss is a clear tax advantage of the potential insurer. Recall that the potential insured can deduct the loss only when it is actually paid.
  12. Long delays of the losses are common in these cases because of the huge amount of losses and the several parties involved, including insurers, insured, victims and beneficiaries. In general, time to settlements of several years is not unusual.
  13. The loss is discounted at the riskfree rate of return because the levels of risk aversion of the insured and insurer are already reflected in their respective utility functions.
  14. As it was explained in footnote 8, the paper assumes that the time to settlement is known with certainty.
  15. The treatment of revenues and expenses of the statutory Accounting Principles used by insurance companies differ from that of Generally Accepted Accounting Principles used by other business firms. In effect, the Statutory Accounting System treats expenses on a cash basis. That is expenses are charged immediately (i.e. when the policy is issued) and not deferred until the corresponding revenues are actually earned.
  16. For more details about the tax differences between potential insured and insurer under the current tax rules, see Smith and Witt (1985). These authors studied the market feasibility of backdated insurance following the traditional profit maximization approach and concluded that economic feasibility would exist when the coverage provided a profit to the insurer while being less expensive to the insured than retaining the loss. The model developed in this paper contains the Smith and Witt model as a special case when the potential insurer and insured are risk neutral.
  17. The use of an exponential utility function is justified by Borch (1968). In effect, Borch states that : "If a preference ordering over the set of all prospects i) is independent of the actual wealth of the decision - maker, and ii) can be represented in Bernouilli's form, the underlying utility function is either  $U(X) = X$  or  $U(X) = e^{ax}$ " (page 45). The author is grateful to an anonymous referee for bringing this to his attention.
  18. The use of exponential loss distribution, is common in the insurance literature. See, i.e., Lau (1984)

19. Smith and Witt (1985) point out that the insured has an incentive to settle quickly not only for economic reasons but also for reasons of good public relations with its customers. In effect, these authors indicate that a quick settlement "would remove the cloud of uncertainty from its financial statements and help to reduce ill will among the claimants and their families." (page 397)
20. In the case of the retroactive insurance covering the fire of the Nevada Hotel at Las Vegas, the underwriters anticipated a lengthy litigation process, which would allow to reap hefty investment gains. However, MGM Grand Hotels, Inc., took its insurers by surprise by settling the case earlier than expected. The insurers reaction was to stop payments for two years until the hotel finally sued to collect in 1985. The policy ultimately paid \$87.5 million of MGM's obligations.

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